

Preliminary syntaxonomic scheme of vegetation classes for the Central Bushveld of South Africa

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Abstract. Data from 29 vegetation studies done in the so-called Central Bushveld, South Africa (a large region N and NW of Pretoria), were subject to syntaxonomic synthesis using TWINSpan and further refined with traditional table-sorting procedures of the floristic-sociological approach to classification of vegetation. The analysis revealed four major groups of communities, interpreted at this stage as zonal vegetation classes which we preliminarily name: *Commiphoro mollis-Colophospermetea mopani*, *Panico maximi-Acacietaea tortilis*, *Terminalio sericeae-Combretetea apiculati* and *Englerophyto magalismsontani-Acacietaea caffrae*.

Keywords: Syntaxonomy; TWINSpan.

Nomenclature: Arnold & De Wet (1994), except for *Englerophytum magalismsontanum* (Sond.) T.D. Penn.

Introduction

The Central Bushveld of South Africa can be defined as the bushveld of the North West Province (N of the Magaliesberg) and the Northern Province. The area is situated between the Kalahari in the west (the Botswana border) and the Lowveld, east of the Great Escarpment (Fig. 1). Several vegetation studies have been conducted in the Central Bushveld. These include published studies (e.g. Schmidt et al. 1993; Schultze et al. 1994; Brown et al. 1996) as well as unpublished reports (e.g. by G.J. Bredenkamp in 1978 and Q. Nel in 1997). These studies were confined to farms or nature reserves, scattered throughout the Central Bushveld. The syntaxonomy and synecology of the vegetation of a part of the North West Province (van der Meulen 1979) are also included in this study.

The present general knowledge of the vegetation of this area is based on descriptions by Acocks (1988) and Low & Rebelo (1996). Their classifications of broad vegetation types were however not based on phytosociological data.

The aim of this study is to present a preliminary syntaxonomic synthesis of the available relevés in order to identify the major zonal vegetation types that may represent phytosociological classes. Relevés from azonal vegetation (e.g. wetlands, synanthropic vegetation) were disregarded.

Material and Methods

Results of classification efforts of 29 phytosociological vegetation studies (Table 1) performed in the region of the Central Bushveld, published as well as those presented in unpublished works, are summarized in 39 phytosociological tables and descriptions of many savanna communities. Relevés from azonal and intra-zonal communities were removed. The resulting data set had 2907 relevés with 1369 taxa. As a first step, we constructed a synoptic vector for each community from each table. Every community, representing zonal vegetation from the 39 phytosociological tables, was thus summarized into a single column in a single synoptic table. In total 378 plant communities representing local tables (sensu Westhoff & van der Maarel 1978) were re-analysed using programme TWINSpan (Hill 1979). A final synoptic table was constructed, and major community groups, each interpreted preliminarily as a zonal vegetation class, were recognized. The final synoptic table (Table 2) contains the constancy values of the species, traditionally given in Roman numbers (I - V) representing 20% intervals.

Results

Four major groups of savanna plant communities were recognized. The first TWINSpan division separated the Mountain Bushveld communities from the other communities. The second division separated communities from the Mopane Veld and the Arid Sweet Bushveld (Acocks 1988). A further division of the remainder resulted in two groups, one representing Broad-Leaved Bushveld (Werger & Coetsee 1978), dominated by *Combretum* species, while the other group is the Microphyllous Thorny Bushveld dominated by *Acacia* species (Cole 1986).

This suggests that the Central Bushveld may be divided into four classes, which we give the preliminary names: *Commiphoro mollis-Colophospermetea mopani*; *Panico maximi-Acacietaea tortilis*; *Terminalio sericeae-Combretetea apiculati*; *Englerophyto magalismsontani-Acacietaea caffrae*.

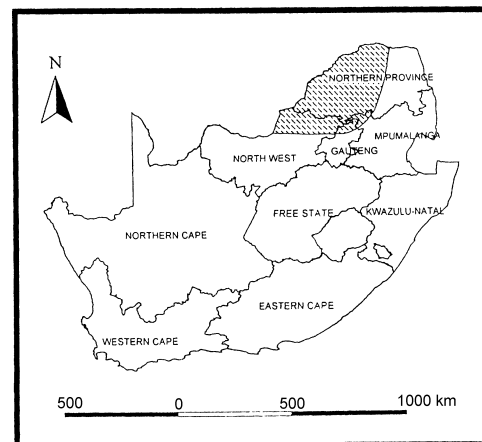


Fig.1. Location of the Central Bushveld, South Africa.

Table 1. Sources of phytosociological data used in re-analysis of the classification scheme for the Central Bushveld of South Africa.

Author	Year	Location	Refs.
Botha	1994	Waterberg Wildsentrum	104
Bredenkamp	unpubl.	Pietersburg Nature Res.	81
Bredenkamp & van Vuuren	1977	Turfloop Dam, Pietersburg	19
Brown & Bredenkamp	1994	Borakalalo Nature Res., Brits	82
Brown et al.	1995	Borakalalo Nature Res., Brits	137
Brown et al.	1996	Borakalalo Nature Res., Brits	132
Coetzee	1975	Rustenburg Nature Res.	191
Coetzee et al.	1976	Nylsvley, Nylstroom	161
De Frey	1993	Loskopdam, Groblersdam	10
De Kock et al.	1977	Wonderboom, Pretoria	41
Dekker & van Rooyen	1995	Messina Experimental Farm	148
Fourie	1994	Kwalata Game Ranch, Ellisras	63
Fourie	unpubl.	De Boveneinde, Vaalwater	27
Hattingh	1994	Warmbaths Nature Reserve	33
Kruger	1990	Mabalingwe, Warmbaths	107
Nel	unpubl.	Rustenburg Nature Res.	283
Pauw	1988	Atherstone Nature Res., Thabazimbi	43
Purchase	1994	Vlakpan, Marblehall	40
Schmidt et al.	1993	Rhino Ranch, Ellisras	43
Schultz et al.	1994	Imberbe Game Ranch, Ellisras	39
Smith	1992	Doornpoort, Pretoria	58
Turner	1995	Mokolo, Ellisras	85
van der Meulen	1979	North West Province	514
van Essen	1993	Bosveld Rentmeesters, Roedtan	25
van Rooyen	1983	Rodeoelaat, Pretoria	70
van Schalkwyk	1993	Mabula Game Res., Warmbaths	87
Visser et al.	1996	Honnet Nature Res., Tsipise	54
Westfall	1978	Silkaatsnek, Pretoria	74
Westfall	1985	Groothoek, Thabazimbi	156

Commiphoro mollis-Colophospermetea mopani

The communities of the *Commiphoro-Colophospermetea mopani* occur in the far northern part of the study area and are well-known as the Mopane Veld. The tree *Colophospermum mopane* is usually the sole spectacular dominant in this sparse-woodland community. It grows on fine-grained, usually deep soil that varies from sandy to loamy and clayey (Werger & Coetzee 1978).

Character species of this class include the woody species *Colophospermum mopane*, *Combretum mossambicense*, *Boscia albitrunca*, *Acacia erubescens*, *A. nigrescens*, *A. senegal*, *Grewia bicolor*, *Kirkia acuminata* and *Terminalia prunioides*. The most important diagnostic forbs are *Acalypha villicaulis*, *Sida ovata* and *Tribulus terrestris* accompanied by prominent grasses *Stipagrostis uniplumis*, *Eragrostis lehmanniana*, *Aristida adscensionis*, *Cenchrus ciliaris*, *Enneapogon cenchroides* and *Tragus berteronianus*. *Grewia bicolor* and *Enneapogon cenchroides* were revealed as the most important indicator species at the division level separating the *Commiphoro-Colophospermetea mopani* from the *Panico-Acacietaea tortilis* and the *Terminalio-Combretetea apiculati*.

Panico maximi-Acacietaea tortilis

This microphyllous Thorny Bushveld is considered as an Arid Bushveld (Huntley 1982, 1984) and it occurs in the Transvaal Plateau Basin, comprising the flat Bushveld Basin and the Waterberg, Soutpansberg and Pietersburg Plateaus (Cole 1986). It is characteristic of the dark, clayey soils often developed over basalt in the low lying areas.

The *Panico-Acacietaea tortilis* gives way to deciduous broad-leaved savanna in upland areas with sandy soils underlain by granite, thus forming an extensive mosaic with the *Terminalio-Combretetea apiculati*.

Diagnostic species for this class include trees and shrubs such as *Acacia karroo*, *A. robusta*, *A. nilotica*, *A. mellifera*, *Rhus lancea*, *R. pyroides* as well as grasses *Eragrostis rigidior*, *E. superba*, *Cymbopogon plurinodis*. Alien herbs such as *Tagetes minuta* and *Bidens bipinnata* are also very abundant and appear to have a diagnostic value.

The TWINSPAN analysis indicated that only one woody species can be considered as indicator: *Terminalia sericea*. This tree is usually associated with sandy soils of the *Terminalio-Combretetea apiculati*. It is possibly an indicator of some of the *Panico-Acacietaea tortilis* plant communities occurring on the relatively sandy side of a soil texture ecocline within the *Panico-Acacietaea tortilis* (Winterbach 1997). Other indicator species include *Eragrostis rigidior*, *Tagetes minuta*, *Aristida stipitata* and *Waltheria indica*.

Terminalio sericeae-Combretetea apiculati

The vegetation of this class occurs on sandy loam underlain by granite, quartzite and dolomite. It is considered by Huntley (1982, 1984) to be a moist savanna. On the Springbok Flats in the Bushveld Basin, where vertic clay soils are formed from underlying basalt, this vegetation is only found on sandy sediments and on aeolian sands (Werger & Coetzee 1978). In the slightly undulating landscape, this broad-leaved sparse woodlands form a mosaic with the *Panico-Acacietaea tortilis*, where the former is found on the upland sandy areas whereas the latter occupies lower lying clayey areas.

The *Terminalio-Combretetea apiculati* are characterized by the woody *Diplorhynchus condylocarpon*, *Croton gratissimus* and *Pseudolachnostylis maprouneifolia*. Diagnostic forbs and grasses are *Rhoicissus revouilii*, *Tephrosia longipes*, *Aristida diffusa*, *Eragrostis chloromelas* and *Schizachyrium jeffreysii*. Other prominent species include trees and shrubs, e.g. *Ziziphus mucronata*, *Terminalia sericea*, *Vitex rehmannii*, *Dombeya rotundifolia*, *Combretum molle*, *C. zeyheri* and *Acacia caffra*, forbs, e.g. *Phyllanthus parvulus*, *Commelina africana* and *Solanum panduriforme* and grasses, e.g. *Brachiaria nigropedata*, *Panicum maximum*, *Digitaria eriantha*, *Aristida congesta* ssp. *congesta*, *Loudetia simplex*, *Schizachyrium sanguineum* and *Melinis repens*.

The indicator species derived from the TWINSPAN analysis for this class are *Combretum molle*, *Burkea africana*, *Diplorhynchus condylocarpon*, *Rhoicissus revouilii* and *Loudetia simplex*.

Englerophyto magalismontani-Acacietaea caffrae

This mountain is found on the slopes of the Waterberg and the bushveld Magaliesberg, Witwatersrand and Suikerbosrand. It occurs mainly on sandy soils underlain by solid rock of various geology.

Table 2. Synoptic table for the vegetation classes of the Central Bushveld. Only very diagnostic or very frequent species were selected.

1: *Commiphoro-Colophospermetea mopani*

2: *Panico-Acacieta tortilis*

3: *Terminalio-Combretetea apiculati*

4: *Englerophyto-Acacieta caffrae*

Class	1	2	3	4
Number of communities	32	192	37	90
Group A: diagnostic species of the <i>Commiphoro-Colophospermetea mopani</i>				
<i>Enneapogon cenchroides</i>	V			
<i>Grewia bicolor</i>	V			
<i>Aristida adscensionis</i>	IV			
<i>Terminalia prunioides</i>	IV			
<i>Stipagrostis uniplumis</i>	IV			
<i>Acacia nigrescens</i>	III			
<i>Acacia senegal</i>	III			
<i>Tribulus terrestris</i>	III			
<i>Aptosimum lineare</i>	III			
<i>Combretum mossambicense</i>	III			
<i>Acalypha villicaulis</i>	III			
<i>Boscia albitrunca</i>	III			
<i>Brachiaria deflexa</i>	III			
<i>Achyranthes aspera</i> var. <i>sicula</i>	III			
<i>Pavonia burchellii</i>	III			
<i>Monechma divaricatum</i>	III			
<i>Hibiscus micranthus</i>	III			
<i>Hermannia odorata</i>	III			
<i>Cenchrus ciliaris</i>	III			
<i>Gisekia africana</i>	III			
Group B: diagnostic species of the <i>Panico-Acacieta tortilis</i>				
<i>Acacia karoo</i>		III		
<i>Eragrostis rigidior</i>		III		
Group C: species common to Classes 1 and 2				
<i>Eragrostis lehmanniana</i>	IV	II		
<i>Grewia flava</i>	III	III		
<i>Acacia tortilis</i>	III	III		
<i>Evolvulus alsinoides</i>	III	II		
<i>Tragus berteronianus</i>	III	II		
<i>Kyphocarpa angustifolia</i>	II	II		
<i>Urochloa mosambicensis</i>	II	II		
<i>Aristida congesta</i> ssp. <i>barbicollis</i>	II	II		
Group D: diagnostic species of the <i>Terminalio-Combretetea apiculati</i>				
<i>Diplorhynchus condylocarpon</i>			IV	
<i>Rhoicissus revoilii</i>			IV	
<i>Tylosema fassoglense</i>			III	
<i>Croton gratissimus</i>			III	
<i>Asparagus africanus</i>			III	
<i>Gardenia volkensii</i>			III	
<i>Hexalobus monopetalus</i>			III	
<i>Euclea natalensis</i>			III	
<i>Mundulea sericea</i>			III	
<i>Pterocarpus rotundifolius</i>			III	
<i>Pseudolachnostylis maprouneifolia</i>			III	
<i>Strychnos pungens</i>			III	
<i>Tephrosia longipes</i>			III	
Group E: species common to Classes 2 and 3				
<i>Ziziphus mucronata</i>		III	II	
<i>Terminalia sericea</i>		II	IV	
<i>Brachiaria nigropedata</i>		II	IV	
<i>Vitex rehmannii</i>		II	IV	
<i>Eragrostis gummiflua</i>		II	III	
<i>Dombeya rotundifolia</i>		II	III	
<i>Ehretia rigida</i>		II	II	
<i>Perotis patens</i>		II	II	
<i>Pogonarthria squarrosa</i>		II	II	
<i>Monsonia angustifolia</i>		II	II	
<i>Merremia tridentata</i>		II	II	
<i>Lantana rugosa</i>		II	II	
<i>Limeum viscosum</i>		II	II	
<i>Enneapogon scoparius</i>		II	II	
<i>Cleome maculata</i>		II	II	
<i>Aristida stipitata</i>		II	II	
<i>Trichoneura grandiglumis</i>		II	II	
<i>Waltheria indica</i>		II	II	
<i>Aerva leucura</i>		I	I	

Group F: species common to Classes 1, 2 and 3

<i>Panicum maximum</i>	III	IV	III
<i>Dichrostachys cinerea</i>	III	IV	II
<i>Digitaria eriantha</i>	II	IV	IV
<i>Aristida congesta</i>	II	IV	IV
<i>Phyllanthus parvulus</i>	II	II	IV
<i>Combretum apiculatum</i>	II	II	IV
<i>Schmidtia pappophoroides</i>	II	II	II
<i>Grewia monticola</i>	III	.	II

Group G: diagnostic species of the *Englerophyto-Acacieta caffrae*

<i>Senecio venosus</i>	.	.	III
<i>Indigofera comosa</i>	.	.	III
<i>Bulbostylis burchellii</i>	.	.	III
<i>Trachypogon spicatus</i>	.	.	III

Group H: species common to Classes 3 and 4

<i>Burkea africana</i>	.	.	V	II
<i>Loudetia simplex</i>	.	.	IV	III
<i>Lankea discolor</i>	.	.	IV	II
<i>Ozoroa paniculosa</i>	.	.	IV	II
<i>Pellaea calomelanos</i>	.	.	III	IV
<i>Englerophytum magalismontanum</i>	.	.	III	III
<i>Andropogon schirensis</i>	.	.	III	III
<i>Tapiphyllum parvifolium</i>	.	.	III	II
<i>Maytenus tenuispina</i>	.	.	III	II
<i>Oldenlandia herbacea</i>	.	.	III	II
<i>Asparagus suaveolens</i>	.	.	III	II
<i>Ochna pulchra</i>	.	.	III	II
<i>Melinis nerviglumis</i>	.	.	II	IV
<i>Vangueria infausta</i>	.	.	II	III
<i>Faurea saligna</i>	.	.	II	II
<i>Setaria lindenbergiana</i>	.	.	II	II
<i>Eragrostis racemosa</i>	.	.	II	III

Group I: species common to Classes 2, 3 and 4

<i>Themeda triandra</i>	.	III	III	IV
<i>Heteropogon contortus</i>	.	III	III	III
<i>Diheteropogon amplexans</i>	.	II	III	IV
<i>Combretum molle</i>	.	II	V	II
<i>Combretum zeyheri</i>	.	II	IV	II
<i>Brachiaria serrata</i>	.	II	III	III
<i>Schizachyrium sanguineum</i>	.	II	III	III
<i>Setaria sphacelata</i>	.	II	II	III
<i>Lippia javanica</i>	.	II	III	II
<i>Elionurus muticus</i>	.	II	II	II
<i>Commelina erecta</i>	.	II	II	II
<i>Acacia caffra</i>	.	II	II	II
<i>Osyris lanceolata</i>	.	I	I	I
<i>Eustachys paspaloides</i>	.	I	I	I
<i>Chamaecrista mimosoides</i>	.	II	.	II
<i>Diospyros lycoides</i>	.	II	.	II
<i>Eragrostis curvula</i>	.	II	.	II
<i>Rhus leptodactyla</i>	.	II	.	II
<i>Celtis africana</i>	.	I	.	I
<i>Hyperthelia dissoluta</i>	.	I	.	I
<i>Nuxia congesta</i>	.	I	.	I

Group J: species common to all classes

<i>Melinis repens</i>	III	III	IV	II
<i>Commelina africana</i>	II	III	III	III
<i>Solanum panduriforme</i>	II	III	II	II
<i>Rhynchosia totta</i>	II	.	II	II
<i>Chaetacanthus costatus</i>	I	I	I	I
<i>Rhus magalismontana</i>	I	.	I	I

The tree *Protea caffra*, the forbs *Indigofera comosa*, *Selaginella dregei* and *Bulbostylis burchellii* and the grasses *Panicum natalense*, *Bewsia biflora*, *Digitaria diagonalis*, *Cymbopogon validus*, *Brachiaria serrata* and *Trachypogon spicatus* are diagnostic species. Constantly present woody species include *Englerophytum magalismontanum*, *Faurea saligna*, *Ozoroa paniculosa* and *Ochna pulchra*. Further frequent prominent forbs include *Pellaea calomelanos*, *Commelina africana*, *C. erecta* and *Chamaecrista mimosoides*, while dominant grasses include *Loudetia simplex*, *Melinis nerviglumis*, *Eragrostis racemosa*, *Themeda triandra*, *Heteropogon contortus* and *Diheteropogon amplexens*.

Melinis nerviglumis, *Pellaea calomelanos* and *Bulbostylis burchellii* were identified as the indicator species separating the Mountain Bushveld from other savanna types of the studied region. Indicator species for further divisions within the class include *Englerophytum magalismontanum*, *Celtis africana*, *Nuxia congesta* and *Rhus magalismontana*.

Discussion and Perspective

This is the first attempt to identify zonal phytosociological classes for the South African savanna from relevé data. We acknowledge that the names of these classes are not validly described according to the Code for Phytosociological Nomenclature (Barkman et al. 1986). The formal descriptions accompanied by full necessary documentation will be presented elsewhere.

We have identified the Mountain Bushveld as a very diverse vegetation type comprising many different communities. Further study may reveal that this class might be divided into various units interpretable as classes. This expectation is enhanced by complex topography of the rugged Waterberg and Magaliesberg mountain ranges, resulting plethora of habitat types and a complicated phytogeographic set-up.

TWINSPAN placed the majority of the Arid Sweet Bushveld (Acocks 1988) communities into the *Commiphoro-Colophospermetea mopani*, even when *Colophospermum mopane* was missing. Some of the communities are, however, grouped together with those of the *Panico-Acacietaea tortilis*. This result suggests that the Arid Sweet Bushveld could be divided into two distinct vegetation types.

The species composition of the *Panico-Acacietaea tortilis* suggests an *Acacia*-dominated vegetation on clay soils, as well as on sandy deposits, overlying the clay. The occurrence of species such as *Acacia mellifera*, *Kyphocarpa angustifolia*, *Tribulus terrestris*, *Eragrostis lehmanniana*, *Stipagrostis uniplumis* and *Aristida adscensionis* in these communities may indicate an affinity with the Kalahari dry savanna (van Rooyen et al. 1988).

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