

## Online Appendix 1

### Description of vegetation types Introduction

Samples were classified into 14 groups or vegetation types. In terms of species composition these form three main clusters: mopane woodlands (seven types, including one type transitional with miombo woodland), miombo woodlands (six types), plus alluvial woodland (one type).

The main dominant species within the mopane woodlands cluster are *Colophospermum mopane* and *Combretum apiculatum*, plus occasional instances of *Acacia exuvialis*, *Combretum zeyheri* and *Mimusops zeyheri*. *Colophospermum mopane* and *Combretum apiculatum* are constant throughout all seven mopane types. Other prevalent species that are constant in four or more types are *Dichrostachys cinerea s. africana* (6 types); *Combretum hereroense v. hereroense* and *Maerua parvifolia* (5 types) and *Cassia abbreviata s. beareana*, *Cissus cornifolia*, *Combretum mossambicense*, *Flueggea virosa s. virosa* and *Markhamia zanzibarica* (four types each). Other species which achieve high (> 75%) constancy levels, but in a more limited number of types, include *Acacia exuvialis*, *Acacia nigrescens* and *Spirostachys africana*.

Type 12 is somewhat intermediary in nature. *Combretum zeyheri* achieves dominance in 4% of the samples, and the presence of both *Colophospermum mopane* and *Combretum apiculatum* is 67%, which is generally lower than for the other mopane types. While the type includes a number of typical mopane constant species (*Cassia abbreviata s. beareana*, *Cissus cornifolia*, *Combretum mossambicense*, *Dichrostachys cinerea s. africana*, *Flueggea virosa s. virosa*, *Maerua parvifolia* and *Markhamia zanzibarica*), it also shares a number of constant species that are characteristic of the miombo woodlands (*Strychnos madagascariensis* and *Xeroderris stuhlmannii*, plus *Combretum zeyheri*, *Lannea schweinfurthii v. stuhlmannii*, *Pseudolachnostylis maprouneifolia*, *Sclerocarya birrea s. caffra*, *Terminalia sericea* and *Xeroderris stuhlmannii*).

Within the miombo woodland cluster, dominant species include *Androstachys johnsonii*, *Brachystegia tamarindoides s. torrei*, *Combretum celastroides s. celastroides*, *Combretum collinum s. collinum*, *Guibourtia conjugata*, *Julbernardia globiflora*, *Millettia usaramensis s. australis*, *Pteleopsis myrtifolia* and *Terminalia sericea*.

Constant species include: *Xeroderris stuhlmannii* (five types), *Cassia abbreviata s. beareana*, *Combretum apiculatum*, *Hugonia orientalis*, *Strychnos madagascariensis* (all four types) and *Combretum collinum s. collinum*, *Guibourtia conjugata*, *Monodora junodii v. junodii*, *Pteleopsis myrtifolia*, *Senna petersiana* (all three types). Other species which achieve high (> 75%) constancy levels, but in a more limited number of types, include *Androstachys johnsonii*, *Boscia angustifolia v. corymbosa*, *Brachystegia tamarindoides s. torrei*, *Combretum mossambicense*, *Croton pseudopulchellus*, *Diplorhynchus condylocarpon*, *Markhamia zanzibarica*, *Ochna pulchra s. pulchra*, *Phyllanthus pinnatus*, *Pseudolachnostylis maprouneifolia* and *Terminalia sericea*.

The alluvial woodlands are quite distinctive. The only dominant species is *Cordyla africana*, but there are a high number of constant species: *Acacia tortilis s. heteracantha*, *Berchemia discolor*, *Boscia mossambicensis*, *Capparis sepiaria v. subglabra*, *Capparis tomentosa*, *Cleistochlamys kirkii*, *Combretum imberbe*, *Combretum mossambicense*, *Cordyla africana*, *Croton megalobotrys*, *Deinbollia xanthocarpa*, *Diospyros loureiriana s. loureiriana*, *Diospyros mespiliformis*, *Drypetes mossambicensis*, *Flueggea virosa s. virosa*, *Kigelia africana*, *Maclura africana*, *Philenoptera violacea*, *Tabernaemontana elegans*, *Thilachium africanum* and *Xanthocercis zambsesiaca*. Most of these are unique to the alluvial woodlands, other than *Combretum imberbe*, *Combretum mossambicense*, *Diospyros loureiriana s. loureiriana*, *Drypetes mossambicensis*, *Flueggea virosa s. virosa*, *Philenoptera violacea*, which are shared predominantly with the mopane types but also a few species with the miombo types (*Combretum mossambicense* and *Drypetes mossambicensis*).

### Mopane woodland

#### Type 1: *Colophospermum mopane* – *Acacia nigrescens* woodland

Number of relevés: 31 (1, 2, 13, 19, 21, 33, 36, 40, 55, 58, 76, 99, 111, 118, 139, 142, 149, 178, 196, 208, 214, 215, 217, 218, 220, 224, 230, 247, 249, 307, 309).

Type 1 occurs across a range of geological formations: 58% of samples occurred on a variety of igneous rocks (basalt, dolerite, granite, granodiorite, rhyolite, syenite and trachyte), the remainder on Cretaceous sediments plus two samples on alluvium. Soils were similarly varied with two thirds of samples comprising clay, loamy clay or clay loam soils and the other third lighter textured to loamy sand soils. In terms of topography roughly half the samples occurred on gently sloping or undulating areas, plus one quarter on flat bottom areas and one quarter flat upland areas. The slope for 55% of samples was level, for 29% gentle and for the remaining 16% was moderate to steep.

Type 1 comprises a relatively open community. The upper tree layer is typically sparse, most frequently < 1% cover, and reaching to between 10 m and 20 m in height, most commonly being 15 m – 20 m. The second tree layer is typically short, being 3 m – 8 m in height. Total tree cover is typically 11% – 25%, as is the shrub cover, giving an overall woody cover of usually 26% – 50%. Total herbaceous cover varies from 11% – 100% and bare ground from < 10% – > 50%. The type exhibits a full range of structural types from bushland to closed woodland but predominantly comprises wooded or bushed grassland to open woodland (71% of samples), the balance being bushland ( $n = 2$ ), woodland ( $n = 6$ ) or closed woodland ( $n = 1$ ).

*Colophospermum mopane* is the most common tree in the upper tree layer, other common species being *Acacia nigrescens*, *Combretum imberbe*, *Kirkia acuminata* and *Spirostachys africana*, and less frequently *Adansonia digitata*, *Berchemia discolor*, *Cassia abbreviata s. beareana* and *Sclerocarya birrea s. caffra*. *Colophospermum mopane* and *Combretum apiculatum*, and occasionally *Spirostachys africana*, are the most abundant species in the lower tree layer. The shrub layer is similarly

dominated by *Colophospermum mopane* and *Combretum apiculatum*, and infrequently by *Dichrostachys cinerea s. africana*.

Constant species for this type are *Flueggea virosa s. virosa* (90%), *Colophospermum mopane* (90%), *Dichrostachys cinerea s. africana* (87%), *Acacia nigrescens* (77%), *Combretum apiculatum* (74%), *Dalbergia melanoxylon* (71%), *Combretum hereroense v. hereroense* (68%), *Philenoptera violacea* (61%), *Cissus cornifolia* (58%), *Grewia bicolor* (55%), *Combretum imberbe* (55%), *Combretum mossambicense* (52%) and *Cassia abbreviata s. beareana* (52%). Other than *Acacia nigrescens* and *Combretum imberbe*, the remainder of these species are all shared as constant species with several of the other mopane types.

Diagnostic species include *Bridelia cathartica* (23.3), *Peltophorum africanum* (23.1), *Pterocarpus brenanii* (21.9), *Hippocratea buchananii* (20.2), *Allophylus rubifolius v. rubifolius* (18.3), *Grewia monticola* (17.7), *Albizia harveyi* (17.1), *Rhoicissus revoilii* (17.0), *Ziziphus mucronata* (15.9) and *Ormocarpum trichocarpum* (15.5). Other than *Ormocarpum trichocarpum* and *Peltophorum africanum*, these species are not shared as diagnostic species with any of the other mopane types.

#### Type 4: *Colophospermum mopane* open woodland

Number of relevés: 29 (5, 6, 18, 28, 38, 39, 54, 66, 72, 73, 84, 106, 119, 160, 163, 164, 166, 169, 181, 204, 221, 242, 243, 250, 256, 258, 261, 275, 304).

The bulk of samples for Type 2 were from Cretaceous sediments (75%), with the rest from igneous rocks (basalt, granodiorite, rhyolite and syenite). Soils varied widely from clay to sand. Topography comprised a mix of gently sloping or undulating areas (50%), plus one third flat bottom areas and the remainder flat upland areas. Slope was level for 90% of samples and gentle for the remaining 10%.

Type 4 comprises an open form of mopane woodland. The upper tree layer reaches from 10 m to 20 m in height, with a cover of usually < 5%, in cases reaching up to a maximum of 20%. The lower tree layer is generally 3 m – 12 m in height. Total tree cover ranges from 1% to 50%, total shrub cover from 1% to 25%, and total woody cover from 11% to 50%. Herbaceous cover is 1% – 50% and bare ground varies from 20% to > 50%. Overall 72% of samples comprise open woodland to bushed or wooded grassland, with the balance comprising woodland ( $n = 6$ ) or bushland ( $n = 2$ ).

*Colophospermum mopane* is the most common species in all three woody layers: upper and lower tree layers and the shrub layer, achieving > 25% cover in one third of the samples. Other relatively frequent upper layer trees are *Spirostachys africana*, *Combretum imberbe* and *Acacia nigrescens*, and in the second tree layer also *Combretum apiculatum*. Locally abundant shrub species, in addition to *Colophospermum mopane*, are *Combretum apiculatum* and *Euclea divinorum*.

Constant species are *Colophospermum mopane* (97%), *Maerua parvifolia* (83%), *Spirostachys africana* (76%), *Markhamia*

*zanzibarica* (72%), *Combretum apiculatum* (72%), *Phyllanthus pinnatus* (69%), *Flueggea virosa s. virosa* (69%), *Combretum mossambicense* (66%), *Cissus cornifolia* (62%), *Cassia abbreviata s. beareana* (62%), *Combretum hereroense v. hereroense* (55%), *Euclea divinorum* (52%), *Drypetes mossambicensis* (52%) and *Dichrostachys cinerea s. africana* (52%).

Diagnostic species, not shared with any other mopane types, include *Hippocratea crenata* (27.2), *Grewia sulcata v. sulcata* (25.4), *Euclea divinorum* (23.4), *Hippocratea indica* (21.9), *Phyllanthus pinnatus* (19.7), *Grewia lepidopetala* (19.6), *Cleistochlamys kirkii* (19.0), *Markhamia zanzibarica* (17.5), *Drypetes mossambicensis* (17.4) and *Tricalysia junodii* (17.3). These are mostly shrub species.

#### Type 7: *Colophospermum mopane* woodland

Number of relevés: 13 (11, 23, 25, 27, 85, 138, 159, 185, 200, 202, 209, 288, 290).

Type 7 occurs on a variety of igneous rocks (basalt, dolerite, gabbrodiorite, granite, granophyre and rhyolite – 62% of samples) and the Cretaceous sediments (38% of samples). Two thirds of the samples comprised clay soils, the remainder were loam soils. Topography comprised a mix of gently sloping or undulating areas (33%), plus one third flat bottom areas and the remaining third flat upland areas. The slope for 92% of samples was level and for the remaining sample was moderate.

Type 7 tends to have somewhat higher woody cover than most of the other mopane woodland types. The upper tree layer is very sparse, < 5% cover, and reaches from 10 m to 20 m in height. The bulk of the tree cover is in the second tree layer which reaches from 3 m to 12 m in height. Total tree cover ranges from 1% to 50%, total shrub cover from 1% to 25%, giving an overall woody cover from 11% to 75%. Herbaceous cover varies between 1% and 50% and bare ground ranges from 20% to over 50%. Half the samples comprise wooded grassland to open woodland, and the other half are bushland or woodland.

*Colophospermum mopane* is present in all 13 samples and is dominant in all main woody layers (upper tree layer, second tree layer and shrub layer). Together with *Colophospermum mopane* other occasional canopy trees include *Adansonia digitata*, *Berchemia discolor*, *Cassia abbreviata s. beareana*, *Kirkia acuminata* and *Spirostachys africana*. *Rhigozum zambesiaceum* is sometimes common in the lower tree layer. *Colophospermum mopane* is also the principal shrub, with *Flueggea virosa s. virosa*, *Hippocratea buchananii*, *Phyllanthus pinnatus* and *Spirostachys africana* being occasionally prominent.

Overall, constant species are *Colophospermum mopane* (100), *Flueggea virosa s. virosa* (69), *Dichrostachys cinerea s. africana* (69), *Maerua parvifolia* (62), *Combretum apiculatum* (62), *Markhamia zanzibarica* (54), *Dalbergia melanoxylon* (54) and *Combretum hereroense v. hereroense* (54).

There are only two diagnostic species, *Colophospermum mopane* (22.0) and *Commiphora africana* (21.5), both of which are shared as diagnostic species with other of the mopane types.

### Type 8: *Colophospermum mopane* – *Combretum apiculatum* woodland

Number of relevés: 14 (14, 20, 26, 63, 65, 140, 141, 143, 180, 189, 223, 259, 264, 324).

In terms of geology two thirds of the samples were from igneous rocks (basalt, dolerite, granodiorite, granophyre and syenite) and the balance on Cretaceous sediments. Soils varied widely from clay to loams. Topography mainly comprised hills and ridges, plus two samples on gently undulating terrain and one on level bottom land terrain. Slope was level for 50% of samples and gentle to moderate for the balance of the samples.

The upper tree layer reaches from 10 m to > 20 m in height and achieves a maximum of 15% cover for one sample, but otherwise the cover is less than 5%. The bulk of the cover is in the second tree layer which extends from 3 m to 12 m in height. Total shrub cover is relatively low (< 25%). Total tree cover is 11% – 75%, as is the total woody cover. Herbaceous cover varies from 11% to 50% and bare ground from 20% to over 50%. The bulk of the samples (71%) comprise wooded grassland to open woodland, the remainder being woodland.

*Colophospermum mopane* and *Combretum apiculatum* are present in all 14 samples. The upper tree layer is dominated by *Colophospermum mopane* and *Kirkia acuminata*; other occasional canopy trees are *Acacia nigrescens*, *Adansonia digitata*, *Azelia quanzensis*, *Cassia abbreviata* s. *beareana*, *Combretum imberbe* and *Sclerocarya birrea* s. *caffra*. *Combretum apiculatum* is dominant in the lower tree layer, together with *Colophospermum mopane*, *Guibourtia conjugata* and *Combretum zeyheri*. Prominent shrubs include *Combretum apiculatum*, *Colophospermum mopane*, *Combretum collinum* s. *collinum* and *Phyllanthus pinnatus*.

In addition to *Combretum apiculatum* (100%) and *Colophospermum mopane* (100%), other constant species comprise *Xeroderris stuhlmannii* (71%), *Tricalysia allenii* (71%), *Strychnos madagascariensis* (71%), *Markhamia zanzibarica* (71%), *Combretum mossambicense* (64%), *Cissus cornifolia* (64%), *Cassia abbreviata* s. *beareana* (64%) and *Boscia angustifolia* v. *corymbosa* (57%).

Diagnostic species not shared with any of the other mopane types are *Ochna inermis* (25.6), *Tricalysia allenii* (24.5) and *Boscia angustifolia* v. *corymbosa* (19.3). These species are generally indicative of lighter loamier soils, particularly as compared to Types 1 and 7.

### Type 11: *Colophospermum mopane* woodland with *Combretum hereroense* and *Terminalia prunioides*

Number of relevés: 26 (32, 45, 48, 68, 87, 130, 144, 147, 150, 151, 153, 161, 176, 229, 236, 246, 251, 253, 255, 257, 265, 300, 313, 317, 325, 327).

Type 11 was virtually confined to the Cretaceous sediments other than two samples from areas of igneous rocks (granodiorite and

rhyolite). Soils were predominantly loam soils but varied considerably from clay to sandy loam soils. The topography comprised a mixture between samples that were gently sloping to gently undulating ( $n = 13$ ) to upland samples predominantly on ridges or steep cliffs ( $n = 11$ ), plus two samples on level bottom land terrain. The slope for 38% of samples was level, for 38% gentle and for the remaining 24% moderate.

Type 11 comprises a relatively open community. The upper tree layer, reaching from 10 m to over 20 m in height, is typically sparse (< 5% cover), occasionally achieving up to 15% cover ( $n = 3$ ). The second tree layer is 3 m – 12 m in height. Total tree cover and total shrub cover both range from 1% to 25%, giving an overall woody cover of 11% – 50%. Total herbaceous cover is relatively high (11% – 75%) and bare ground varies from 20% to > 50%. Overall, 85% of the samples comprise wooded/bushland grassland to open woodland with the balance being bushland ( $n = 4$ ).

The most common upper tree species is *Colophospermum mopane*, followed by *Terminalia prunioides*, *Kirkia acuminata* and *Spirostachys africana*. The second tree layer is again dominated by *Colophospermum mopane*; other occasionally common species are *Terminalia prunioides*, *Combretum hereroense* v. *hereroense*, *Combretum apiculatum*, and *Androstachys johnsonii*. Common shrub species are *Colophospermum mopane*, *Acacia exuvialis*, *Combretum hereroense* v. *hereroense*, *Androstachys johnsonii* and *Grewia bicolor*.

Constant species are *Colophospermum mopane* (100%), *Combretum hereroense* v. *hereroense* (81%), *Acacia exuvialis* (81%), *Combretum apiculatum* (77%), *Terminalia prunioides* (69%), *Maerua parvifolia* (65%), *Grewia bicolor* (65%), *Euclea racemosa* s. *schimperii* (58%) and *Dichrostachys cinerea* s. *africana* (54%).

Diagnostic species not shared with any of the other mopane types are *Acacia exuvialis* (70.9), *Bolusanthus speciosus* (53.5), *Acacia senegal* v. *leiorhachis* (38.6), *Sideroxylon inerme* s. *diospyroides* (37.6), *Pappea capensis* (35.4), *Grewia villosa* v. *villosa* (28.7), *Balanites aegyptiaca* v. *aegyptiaca* (28.4), *Olax dissitiflora* (26.8), *Cissus rotundifolia* v. *rotundifolia* (26.8), *Commiphora caerulea* (26.3), *Zanthoxylum humile* (20.5), *Ximenia americana* v. *microphylla* (20.1) and *Sterculia rogersii* (16.9). Additional diagnostic species shared with one or more of the other mopane types are *Terminalia prunioides* (41.1), *Ormocarpum trichocarpum* (34.8), *Euclea racemosa* s. *schimperii* (32.6), *Combretum hereroense* v. *hereroense* (28.4), *Colophospermum mopane* (22.0) and *Grewia bicolor* (21.5).

### Type 13: *Colophospermum mopane* bushland

Number of relevés: 13 (43, 46, 56, 61, 62, 74, 75, 145, 177, 183, 291, 292, 305).

Type 13 was predominantly recorded from the Cretaceous sediments, except for two samples on igneous rocks (granophyre and syenite). Soils comprise various loams varying from loam clays to sandy loams. Topography was dominated by gently sloping to



gently undulating terrain, with smaller proportions of both level upland and bottom land terrain. The slope for 69% of samples was level, the balance were on gently sloping areas.

The upper tree layer in cases extends to over 20 m in height. Cover is typically low (absent or 1% or less), but occasionally is up to 20%. The second tree layer is sometimes absent and where present is low in height (< 8 m). The bulk of the woody cover occurs in the shrub layer, which ranges in cover from 26% to 75%, as does the total woody cover. Total tree cover varies from 1% to 25%. In terms of structure this type is consistently a bushland community, other than a single woodland sample.

*Colophospermum mopane* is present in all samples with a cover of > 25%, and is dominant in all three of the main woody layers: upper tree layer, second tree layer and the shrub layer. The upper tree layer is frequently absent; in addition to *Colophospermum mopane* other occasional species are *Adansonia digitata* and *Terminalia prunioides*. *Terminalia prunioides* is also present in the second tree layer, together with *Combretum apiculatum*, *Markhamia zanzibarica* and *Vitex patula*. The shrub layer is typically dominated by *Colophospermum mopane*.

Constant species are *Colophospermum mopane* (100%), *Maerua parvifolia* (85%), *Dichrostachys cinerea s. africana* (85%), *Grewia bicolor* (69%), *Gymnosporia pubescens* (62%), *Dalbergia melanoxylon* (62%), *Combretum hereroense v. hereroense* (62%), *Mundulea sericea* (54%), *Jasminum stenolobum* (54%), *Euclea racemosa s. schimperii* (54%) and *Combretum apiculatum* (54%).

Diagnostic species not shared with any of the other mopane types are *Gymnosporia pubescens* (47.2), *Mundulea sericea* (43.7), *Jasminum stenolobum* (35.8) and *Rhigozum zambesiacum* (21.4). Additional diagnostic species are *Euclea racemosa s. schimperii* (29.6), *Ormocarpum trichocarpum* (27.5), *Maerua parvifolia* (24.7), *Grewia bicolor* (23.9), *Terminalia prunioides* (23.4), *Colophospermum mopane* (22.0) and *Commiphora africana* (21.5).

### **Type 12: Mixed open woodland with *Colophospermum mopane*, *Combretum apiculatum* and *Combretum zeyheri***

Number of relevés: 27 (34, 51, 53, 59, 60, 77, 88, 94, 112, 121, 136, 157, 162, 168, 174, 193, 206, 216, 225, 228, 237, 268, 306, 316, 318, 320, 323).

In terms of geology, three quarters of samples were recorded from Cretaceous sediments and the remaining quarter from igneous rocks (granite, rhyolite and syenite). Soils tended to be generally lighter textured than most of the other mopane types, varying from clay loams to sands. Samples were recorded from a variety of positions in the landscape: from the bottom of depressions ( $n = 5$ ), to gently undulating terrain ( $n = 7$ ), to flat upland areas ( $n = 9$ ) and ridge tops ( $n = 6$ ). Slope was level for 89% of samples, gentle for two samples and moderate for the remaining single sample.

Type 12 comprises an open form of woodland. The upper tree layer reaches from 10 m to 20 m in height, typically with a cover

of < 5% (and often 1% or less), but occasionally extending to 25%. The bulk of the woody cover is in the tree layer (1% – 50%). Shrub cover is consistently less than 10%, giving an overall woody cover of 11% – 50%. Herbaceous cover is relatively high (11% – 75%) and bare ground varies from 10% to over 50%. Structurally the bulk of samples (81%) in this type comprise wooded grassland or open woodland, the remaining samples being classified as bushland ( $n = 1$ ) or woodland ( $n = 4$ ).

For this type the presence of *Colophospermum mopane* and *Combretum apiculatum* drops to 67% in each case, these being the lowest levels of all the mopane types. The upper tree layer is dominated by *Colophospermum mopane*; other common species are *Spirostachys africana*, *Combretum imberbe* and *Kirkia acuminata*. For the second tree layer the most frequent species are *Combretum apiculatum* and *Combretum zeyheri*, followed by *Colophospermum mopane*, *Spirostachys africana*, *Guibourtia conjugata* and *Terminalia sericea*. The shrub layer is relatively mixed, the most common dominant species being *Colophospermum mopane*, *Combretum apiculatum*, *Flueggea virosa s. virosa* and *Strychnos madagascariensis*.

This type has 19 constant species which is higher than any of the other mopane types (range = 8–14 species). The only one of these not shared by one or more of the other mopane or miombo types is *Diospyros loureiriana s. loureiriana* (63%). Eight of the remainder are shared with both one or more mopane and miombo types: *Xeroderris stuhlmannii* (74%), *Cassia abbreviata s. beareana* (70%), *Strychnos madagascariensis* (67%), *Dichrostachys cinerea s. africana* (67%), *Combretum apiculatum* (67%), *Colophospermum mopane* (67%), *Combretum mossambicense* (63%) and *Markhamia zanzibarica* (52%); five other species are shared as constant species only with other mopane types (*Philenoptera violacea* [74%], *Spirostachys africana* [67%], *Maerua parvifolia* [59%], *Cissus cornifolia* [59%] and *Flueggea virosa s. virosa* [56%]), and five only with other miombo types (*Terminalia sericea* [67%], *Combretum zeyheri* [63%], *Lannea schweinfurthii v. stuhlmannii* [59%], *Sclerocarya birrea s. caffra* [56%] and *Pseudolachnostylis maprouneifolia* [52%]).

There are 15 diagnostic species, of which as diagnostic species only *Acacia nilotica s. kraussiana* (26.9) and *Diospyros loureiriana s. loureiriana* (25.3) are unique to this type. Four other species, *Peltophorum africanum* (31.5), *Philenoptera violacea* (30.5), *Spirostachys africana* (22.3) and *Ximenia americana v. microphylla* (15.7), are shared with one or more of the other mopane types and the remaining nine species with one or more of the other miombo types: *Catunaregam swynnertonii* (23.6), *Combretum zeyheri* (28.2), *Erythrococca menyharthii* (17.0), *Gymnosporia senegalensis* (22.7), *Lannea schweinfurthii v. stuhlmannii* (17.9), *Pseudolachnostylis maprouneifolia* (23.5), *Sclerocarya birrea s. caffra* (18.5), *Terminalia sericea* (25.7) and *Xeroderris stuhlmannii* (15.4).

Type 12 is somewhat intermediary in nature. *Combretum zeyheri* achieves dominance in 4% of the plots, and the type has a lower prevalence of *Colophospermum mopane* and *Combretum apiculatum* than any of the other mopane types. While the type includes a number of typical mopane constant species (*Cassia abbreviata s. beareana*, *Cissus cornifolia*, *Combretum*

*mossambicense*, *Dichrostachys cinerea s. africana*, *Flueggea virosa s. virosa*, *Maerua parvifolia* and *Markhamia zanzibarica*), it also shares a number of constant species that are characteristic of the miombo woodlands (*Strychnos madagascariensis* and *Xeroderris stuhlmannii*, plus *Combretum zeyheri*, *Lannea schweinfurthii v. stuhlmannii*, *Pseudolachnostylis maprouneifolia*, *Sclerocarya birrea s. caffra*, *Terminalia sericea* and *Xeroderris stuhlmannii*).

## Miombo woodland

### Type 2: *Brachystegia tamarindoides* woodland

Number of relevés: 17 (3, 92, 93, 104, 134, 137, 171, 191, 192, 241, 273, 289, 294, 308, 321, 328, 329).

Type 2 occurred on both Cretaceous sediments (10 samples) and on igneous rocks (seven samples on granite, granophyre and syenite). Soils were predominantly sands, sandy loams or loamy sands. The topography was dominated by flat or gently undulating upland areas, plus a few samples on ridges.

Slope was level for 71% of the samples, the balance being split between gentle and moderate.

The upper tree layer ranges in height from 10 m to 20 m, and has a cover that is usually < 5% but occasionally reaches to 40%. The lower tree layer reaches from 3 m to over 12 m in height. Total tree cover varies from 1% to 50%, total shrub cover from 1% to 25%, and overall woody cover from 1% to 75%. Herbaceous cover similarly extends between 1% and 75%, and bare ground from 20% to over 50%.

*Brachystegia tamarindoides s. torrei* is the dominant tree in the upper layer; other occasional species are *Acacia welwitschii subsp. delagoensis*, *Adansonia digitata*, *Cleistanthus schlechteri*, *Erythrophleum africanum* and *Guibourtia conjugata*. The second tree layer is again dominated by *Brachystegia tamarindoides s. torrei*. Other occasionally prominent trees are *Philenoptera bussei*, *Guibourtia conjugata* and *Pteleopsis myrtifolia*. The main shrub species are *Millettia usaramensis s. australis*, *Monodora junodii v. junodii*, *Vepris bremekampii* and *Hugonia orientalis*.

There are 15 constant species, seven of which are shared with one or more of the other miombo types: *Hugonia orientalis* (100%), *Monodora junodii v. junodii* (94%), *Brachystegia tamarindoides s. torrei* (88%), *Strychnos madagascariensis* (82%), *Pteleopsis myrtifolia* (71%), *Xeroderris stuhlmannii* (65%) and *Senna petersiana* (59%), with the remaining eight species being unique as constant species to this type: *Artabotrys brachypetalus* (71%), *Hymenocardia ulmoides* (71%), *Vitex mombassae* (71%), *Coffea racemosa* (65%), *Margaritaria discoidea s. nitida* (65%), *Synaptolepis alternifolia* (59%), *Alchornea laxiflora* (53%) and *Heinsia crinita s. parviflora* (53%).

There are 32 diagnostic species, 15 of which are shared with one or more of the other miombo types: *Brachystegia tamarindoides s. torrei* (64.3), *Hymenocardia ulmoides* (47.7), *Artabotrys brachypetalus* (44.3), *Hugonia orientalis* (41.1), *Monodora junodii v. junodii* (39.6), *Vitex mombassae* (39.6), *Alchornea laxiflora* (35.6), *Dalbergia nitidula* (35.0), *Maerua kirkii* (25.3), *Pteleopsis*

*myrtifolia* (24.2), *Millettia usaramensis s. australis* (23.6), *Philenoptera bussei* (22.1), *Strychnos madagascariensis* (20.5), *Xylia torreana* (20.5) and *Boscia albitrunca* (17.6).

The remaining 17 diagnostic species are unique to this type. *Synaptolepis alternifolia* (62.2), *Margaritaria discoidea s. nitida* (59.0), *Coptosperma littorale* (53.7), *Vepris bremekampii* (48.0), *Cleistanthus schlechteri* (45.0), *Suregada zanzibariensis* (43.3), *Heinsia crinita s. parviflora* (41.8), *Psydrax livida* (40.3), *Friesodielsia obovata* (36.5), *Coffea racemosa* (35.4), *Leptactina delagoensis s. delagoensis* (33.6), *Lagynias dryadum* (33.4), *Ochna barbosa* (31.8), *Clerodendrum buchneri* (29.6), *Tiliacora funifera* (29.3), *Cladostemon kirkii* (26.2) and *Gardenia volkensii s. volkensii v. volkensii* (25.8).

### Type 5: *Androstachys johnsonii* – *Croton pseudopulchellus* woodland

Number of relevés: 14 (8, 24, 35, 71, 86, 105, 132, 148, 219, 238, 260, 276, 311, 322).

In terms of geology, seven samples were recorded from Cretaceous sediments and five from igneous rocks (granodiorite, mylenite, rhyolite and syenite). Soils varied considerably from clay loam to sand. Topography was split more or less evenly between gently undulating upland areas and ridges. Samples were recorded from a full range of slopes, from level to steep, with the bulk of samples comprising gentle to moderate slopes.

The upper tree layer varies in height from 10 m to 20 m, and in cover up from absent to 25%. The bulk of the tree cover is in the second tree layer which reaches from 3 m to 12 m in height. Total tree cover is 26% – 100%, as is the overall woody cover; shrub cover tends to be low (1% – 10%). Herbaceous cover is also relatively low (1% – 55%), while bare ground is typically > 50%. In terms of structure this type varies from open woodland ( $n = 6$ ) to woodland ( $n = 5$ ) to closed woodland ( $n = 3$ ).

*Androstachys johnsonii* is the dominant tree in both the upper and second tree layers. Other top layer trees are *Azelia quanzensis*, *Guibourtia conjugata* and *Kirkia acuminata*, and less commonly *Adansonia digitata*, *Colophospermum mopane*, *Commiphora caerulea*, *Terminalia prunioides* and *Xeroderris stuhlmannii*. The second tree layer is similarly dominated by *Androstachys johnsonii*, and occasionally by *Guibourtia conjugata* and *Combretum celastroides s. celastroides*. The main shrub species are *Androstachys johnsonii*, *Croton pseudopulchellus* and *Phyllanthus kirkii*. The overall cover of *Androstachys johnsonii* exceeds 25% in all but one of the samples.

There are only five constant species: *Androstachys johnsonii* (100%), *Croton pseudopulchellus* (79%), *Cassia abbreviata s. beareana* (64%), *Phyllanthus pinnatus* (57%) and *Colophospermum mopane* (57%). Other than *Croton pseudopulchellus* the others are all shared with Type 6 and in some cases with other miombo woodland types.

The number of diagnostic species ( $n = 8$ ) is also low, particularly as compared to the other miombo woodland types (range = 13–54

species). Half of these are unique to this type: *Croton pseudopulchellus* (72.6), *Wrightia natalensis* (35.3), *Diospyros lycioides* (33.3) and *Canthium setiflorum s. setiflorum* (22.2); the remainder are shared with one or more of the other miombo types, particularly Type 6: *Androstachys johnsonii* (60.3), *Combretum celastroides s. celastroides* (33.1), *Strophanthus kombe* (26.9) and *Vitex mombassae* (24.4).

### Type 6: Mixed woodland with *Androstachys johnsonii*

Number of relevés: 33 (9, 10, 12, 15, 16, 17, 22, 37, 184, 187, 188, 190, 195, 197, 198, 199, 201, 203, 205, 207, 210, 211, 213, 262, 263, 267, 281, 286, 293, 296, 301, 326, 330).

Virtually all samples of Type 6 were recorded on igneous rocks (dolerite, granite, granodiorite, granophyre, rhyolite, syenite and trachyte), other than one sample on the Cretaceous sediments. Soils were most commonly clay loams, but varied from loamy clay to sand. The topography was split between one third of samples on gently undulating upland areas and two thirds on ridges and escarpments. Slopes were roughly one third level, one third gentle and one third moderate, with one sample on steep terrain.

This comprises a more open community than Type 5 *Androstachys johnsonii* woodland. The height of the upper tree layer varies from 10 m to 20 m, and of the second tree layer from 3 m to 12 m. Total tree cover ranges from 1% to 50%, shrub cover from 1% to 25%, and overall woody cover from 1% to 50%. Herbaceous cover is relatively high (1% – 75%) and bare ground ranges from 10% to over 50%, often comprising bare rock. In terms of structure most samples (91%) are classified as wooded or bushed grassland or open woodland, with two samples of woodland and one of bushland.

The most common upper layer trees are *Kirkia acuminata*, *Adansonia digitata*, *Brachystegia tamarindoides s. torrei*, *Colophospermum mopane* and *Entandrophragma caudatum*. Other less common species include *Acacia nigrescens*, *Androstachys johnsonii*, *Berchemia discolor*, *Combretum imberbe*, *Spirostachys africana* and *Xeroderris stuhlmannii*. The second tree layer is similarly mixed in terms of species composition, the most common species are *Androstachys johnsonii*, *Combretum apiculatum*, *Vitex ferruginea s. amboniensis*, *Colophospermum mopane*, *Markhamia zanzibarica*, *Brachystegia tamarindoides s. torrei*, *Philenoptera bussei* and *Xylia torreana*. Important species in the shrub layer include *Phyllanthus pinnatus*, *Androstachys johnsonii*, *Vitex ferruginea s. amboniensis*, *Combretum mossambicense*, *Brachystegia tamarindoides s. torrei*, *Colophospermum mopane*, *Gardenia resiniflua s. resiniflua* and *Millettia usaramensis s. australis*. *Androstachys johnsonii* reaches a cover of > 25% in a single sample.

There are 20 constant species, half of which are shared with one or more of the other miombo types: *Phyllanthus pinnatus* (88%), *Cassia abbreviata s. beareana* (85%), *Combretum apiculatum* (73%), *Xeroderris stuhlmannii* (67%), *Monodora junodii v. junodii* (67%), *Lannea schweinfurthii v. stuhlmannii* (64%), *Androstachys johnsonii* (64%), *Brachystegia tamarindoides s. torrei* (58%), *Strychnos madagascariensis* (55%) and *Colophospermum mopane* (52%). The other ten species that are unique within the miombo types are: *Markhamia zanzibarica* (82%), *Boscia angustifolia v.*

*corymbosa* (76%), *Dichrostachys cinerea s. africana* (70%), *Canthium glaucum s. frangula v. frangula* (67%), *Kirkia acuminata* (61%), *Vitex ferruginea s. amboniensis* (61%), *Drypetes mossambicensis* (58%), *Acacia erubescens* (52%) and *Gardenia resiniflua s. resiniflua* (52%). Collectively, 11 of these species are also shared with one or more of the mopane types: *Phyllanthus pinnatus*, *Cassia abbreviata s. beareana*, *Markhamia zanzibarica*, *Boscia angustifolia v. corymbosa*, *Combretum mossambicense*, *Combretum apiculatum*, *Dichrostachys cinerea s. africana*, *Xeroderris stuhlmannii*, *Lannea schweinfurthii v. stuhlmannii*, *Drypetes mossambicensis*, *Strychnos madagascariensis* and *Colophospermum mopane*.

This type has the highest number of diagnostic species ( $n = 54$ ), of which the bulk ( $n = 39$ ) are unique to this type: *Combretum padoides* (40.6), *Vitex ferruginea s. amboniensis* (37.9), *Canthium glaucum s. frangula v. frangula* (36.6), *Commiphora edulis s. edulis* (35.0), *Gardenia resiniflua s. resiniflua* (34.6), *Acacia erubescens* (33.4), *Gyrocarpus americanus s. africanus* (31.4), *Boscia angustifolia v. corymbosa* (31.0), *Cordia grandicalyx* (31.0), *Kirkia acuminata* (30.9), *Canthium racemosum v. racemosum* (30.0), *Ficus abutilifolia* (29.7), *Pachypodium saundersii* (29.1), *Entandrophragma caudatum* (27.9), *Bauhinia tomentosa* (27.7), *Bridelia mollis* (26.6), *Grewia caffra* (26.6), *Elephantorrhiza goetzei s. goetzei* (25.8), *Anisotes rogersii* (25.6), *Adenium multiflorum* (24.3), *Clerodendrum wildii* (23.8), *Pouzolzia mixta* (23.8), *Euphorbia espinosa* (23.2), *Maerua decumbens* (23.0), *Vitex patula* (22.8), *Adansonia digitata* (21.6), *Adenia fruticosa s. simplicifolia* (20.5), *Strychnos decussata* (20.4), *Dovyalis hispidula* (20.3), *Euphorbia tirucalli* (19.6), *Dalbergia arbutifolia s. arbutifolia* (18.4), *Cassia abbreviata s. beareana* (18.1), *Steganotaenia araliacea v. araliacea* (16.7), *Azalia quanzensis* (16.5), *Combretum mossambicense* (16.4), *Albizia brevifolia* (15.6), *Euphorbia cooperi v. cooperi* (15.4), *Manilkara mochisia* (15.4) and *Crossopteryx febrifuga* (15.3). A further nine diagnostic species are shared with one or more of the other miombo types: *Brachystegia tamarindoides s. torrei* (38.4), *Androstachys johnsonii* (33.7), *Maerua kirkii* (29.6), *Artabotrys brachypetalus* (24.4), *Monodora junodii v. junodii* (22.8), *Millettia usaramensis s. australis* (21.3), *Vitex mombassae* (18.8), *Alchornea laxiflora* (16.1) and *Strophanthus kombe* (15.5); one with both miombo and mopane types: *Lannea schweinfurthii v. stuhlmannii* (20.6) and five with mopane types: *Phyllanthus pinnatus* (30.7), *Markhamia zanzibarica* (22.8), *Drypetes mossambicensis* (21.1), *Ochna inermis* (20.6) and *Sterculia rogersii* (20.1).

### Type 9: Mixed Combretaceae woodland with *Burkea africana*

Number of relevés: 40 (29, 31, 49, 52, 57, 81, 82, 95, 96, 102, 108, 109, 114, 117, 126, 127, 128, 129, 133, 135, 146, 152, 158, 167, 170, 173, 175, 194, 222, 231, 232, 244, 252, 254, 270, 272, 278, 279, 312, 319).

Type 9 was confined to the Cretaceous sediments. Soils were predominantly loamy sands or sands. The topography was dominated by flat upland areas other than a few samples from gently sloping or undulating terrain. Slope was generally level (95%), the balance being gentle.



This is a relatively open community with total woody cover from 11% to 50%, most of which is in the tree layer (1% – 50%), and the cover of the shrub layer varies from 1% to 25%. Herbaceous ground cover is correspondingly high (11% – 75%), with bare ground varying from 20% to over 50%. The upper tree layer varies considerably from absent to over 20 m in height, with only a single sample exceeding 5% in cover. The lower tree layer is usually 3 m to 12 m in height. The majority of samples (83%) classify as wooded (or bushed) grassland to open woodland, the remainder comprising woodland ( $n = 6$ ) or bushland ( $n = 1$ ).

The upper tree layer is often absent or very sparse. The most frequent tree species are *Sclerocarya birrea*, *Guibourtia conjugata*, *Combretum collinum s. collinum*, *Julbernardia globiflora*, *Xeroderris stuhlmannii*, *Brachystegia tamarindoides s. torrei*, *Burkea africana*, *Erythrophleum africanum*, *Pseudolachnostylis maprouneifolia* and *Pterocarpus angolensis*. Dominant tree species in the second tree layer are *Combretum collinum s. collinum*, *Combretum apiculatum*, *Pteleopsis myrtifolia*, *Terminalia sericea*, *Combretum zeyheri*, *Guibourtia conjugata* and *Julbernardia globiflora*. Common shrub species are *Diplorhynchus condylocarpon*, *Terminalia sericea*, *Strychnos madagascariensis*, *Ochna pulchra s. pulchra*, *Combretum collinum s. collinum*, *Euclea natalensis s. angustifolia*, *Pteleopsis myrtifolia*, *Uvaria gracilipes* and *Xeroderris stuhlmannii*.

The only species to achieve over 25% cover are *Combretum collinum s. collinum*, *Pteleopsis myrtifolia* and *Terminalia sericea*, each in a single sample.

There are 15 constant species, the bulk of which are shared with one or more of the other miombo types: *Combretum collinum s. collinum* (98%), *Terminalia sericea* (92%), *Pteleopsis myrtifolia* (92%), *Diplorhynchus condylocarpon* (92%), *Strychnos madagascariensis* (90%), *Xeroderris stuhlmannii* (80%), *Senna petersiana* (78%), *Sclerocarya birrea s. caffra* (68%), *Combretum apiculatum* (65%), *Guibourtia conjugata* (60%) and *Hugonia orientalis* (55%). Constant species unique among the miombo types to this type are *Ochna pulchra s. pulchra* (88%), *Pseudolachnostylis maprouneifolia* (82%), *Combretum zeyheri* (65%) and *Vangueria infausta s. infausta* (62%).

There are 27 diagnostic species: of which 14 are unique to this type: *Ochna pulchra s. pulchra* (65.7), *Burkea africana* (50.6), *Pseudolachnostylis maprouneifolia* (45.3), *Vangueria infausta s. infausta* (42.1), *Euclea natalensis s. angustifolia* (36.0), *Pterocarpus angolensis* (34.2), *Combretum zeyheri* (29.6), *Catunaregam swynnertonii* (29.2), *Ximenia caffra* (25.1), *Securidaca longepedunculata* (23.2), *Holarrhena pubescens* (23.2), *Ancylobotrys petersiana* (20.1), *Julbernardia globiflora* (18.8), *Uvaria gracilipes* (16.9) and *Ochna natalitia* (15.2). The other 13 are all shared with one or more of the other miombo types: *Diplorhynchus condylocarpon* (53.7), *Combretum collinum s. collinum* (45.9), *Terminalia sericea* (42.0), *Pteleopsis myrtifolia* (37.4), *Erythrophleum africanum* (33.5), *Senna petersiana* (26.3), *Sclerocarya birrea s. caffra* (26.1), *Ozoroa paniculosa v. paniculosa* (25.7), *Strychnos madagascariensis* (24.8), *Strychnos spinosa* (22.4), *Clerodendrum robustum* (21.1), *Dalbergia nitidula* (19.0), *Xeroderris stuhlmannii* (18.7) and *Guibourtia conjugata* (17.6). In fact all these species are shared with Type 10 and

the following four species with other miombo types too: *Dalbergia nitidula*, *Guibourtia conjugata*, *Pteleopsis myrtifolia* and *Strychnos madagascariensis*.

### Type 10: Mixed Combretaceae woodland with *Guibourtia conjugata*

Number of relevés: 39 (30, 41, 42, 44, 50, 67, 69, 70, 79, 80, 90, 97, 98, 100, 101, 103, 107, 110, 113, 115, 116, 120, 122, 123, 124, 125, 131, 154, 172, 226, 233, 235, 240, 245, 271, 274, 280, 314, 315).

The environmental setting for Type 10 was very similar to that of Types 9 and 14. All samples were recorded from Cretaceous sediments; with sandy loam, loamy sand or sand soils; predominantly on flat upland plains other than a few samples on gently undulating terrain; and with slope being level for 90% of samples, and gentle for the remainder other than a single sample on steep terrain.

Structurally, in terms of the height and cover of the main vegetation layers, this type is very similar to Type 9. Total tree cover ranges from 1% to 50%, shrub cover from 1% to 25% and total woody cover from 11% to 50%. Herbaceous cover is 11% – 75% and bare ground varies from 20% to over 50%. Similarly, 85% of samples are classified as wooded (or bushed) grassland or open woodland, and a few samples were woodland ( $n = 5$ ) or bushland ( $n = 1$ ).

This type has many similarities to Type 9 but with a greater dominance of *Guibourtia conjugata*.

The most frequent species in the upper tree layer is *Guibourtia conjugata*. Other common species are *Acacia nigrescens*, *Adansonia digitata*, *Balanites maughamii*, *Cassia abbreviata s. beareana*, *Colophospermum mopane*, *Combretum collinum s. collinum*, *Erythrophleum africanum*, *Julbernardia globiflora*, *Kirkia acuminata*, *Lannea schweinfurthii v. stuhlmannii*, *Pterocarpus angolensis*, *Spirostachys africana* and *Xeroderris stuhlmannii*. The lower tree layer is dominated by *Combretum collinum s. collinum*, *Combretum apiculatum* and *Guibourtia conjugata*. Other common species are *Combretum zeyheri*, *Pteleopsis myrtifolia*, *Terminalia sericea*, *Julbernardia globiflora* and *Milletia stuhlmannii*. The main shrub species are *Combretum collinum s. collinum*, *Strychnos madagascariensis*, *Combretum apiculatum*, *Pteleopsis myrtifolia*, *Julbernardia globiflora*, *Guibourtia conjugata* and *Milletia stuhlmannii*.

As for Type 9 there are only three plots where the cover of one species is greater than 25%, these being two of *Combretum collinum s. collinum* and one of *Julbernardia globiflora*.

This type has 13 constant species: *Combretum collinum s. collinum* (95%), *Xeroderris stuhlmannii* (92%), *Pteleopsis myrtifolia* (90%), *Guibourtia conjugata* (85%), *Strychnos madagascariensis* (79%), *Terminalia sericea* (74%), *Senna petersiana* (72%), *Cassia abbreviata s. beareana* (72%), *Combretum apiculatum* (69%), *Lannea schweinfurthii v. stuhlmannii* (67%), *Hugonia orientalis* (62%), *Sclerocarya birrea s. caffra* (56%) and *Diplorhynchus condylocarpon* (51%). All of these are shared with one or more of the other miombo types, in particular all except *Cassia abbreviata s. beareana* and *Lannea schweinfurthii v. stuhlmannii* are shared with Type 9.

There are 20 diagnostic species. Fourteen of these are shared with Type 9 (*Combretum collinum* s. *collinum* [44.2], *Pteleopsis myrtifolia* [35.7], *Guibourtia conjugata* [32.4], *Terminalia sericea* [30.6], *Xeroderris stuhlmannii* [25.6], *Dalbergia nitidula* [24.5], *Diplorhynchus condylocarpon* [24.0], *Strychnos spinosa* [23.3], *Senna petersiana* [22.9], *Ozoroa paniculosa* v. *paniculosa* [22.7], *Erythrophleum africanum* [19.7], *Sclerocarya birrea* s. *caffra* [19.1], *Strychnos madagascariensis* [18.9], *Clerodendrum robustum* [17.9]), and three with other miombo types (*Lannea schweinfurthii* v. *stuhlmannii* [22.4], *Hugonia orientalis* [18.1] and *Pterocarpus lucens* s. *antunesii* [15.9]). The remaining three species are unique to this type (*Pseudolachnostylis maprouneifolia* [19.5], *Vangueria infausta* s. *infausta* [17.6] and *Gymnosporia senegalensis* [16.4]).

### Type 14: *Guibourtia conjugata* woodland

Number of relevés: 12 (47, 78, 89, 91, 165, 179, 227, 234, 239, 277, 299, 310).

Type 14, as for Types 9 and 10, was restricted to the Cretaceous sediments, and to areas with loamy sand or sand soils. The topography generally comprised flat to gently sloping upland areas. For 83% of samples the slope was flat, and for the balance gentle.

Tree cover (11 to 50) is slightly higher 11% – 50% for this type as compared to Types 9 and 10, and which results in a higher total woody cover of 11% – 75% (as compared to 11% – 50% for Types 9 and 10). Shrub cover remains at 1% – 25%, herbaceous cover (at 1% – 50%) is slightly lower, and bare ground (at > 50%) slightly higher. The heights of the main and second tree layers vary from 15 m to 20 m and from 9 m to 12 m, respectively. Overall, the community comprises open woodland ( $n = 6$ ) or woodland ( $n = 5$ ), with a single sample of closed woodland.

*Guibourtia conjugata* is dominant in all the main woody layers (upper tree, second tree and shrub layers), reaching over 25% cover in 50% of the samples, and *Milletia usaramensis* s. *australis* in 17% of samples. Other prominent upper layer tree species include *Colophospermum mopane*, *Entandrophragma caudatum* and *Newtonia hildebrandtii* var. *pubescens*, and in the second tree layer *Milletia usaramensis* s. *australis*. Additional common shrubs include *Combretum celastroides* s. *celastroides*, *Milletia stuhlmannii*, *Milletia usaramensis* s. *australis*, *Monodora junodii* v. *junodii* and *Phyllanthus pinnatus*.

There are only 10 constant species, most of which are shared with one or more of the other miombo types, particularly Types 9 and 10: *Guibourtia conjugata* (100%), *Monodora junodii* v. *junodii* (92%), *Hugonia orientalis* (83%), *Cassia abbreviata* s. *beareana* (75%), *Xeroderris stuhlmannii* (67%), *Combretum collinum* s. *collinum* (58%) and *Combretum apiculatum* (58%). Constant species that are unique to this type are *Philenoptera bussei* (67%), *Pterocarpus lucens* s. *antunesii* (67%) and *Strychnos potatorum* (58%).

Similarly, there are relatively few diagnostic species ( $n = 13$ ), and most of these are shared with one or more of the other miombo types: *Pterocarpus lucens* s. *antunesii* (42.8), *Guibourtia conjugata* (41.7), *Monodora junodii* v. *junodii* (38.1), *Philenoptera bussei*

(36.6), *Xylia torreana* (31.3), *Hugonia orientalis* (31.1), *Combretum celastroides* s. *celastroides* (30.4), *Strophanthus kombe* (24.5), *Hymenocardia ulmoides* (23.8) and *Boscia albitrunca* (22.8). The three diagnostic species unique to this type are *Coptosperma zygoon* (35.5), *Acacia ataxacantha* (30.0) and *Erythrococca menyharthii* (27.8).

## Alluvial woodland

### Type 3: Mixed woodland on alluvium

Number of relevés: 22 (4, 7, 64, 83, 155, 156, 182, 186, 212, 248, 266, 269, 282, 283, 284, 285, 287, 295, 297, 298, 302, 303).

Type 3 was confined to alluvial deposits along the larger streams and rivers. Soils were generally relatively heavily textured clays to loams, although one sample was recorded on sand. Topography comprised flat alluvial terraces, the slope being level for 95% of samples and gentle for the remaining sample.

In terms of structure this is a highly variable type. The upper tree layer is relatively tall, reaching from 15 m to usually over 20 m in height. Cover of the upper tree layer varies from absent to 60%. The second tree layer is usually 3 m to 12 m in height. The bulk of the woody cover is usually in the tree component. Total tree cover ranges from 1% to 50%, total shrub cover from 1% to 25% and total woody cover from 1% to 100%. Herbaceous cover is equally variable (1%–100%), while bare ground ranges from < 10% to > 50%. The structure of this type varies from bushed grassland to closed woodland, but 82% of samples classify as bushed or wooded grassland to open woodland, with two samples each of woodland and closed woodland.

Dominant species in the upper tree layer include *Philenoptera violacea*, *Combretum imberbe*, *Cordyla africana*, *Diospyros mespiliformis*, *Kigelia africana* and *Spirostachys africana*. Dominance in the lower tree layer is typically mixed; common species include *Croton megalobotrys*, *Capparis tomentosa*, *Philenoptera violacea* and *Tabernaemontana elegans*. The shrub layer is also mixed, common dominant species are *Croton megalobotrys*, *Acacia tortilis* s. *heteracantha*, *Capparis sepiaria* v. *subglabra* and *Thilachium africanum*.

Overall this type is characterized by high species diversity and this is reflected in high numbers of constant ( $n = 21$ ) and diagnostic ( $n = 46$ ) species, many of which are unique to this type. Unique constant species are *Xanthocercis zambesiaca* (86%), *Capparis tomentosa* (86%), *Acacia tortilis* s. *heteracantha* (82%), *Thilachium africanum* (77%), *Kigelia africana* (73%), *Croton megalobotrys* (73%), *Capparis sepiaria* v. *subglabra* (73%), *Cordyla africana* (68%), *Cleistochlamys kirkii* (64%), *Boscia mossambicensis* (59%), *Berchemia discolor* (59%), *Tabernaemontana elegans* (55%), *Maclura africana* (55%), *Diospyros mespiliformis* (55%) and *Deinbollia xanthocarpa* (55%). Another five constant species are shared with one or more of the mopane types: *Philenoptera violacea* (91%), *Combretum imberbe* (82%), *Flueggea virosa* s. *virosa* (77%), *Diospyros loureiriana* s. *loureiriana* (59%) and *Drypetes mossambicensis* (55%), while *Combretum mossambicense* (86%), is represented also in both mopane and miombo types.



There are no constant species shared with any of the miombo types.

Much the same applies to the 46 diagnostic species, the majority of which are unique to this type: *Xanthocercis zambesiaca* (87.1), *Croton megalobotrys* (84.4), *Capparis sepiaria* v. *subglabra* (80.1), *Kigelia africana* (77.2), *Cordyla africana* (72.1), *Maclura africana* (70.4), *Trichilia emetica* s. *emetica* (69.4), *Deinbollia xanthocarpa* (68.2), *Acacia tortilis* s. *heteracantha* (66.3), *Boscia mossambicensis* (61.3), *Tabernaemontana elegans* (56.1), *Capparis tomentosa* (50.1), *Faidherbia albida* (46.3), *Acacia schweinfurthii* v. *schweinfurthii* (44.2), *Acacia robusta* s. *clavigera* (43.2), *Lecaniodiscus fraxinifolius* (35.9), *Senna septemtrionalis* (35.8), *Azima tetracantha* (35.8), *Commiphora zanzibarica* (35.0), *Ficus sycomorus* s. *sycomorus* (34.8), *Hyphaene petersiana* (32.5), *Phyllanthus reticulatus* v. *reticulatus* (31.8), *Thilachium africanum* (31.3), *Salvadora persica* v. *pubescens*

(31.2), *Diospyros mespiliformis* (31.1), *Tricalysia jasminiflora* v. *jasminiflora* (29.1), *Senna occidentalis* (29.1), *Albizia glaberrima* v. *glabrescens* (29.1), *Acacia sieberiana* v. *woodii* (29.1), *Acacia galpinii* (28.5), *Acalypha ornata* (28.3), *Garcinia livingstonei* (27.9), *Cordia goetzei* (25.3), *Berchemia discolor* (24.6) and *Pavetta gracillima* (19.2).

Another seven diagnostic species are shared with one or more of the mopane types: *Combretum imberbe* (44.9), *Philenoptera violacea* (41.2), *Cleistochlamys kirkii* (32.5), *Allophylus rubifolius* v. *rubifolius* (28.1), *Albizia harveyi* (26.8), *Diospyros loureiriana* s. *loureiriana* (22.7) and *Flueggea virosa* s. *virosa* (20.4); three with one or more of the miombo types: *Adansonia digitata* (26.5), *Combretum mossambicense* (22.3) and *Tiliacora funifera* (21.4); and *Drypetes mossambicensis* (19.2) is shared with one or more of both mopane and miombo types.

**Note:** This is Online Appendix 1 of Martini, F., Cunliffe, R., Farcomeni, A., De Sanctis, M., D'Ammando, G. & Attorre, F., 2016, 'Classification and mapping of the woody vegetation of Gonarezhou National Park, Zimbabwe', *Koedoe* 58(1), a1388. <http://dx.doi.org/10.4102/koedoe.v58i1.1388>.