

## Caiundo - Vegetation

The vegetation of the Caiundo core site represents relatively intact *Baikiaea-Burkea* woodlands of south-eastern Angola (Tab. 1). Due to the much drier climate only a few Miombo elements such as *Julbernardia paniculata* still occur here (Tab. 2). Hence, the core site represents a link between the Mashare area and the highlands of the Cusseque area. Furthermore, it represents a reference state as human impact can be regarded as low compared to other areas in the proximity of the river (Fig. 1). However, vegetation is heavily impacted by fire and most of the area is burned almost every year (Frantz et al. 2013).

According to the classification of Olson et al. (2001) the area falls into the *Baikiaea* woodlands. These woodlands cover the vast areas of the Kalahari Sandveld representing the majority of the Caiundo core site. In the classification of the woody vegetation four subunits of the *Baikiaea* woodlands are differentiated (Tab. 2). The respective vegetation units of the land cover classification (Frantz et al. 2013) are given in brackets. The *Erythrophleum africanum* - *Bauhinia urbaniana* vegetation unit [*Baikiaea-Burkea* woodlands (dense and medium dense)] covers the largest area within the core site. It depicts woodlands with a relative high coverage especially of the tree layer (Fig. 2) whereas the *Diplorhynchus condylocarpon* - *Gymnosporia senegalensis* unit [*Baikiaea-Burkea* woodlands (open); grasslands] represents a rather open woodland type (Fig. 3). The latter is located adjacent to the old floodplain where the impact of browsing livestock is high. Moreover, it also occurs in depressions in the hinterland with less favourable edaphic conditions. This unit is composed of spiny shrub species such as *Gymnosporia senegalensis*, or fire resistant species such as *Bobgunnia madagascariensis* and *Diplorhynchus condylocarpon*. However, these two woodland units have a large species set in common (Tab. 2). Important tree species are *Schinziophyton rautanenii* (commonly named Manketti tree and sought after for its oil rich fruits), *Pterocarpus angolensis*, *Guibourtia coleosperma*, *Burkea africana* and *Baikiaea plurijuga*. Furthermore, dwarf shrubs such as *Diospyros*

**Table 1: Vegetation of the Caiundo core site in numbers: sampling size and biodiversity indices.**

Ecoregion	Zambeian <i>Baikiaea</i> woodlands
Sampling period:	2011 - 2013
1,000 m <sup>2</sup> plots sampled	46
100 m <sup>2</sup> plots sampled	66
Vegetation unit (MODIS classification)	<i>Baikiaea-Burkea</i> woodlands on Kalahari sands (open, medium and dense), mixed <i>Burkea</i> woodlands (with <i>Terminalia sericea</i> ), thornbush savannah, seasonally flooded grasslands and reedbeds
Dominant families (cover)	Fabaceae, Euphorbiaceae, Apocynaceae, Combretaceae
Dominant families (richness)	Fabaceae, Combretaceae, Euphorbiaceae, Poaceae
Species richness on 1,000 m <sup>2</sup>	33 (9 - 55)
Species richness on 100 m <sup>2</sup>	23 (5 - 41)
Evenness (J') on 1,000 m <sup>2</sup>	0.693 (0.290 - 0.811)
Evenness (J') on 100 m <sup>2</sup>	0.657 (0.152 - 0.838)
Simpson index (D <sub>si</sub> ) on 1,000 m <sup>2</sup>	0.877 (0.353 - 0.928)
Simpson index (D <sub>si</sub> ) on 100 m <sup>2</sup>	0.815 (0.108 - 0.915)

*chamaetamnus*, *Dichapetalum rhodesicum* or *Gardenia brachythamnus* are characteristic. Very distinct *Combretum celastroides* - *Baikiaea plurijuga* woodlands [*Baikiaea-Burkea* woodlands with thicket like understory] prevail on the hill tops on the eastern side

of the river forming the third unit in the vegetation classification (Tab. 2).

The species composition is very distinct and character species reach very high *phi*-values. There is just one tree species forming the upper canopy, *Baikiaea plurijuga*, whereas several shrub species



**Fig. 1: Maize field on the old floodplain, solitary *Acacia sieberiana* tree (photo: R. Revermann).**

form an almost impenetrable thicket-like understorey. It is composed of shrubs of *Combretum celastroides*, *Combretum engleri*, *Croton gratissimus* and *Acacia ataxacantha*.

These dense woodlands are hardly affected by fire and did never undergo larger fires throughout the last ten years (Frantz et al. 2013). They form part of a larger woodland complex extending along the river in north-south direction, especially on the eastern side of the Cubango in the communal area of Savate. As this is a preferred area for agriculture, a further study within TFO investigates the reasons for the occurrence of this vegetation type, its regeneration dynamics after slash and burn agriculture and the causes of higher yields of fields in this area (Wallenfang et al. in preparation, Fig. 4 and 5).

The *Acacia sieberiana* - *Piliostigma thonningii* vegetation unit [grasslands] is located on the old floodplain and represents the other vegetation unit preferred for agriculture. It is dominated by tall grasses and only scattered individual trees (Fig. 6)

Furthermore, the core site features

vegetation units that have not been included in the statistical classification as their spatial extent is very restricted and they can clearly be distinguished from the remaining vegetation. Although there are just a few wetlands compared to the Cusseque area, some are located along the Dindi River and in the floodplains of the Cubango River [seasonally flooded grasslands]. Species composition is governed by the position above the mean water level of the river and hence the duration of flooding per year. The areas temporarily inundated are dominated by just a few species of grasses and sedges (Fig. 7). Wetlands with permanent water are rare and peat lands such as in Cusseque are absent from the Caiundo core site. Remnants of a gallery forest form a fringe accompanying the Cubango River (Fig. 8). On the river side it is delimited by a dense belt of *Phragmites mauritianus*. Towards the recent floodplain on sandy ridges and levees it is characterized by a dense shrub belt dominated by *Rhus quartiniana* var. *zambesiensis*. On the upper levee the palm *Phoenix reclinata* and *Albizia versicolor* are common trees [riparian vegetation].

The transition zone between the old and

recent floodplain is dotted with giant termite mounds created by species of the genus *Macrotermes*. These mounds reach heights of up to 4 m and their diameter exceeds 10 m. Due to the accumulation of clay and silt the mounds represent a special habitat in an otherwise sandy and nutrient-poor environment. Hence, a distinct vegetation in terms of species composition and structure has evolved around the termite mounds creating a local hotspot of biodiversity (Fig. 9). Succulent species such as *Sansevieria* sp. and spiny shrubs and trees dominate the vegetation.



Fig. 2: *Erythrophleum africanum* - *Bauhinia urbaniana* vegetation unit [*Baikiaea* - *Burkea* woodlands (dense)] (photo: R. Revermann).

Table 2: Vegetation classification of the woody vegetation of the Caiundo core site based on the 1,000 m<sup>2</sup> plots. The first part gives a general description of the vegetation units according to structure as well as diversity indices. The second part displays the indicator species of every vegetation unit. Species are ordered according to Pearson's *phi* coefficient of association. The *phi*-value ranges from -100 to 100 where *phi*-value >50 are regarded as diagnostic and >75 as highly diagnostic. Species can be associated to more than one group or group combinations. Only species with a *phi*-value >50 and a *p*-value <0.05 are shown.

Vegetation unit	1	2	3	4	1+2	2+3	2+4	1+4	3+4	1+2+3	1+2+4	<i>p</i> -value
<b>Number of plots</b>	21	12	5	4								
<b>Median total cover [%]</b>	60	60	85	93								
<b>Median tree cover [%]</b>	25	7	0	32								
<b>Median shrub cover [%]</b>	40	23	10	103								
<b>Median herb cover [%]</b>	40	50	80	65								
<b>Median species richness</b>	33	35	22	36								
<b>Evenness (J')</b>	0.754	0.681	0.480	0.624								
<b>Simpson index (D<sub>si</sub>)</b>	0.901	0.875	0.672	0.825								
<b>Unit 1: <i>Erythrophleum africanum</i> - <i>Bauhinia urbaniana</i> [<i>Baikiaea</i>-<i>Burkea</i> woodlands (dense and medium dense)]</b>												
<i>Bauhinia urbaniana</i>	67				63							0.002
<i>Erythrophleum africanum</i>	67				63							0.005
<i>Guibourtia coleosperma</i>	61											0.010
<i>Strychnos pungens</i>	58											0.011
<i>Combretum psidioides</i>	55				50							0.026
<i>Pterocarpus angolensis</i>	54				69							0.004
<i>Schinziophyton rautanenii</i>	54											0.033
<i>Ochna pulchra</i>	53				59						63	0.006
<i>Paropsia brazzaeana</i>	52				51							0.043
<i>Burkea africana</i>	50				84					60		0.001
<i>Combretum zeyheri</i>	48											0.028
<i>Gardenia brachythamnus</i>	48											0.043
<b>Unit 2: <i>Diplorhynchus condylocarpon</i> - <i>Gymnosporia senegalensis</i> [<i>Baikiaea</i>-<i>Burkea</i> woodlands (open) and grasslands]</b>												
<i>Diplorhynchus condylocarpon</i>		55			85							0.001
<i>Strychnos cocculoides</i>		53			68							0.002
<i>Bobgunnia madagascariensis</i>		51			53							0.025
<i>Gymnosporia senegalensis</i>		51				51						0.043
<b>Unit 3: <i>Piliostigma thonningii</i> - <i>Acacia sieberiana</i> [grasslands]</b>												
<i>Piliostigma thonningii</i>			83			64						0.002
<i>Acacia sieberiana</i>			60									0.012
<i>Rhus quartiniana</i> var <i>zambesiensis</i>			58									0.020
<b>Unit 4: <i>Combretum celastroides</i> - <i>Baikiaea plurijuga</i> [<i>Baikiaea</i>-<i>Burkea</i> woodlands (dense with thicket like understorey)]</b>												
<i>Acacia ataxacantha</i>				100			58	58	58			0.001
<i>Combretum celastroides</i>				100			58	58	58			0.001
<i>Combretum engleri</i>				100			58	58	58			0.001
<i>Croton gratissimus</i>				100			58	58	58			0.001
<i>Baphia massaiensis</i>				91				63				0.001
<i>Philenoptera nelsii</i>				83								0.001
<i>Baikiaea plurijuga</i>				75				76				0.001
<b>Unit 1+2:</b>												
<i>Hymenocardia acida</i>					64							0.001
<i>Pseudolachnostylis maprouneifolia</i>					64							0.002
<i>Dialium englerianum</i>					59							0.013
<i>Dichapetalum rhodesicum</i>					59							0.014
<i>Diospyros chamaethamnus</i>					55							0.025
<i>Ozoroa longipes</i>					50							0.043
<b>Unit 2+4:</b>												
<i>Grewia flavescens</i>									53			0.039



Fig. 3: *Diplorhynchus condylocarpon* - *Gymnosporia senegalensis* unit [*Baikiaea* - *Burkea* woodlands (open)] (photo: R. Revermann).



Fig. 4: *Combretum celastroides* - *Baikiaea plurijuga* unit [*Baikiaea* - *Burkea* woodlands with thicket like understorey] on the eastern hills of the Caiundo core site (photo: R. Revermann).



Fig. 5: *Combretum celastroides* - *Baikiaea plurijuga* woodland has been cleared for agriculture (photo: R. Revermann).



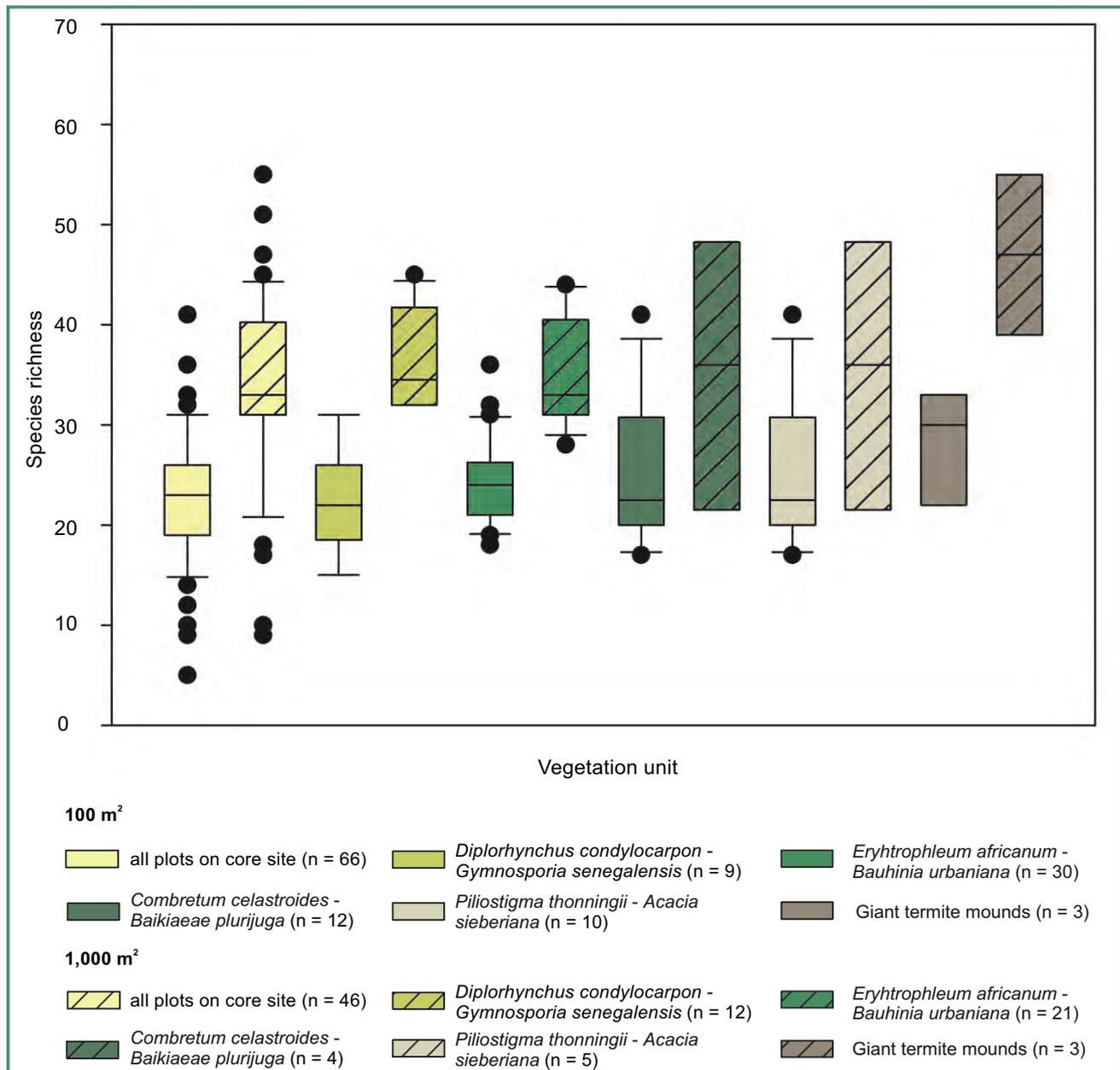
Fig. 6: *Piliostigma thonningii* - *Acacia sieberiana* unit [grasslands] of the old floodplain with wooded islands on and around giant termite mounds (photo: R. Revermann).



**Fig. 7:** Recent floodplain at the start of the rainy season [seasonally flooded grasslands] (photo: R. Revermann).



**Fig. 8:** *Phragmites* reeds along the river and dense gallery forest on the opposite bank of the river [riparian vegetation] (photo: R. Revermann).



**Fig. 9: Species richness on the Caiundo core site according to vegetation units and on two different spatial scales. Values are shown for vegetation plots sized 100 m<sup>2</sup> and 1,000 m<sup>2</sup>, indicated by the same colour. Note that sample sizes may be different for the two plot sizes.**

In terms of biodiversity the woodlands of the Caiundo core sites exhibit an overall lower species richness than the Cusseque core site (Tab. 1). However, evenness is higher in Caiundo resulting in a similar Simpson index for the two core sites. There is no big difference in diversity among the four woodland types identified in Caiundo. Only the grasslands of the old floodplain show a much lower species richness (Fig. 9 and Tab. 2).

For details on the applied methods and study design please refer to the Electronic Appendix.

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## References

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