CHAPTER 9

SOUTPANSBERG MISTBELT COMMUNITIES

Introduction

In an overview of the vegetation of the Soutpansberg Conservancy and the Blouberg Nature Reserve (Chapter 4), the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt was identified as a Major Vegetation Type. The classification of this Major Vegetation Type is addressed in this chapter.

The mistbelt vegetation of the northern and eastern mountainous regions of South Africa has been studied and described by various authors (Acocks 1953; Moll 1972; White 1983; Lubke *et al.* 1988; Matthews *et al.* 1992b; Geldenhuys & Murray 1993; Von Maltitz *et al.* 2003). Detailed studies of the mistbelt vegetation of the north-eastern escarpment region were done by Matthews *et al.* (1991; 1992a; 1992b; 1993; 1994). These studies encompassed the Wolkberg Centre of Endemism (Van Wyk & Smith 2001). As the centre's Afrikaans name refers, this mountain's summit is often covered in clouds and mist, resulting in a variety of mistbelt vegetation types of the subtropical eastern escarpment (Fabricius 1988). Only a few of the above mentioned studies included the vegetation of the Soutpansberg. Most of these involve coarse scaled descriptions of regional vegetation types. Geldenhuys & Murray (1993) gave a detailed phytosociological description of the small and isolated Hanglip State Forest within the western Soutpansberg. In a later synthesis and reclassification of the existing forest data, Von Maltitz *et al.* (2003) lumped the forests of the Soutpanberg and north-eastern escarpment under the "Northern Mistbelt Forests". These studies, however, focussed on the forests alone and did not include any of the other plant communities situated within the mistbelt of the Soutpansberg. Acocks (1953) gave a very broad and general description of the extensive higher rainfall regions of the Soutpansberg. He lumped the plant communities of this very diverse and heterogeneous landscape under the broad categories of (8) North-eastern Mountain Sourveld and (20) Sour Bushveld. His description of the veldtypes aimed at identifying vegetation units of similar agricultural production potential, and therefore lacks the detail aimed for in the study presented in this thesis. White (1978a; 1978b;

1983) included the entire Soutpansberg region in the more inclusive Drakensberg Regional Mountain System of the Afromontane Region. The Afromontane Region was recognised as an important Centre of Plant Diversity in Africa (Site Af67), and called the Drakensberg Afromontane Regional System (Davies *et al.* 1994).

Except for the localised Hanglip State Forest vegetation study (Geldenhuys & Murray 1993), no attempt has been made to describe the different mistbelt plant communities of the Soutpansberg. This chapter is a first attempt to identify and describe the western Soutpansberg mistbelt plant communities at the syntaxonomic level of the association.

Vegetation classification

The analysis of the vegetation data resulted in the identification of a number of very diverse (structurally and floristically) plant communities within the mistbelt of the western Soutpansberg. It was decided to group and discuss these plant communities in a single chapter based on their geographical proximity along the landscape and affinity for the relatively moist and cool climatic conditions of the high lying mistbelt along the southern ridges of the Soutpansberg. Based on the hierarchical classification generated by the computer software package TWINSPAN (Hill 1979a) (Chapter 4), the plant communities were grouped into two major vegetation types:

- *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type
- *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

By using Braun-Blanquet procedures (Mueller-Dombois & Ellenberg 1974) to further refine the phytosociological tables in MEGATAB (Hennekens & Schaminée 2001), four associations were described within the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type (Table 8):

1. *Viteco rehmannii–Syzygietum legatti*
2. *Heteropyxo natalensis–Combretetum mollis*
3. *Proteo caffrae–Setarietum sphacelatae*

4. *Cypero albostriati–Pennisetetum glaucocladii*

The first division created by the statistical computer software package TWINSPAN (Hill 1979) separated the wetlands and peatlands (*Cypero albostriati–Pennisetetum glaucocladii*) from the remaining floristic data. The second division separated the high altitude grasslands (*Proteo caffrae–Setarietum sphacelatae*) from the thickets and bush clumps. A last division split the thickets and bush clumps into the predominantly north-facing (*Heteropyxo natalensis–Combretetum mollis*) and predominantly south-facing (*Viteco rehmannii–Syzygietum legatti*) plant communities.

Table 8 Phytosociological table of the plant communities of the *Rhus rigida* var. *rigida*–*Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type

Association no.	**1**								**2**					**3**														**4**					
Relevé number	78	79	80	81	82	83	84	85	164	165	166	167	168	126	127	128	129	130	131	132	133	134	135	136	137	138	139	72	73	74	75	76	77
Diagnostic species of the *Viteco rehmannii–Syzygietum legatti*																																	
Species Group A																																	
Syzygium legatii	a	a	a	a	b	a	1	a				+									+	+		+									
Olea capensis ssp. *enervis*	a	a	1	a	a	a	1	a	+		+				+		+							+									
Vitex rehmannii	a	a	1	1	a	1	a	1																									
Euclea linearis	1	+	1	1	+	1	1	1									+	+			+			+									
Kalanchoe sexangularis	+	+	+	1	+	1	1	1																									
Lopholaena festiva	+	+	+	+	+	+	+	+																									
Xerophyta retinervis	+	+	+	+	+	+	+	+																									
Aloe arborescens	+	+	+	+	+	+	+	+	+		+						+		+					+									
Crassula swaziensis	+	+	+	+	+	+	+	+	+												+	+		+									
Senecio barbertonicus	+	+	+	+	+	+	+	+	+						+						+			+									
Khadia borealis	+	+	+	+	+	+	+	+										+			+				r								
Combretum moggii	+	+	+	+		+	+	+									+				+			+									
Apodytes dimidiata ssp. *dimidiata*	1	+	1	1	+		1	1					+																				
Vangueria parvifolium	+	+	1	+	+	+		+				+																					
Vangueria soutpansbergensis	+	+	+	+	+	+	+						+														+						
Viscum rotundifolium	+	+		+	+	+	+	+																									
Diospyros whyteana	+	+		1		1	1	1									+				+												
Rhoicissus revoilii	1	1	1	+	+	+																											
Mystacidium braybonae	+		+	+		+	+	+																									
Aloe sessiliflora	+	+		+		+	+	+																									
Psychotria capensis ssp. *capensis*	+	+	+	+		+																											
Sericanthe andongensis andongensis		+	+	+		+	+					+																					
Ekebergia pterophylla		+		+		+	+	+											+					+									
Maytenus acuminata var. *acuminata*	+	+		+		+		+				+																					
Tetradenia riparia	+	+		+			+	+					+		+												+						
Chionanthus battiscombei	+	+		+	+			+																									
Cyperus denudatus	+		+	+	+			+			+																						
Enneapogon cenchroides	+	+	+		+			+			+																						
Commelina benghalensis		+	+		+		+	+					+																				
Selaginella dregei	+	+			+	+		+																									
Anthospermum welwitschii				+	+	+	+	+			+					+						+											
Tarenna zimbabwensis	+	+			+			+				+			+									+									
Cotyledon barbeyi	+	+	+		+																												
Avonia rhodesica	+		+	+			+																										
Anacampseros subnuda		+		+	+			+																									
Nuxia floribunda	r		+	r		r																											

Rothmannia capensis	+			+	+		+																				
Rapanea melanophloeos				+		+	+	+															+					
Portulaca kermesina		+	+		+		+																				
Schefflera umbellifera				+		+		+			+																	
Cyanotis speciosa	+						+	+					+													+	
Tricalysia junodii var. *kirkii*				+				+																				
Euphorbia zoutpansbergensis	+				r																							
Polygala hottentotta				+			+																					
Isoglossa grantii			+	+																								
Ursinia nana	+					+													+					+				
Eragrostis chloromelas		+	+																		+							
Podocarpus latifolius				r		+																						
Rhus chirindensis				+			+																					
Robsonodendron eucleiform				+		+																						

Diagnostic species of the *Heteropyxo natalensis–Combretetum mollis*

Species Group B

Heteropyxis natalensis									a	+	b	a	a														
Rhus pentheri									1	r	+	1	a														
Coddia rudis									1	+	1	1	+														
Orthosiphon labiatus									+	1	+	+	+														
Lagynias dryadum									+	+		+	+														+
Erythrina lysistemon									+	+		+	+														
Dombeya rotundifolia var. *rotundifolia*									+	+		+															
Pavetta schumanniana									+	+			+														
Rhoicissus tridentata ssp. *tridentata*										+	+	+															
Tecoma capensis									+	+	+		+														
Ficus sur									+	+			+														
Flacourtia indica									+	+		+															
Oncoba spinosa									+	+			+														
Felicia muricata									+			+	+				+	+									
Senecio venosus									+	+	+					+											
Rhus lucida				+			+			+	+		+														
Tetradenia brevispicata									+	+			+											+			+
Pseudognaphalium luteo-album						+				+			+				+										
Cussonia natalensis									+		+																
Carissa edulis									+			+															
Acacia caffra									+		+																
Lantana rugosa									+		+																
Acacia ataxacantha										+			+														
Vepris lanceolata									+		+																

Species Group C

Englerophytum magalismontanum	a	a	1	a	1	a	a	a	+	a	+	+		1	+		+		+			+		1			
Maytenus undata	+	+	+	1	1	1	1	1	+	r	1	1	1	+								+		+			
Combretum molle	+	+	+	+	+	+	+	+	1	1	+	+	1	+					+								
Hyperacanthus amoenus	+	+	+	+	+	+	+	+	+	r	+	+	+														
Rotheca myricoides	+	+	+	+	+	+		+	+	r	+	+	+														
Combretum vendae	+		+	+	+	+	+	+	+		+	+															
Commelina erecta	+		+	+	+		+		+			+	+				+										+
Tarenna supra-axillaris			+	+	+		+	+		1	+		+														+
Olinia rochetiana	1	1	+	+	+	+	+	+			+		+														

Senecio oxyriifolius	+		+	+	+	+		+		+		+																						
Dioscorea sylvatica	+		+	+		+	+	+	+				+																					
Plectranthus neochilus			+	+	+	+			+		+	+	+				+																	
Myrothamnus flabellifolius	r	r		r					a	+	+	+	+																					
Sarcostemma viminale	+			+	+		+		+	+		+	+																					
Cyperus rupestris	+	+	+					+			+	+																						
Zanthoxylum capense	+			+	+			+	+			+		+																				
Diagnostic species of the *Proteo caffrae–Setarietum sphacelatae*																																		
Species Group D																																		
Setaria sphacelata var. *torta*														+	a	1	3	b	b	3	1	a	4	1	3	3	b							
Trachypogon spicatus														+	+	+	+	+	+		+	+			+	+	+							
Protea caffra ssp. *caffra*														+	+		+	1	+	1		+		+			+							
Elionurus muticus														+	+		+	+	+		+	+			+		+							
Dicoma anomala														+	+	+	+		+	+	+	+		+										
Schistostephium crataegifolium																+	+	+	+	+		+	+		+	+								
Elephantorrhiza elephantina														+	+		+		+		+	+			+		+							
Protea roupelliae ssp. *roupelliae*															+			+	+	1	+	+		+			+							
Wahlenbergia undulata														+	+		+	+			+	+	+		+									
Vernonia oligocephala														+	+	+				+	+	+				+	+							
Hypoxis argentea var. *argentea*														+	+	+	+				+				+	+	+							
Eulophia ensata														+			+	+	+	+	+	+					+							
Hypoxis hemerocallidea														+	+		+	+	+			+			+									
Bulbostylis contexta														+		+			+	+	+					+	+							
Gnidia cuneata			+												+	+					+	+	+	+			+			+				
Cyperus obtusiflorus var. *obtusiflorus*					+						+			+		+			+	+			+			+	+			1				
Aristea woodii	+														+	+	+					+			+		+			+				
Bulbostylis burchellii															+			+	+	+				+	+									
Ipomoea oblongata						+									+	+	+	+	+				+											
Scabiosa columbaria														+			+					+			+	+	+							
Andropogon chinensis																1	+	+	+		+													
Eragrostis gummiflua														+							+	+			+		+	+						
Vernonia capensis															+		+			+				+			+							
Themeda triandra																		1		1		+	1		+									
Wahlenbergia grandiflora																+				+	+				+	+								
Senecio purpureus												+				+		+	+			+												
Heteropogon contortus															+					+			+				+							
Chamaecrista mimosoide															+				+	+			+											
Senecio speciosus					+										+									+	+	+						+		
Senecio inornatus		+												+							+		+		+						+			
Senecio coronatus			+								+							+				+				+							+	
Faurea saligna														+			+								+									
Gerbera jamesonii														+					+		+													
Thunbergia atriplicifolia																			+						+		+							
Eragrostis acraea																	+			+							+							
Anthospermum hispidulum																	+		+	+														
Schrebera alata															+									+			+							
Schizachyrium sanguineum															+	+	+																	
Lapeirousia sandersonii															+				+					+										
Senecio gerrardii										+				+						+				+										
Brachiaria nigropedata															+										+		+							
Eragrostis superba															+				+							1								

Dicoma montana																+					+					+							
Ochna pulchra																		+	+								+						
Conostomium zoutpansbergense														+	+										+								
Pygmaeothamnus zeyheri var. *zeyheri*																		+	+		+												
Salacia rehmannii																					+				+	+							
Dichapetalum cymosum														+			+		+														
Digitaria eriantha																+					+	+			+								

Species Group E

Vangueria infausta ssp. *infausta*	+								+	1	+	+	1					+				+		+									
Aloe greatheadii var. *greatheadii*									+	+	+			+	+				+														
Lippia javanica									+	r			+								+			+			+						
Polygala uncinata										+	+		+				+							+			+						
Rhynchosia monophylla										+	+			+	+	+	+		+		+	+		+	+	+	+						
Rhus tumulicola var. *meeuseana* forma *pumila*										+			+			+	+	+	+			+	+	+	+	+							
Helichrysum cerastioides										+			+		+			+			+	+	+										
Sporobolus fimbriatus									+		+						+				+			+									
Jasminum multipartitum									+			+							+					+			+						
Diospyros lycioides ssp. *sericea*													+	+			+		+					+									

Species Group F

Rhus rigida var. *rigida*	1	1	1	1	+	+	+	+	+	+			+	+	+	+	+		+	+	+			+	+	+	+						
Loudetia simplex	+	+	+	+	+	+	+	+	+	1	1		+	a	1	1	1	1	a	+	a	1	+	1	1		a						
Rhus magalismontana ssp. *coddii*	a	1	a	1	a	1	1	1	+				+	+	+	1	+	+	+		+	+		+	+		+						
Helichrysum kraussii	+	+	+	r	1			+						a	+	a	+		+	1	+	1	1	1	+		+			+			
Brachiaria serrata	+	+	+		+	+	+	+							1	+	+		+		1	1		1	+	+	+						
Parinari capensis ssp. *capensis*	+	+												1	+	1	+	+	+	1	+	+	+		+	+	+						
Mimusops zeyheri	+	1	+	+	+	1	1	1	+	1		+		+			+					+											
Melinis nerviglumis	+	+	+	+	+	+	+	+	+	+		+	+	a			+	+	+				+	+									
Pellaea calomelanos var. *calomelanos*				+	+	+	+	+	+	+		+		+	+		+					+		+									
Ectadiopsis oblongifolia			+	+		+			+		+	+	+			+	+	+	+	+	+	+			+		+						
Landolphia kirkii				+			+		+	+		+		+								+		+			+						
Corchorus kirkii	+	+			+				+	+	+	+	+											+	+		+						
Commelina africana	+	+							+				+		+	+						+											
Coleochloa setifera	+	+	+	+	+	+	+	+								+	+			+	+		+				+						
Asparagus falcatus	+	+	+	+		+	+	+						+							+			+			+						
Pentanisia prunelloides ssp. *prunelloides*		+	+			+	+	+						+	+						+												
Myrsine africana				+			+	+					+								+	+		+									

Diagnostic species of the *Cypero albostriati–Pennisetetum glaucocladii*

Species Group G

Cyperus albostriatus																												b	3	b	4	4	b
Thelypteris confluens																												3	b	b	a	3	a
Pennisetum glaucocladum																												3	b	b	b	b	3
Cyperus sphaerospermus																													+	a	1	b	+
Pteridium aquilinum										+										r	+								1	1	+	+	1
Bulbostylis hispidula																												1	+		+	+	+
Pycreus polystachyos																												+	+	+		+	+
Psoralea pinnata																												+	+		+	+	+
Cyperus solidus																												a	a		a	a	
Alloteropsis semialata																											+	+		+	+	+	

Persicaria decipiens																	a	1			a	a
Gunnera perpensa																			1		1	1
Drimia robusta																					+	+
Kniphofia species																				+		+
Schoenoplectus brachyceras																		+			+	
Dissotis canescens																		+				+
Chironia purpurascens																	+	+				
Chironia palustris																	+					+
Andropogon eucomus																	+			+		
Species Group H																						
Fadogia homblei				+	1	+		+	1	+	+	+	+	+	+	+			+		+	
Vernonia natalensis				+		+	+		+	+	+				+		+			+		

Seventy forest vegetation relevés were classified, using the statistical computer software package TWINSPAN (Hill 1979a). The Braun-Blanquet procedures (Werger 1974; Mueller-Dombois & Ellenberg 1974) were used to further refine the phytosociological tables in MEGATAB (Hennekens & Schaminée 2001), resulting in four associations within the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type (Table 9):

1. *Acacio ataxacanthae–Rhoetum chirindensis*
2. *Rapaneo melanophloei–Rhoetum chirindensis*
3. *Ocoteo kenyensis–Xymaloetum monosporae*
4. *Diospyro whyteanae–Widdringtonietum nodiflorae*

The first division, created by the statistical computer software package TWINSPAN (Hill 1979a), isolated the *Widdringtonia nudiflora* dominated cliff forests from the rest of the forest communities. A further division led to the separation of regrowth and mature forest. Regrowth forest was further divided into early regrowth and advanced regrowth forest.

This very diverse group of plant communities have been group together based on the classification by the multivariate algorithm within TWINSPAN (Hill 1979a). This grouping may have been dramatically different if this data set included floristic data from a broader geographical range, e.g. including Afrotemperate regions from the eastern Soutpansberg, the upper Blouberg summits and the adjacent Wolkberg–Drakensberg range. It may be that some of the associations within the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type belong to different classes within the syntaxonomical hierarchy of southern Africa's vegetation. However, many species are shared between the four described associations, rendering them more alike to one another than to the associations of the other major vegetation types of the Blouberg and Soutpansberg Conservancy. More intense sampling of the topographically diverse mistbelt landscape of the Soutpansberg will certainly lead to an increased number of associations. More phytosociological work is sorely needed within this landscape.

As with the rest of the major vegetation types described within this thesis, the decision was made not to describe any new alliances, orders and classes at this point in time. The classification of vegetation data representative of a small geographical range into higher order groupings, without understanding its floristic association and position within the vegetation of the relevant associated vegetation, is premature and unproductive (Werger 1974). Such classified units are artificial and without any predictive value. The formal syntaxonomic description of alliances, orders and classes should be based on a classification of ecologically related plant communities, and should not be dictated by geographical or artificial boundaries of nature reserves or countries. The associations described in this thesis were assigned to existing vegetation classes from the literature where deemed appropriate.

Community description

Rhus rigida var. _rigida–Rhus magalismontanum_ subsp. _coddii_ Soutpansberg Cool Mistbelt Major Vegetation Type

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type consists of somewhat artificial conglomerate of associations, which may belong different syntaxanomic vegetation classes. Syntaxanomic affiliations will be discussed under the headings of the various associations.

Environmental data

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type is confined to the higher lying crests and plateaus situated above 1 200 m above sea level and include the highest peak of the Soutpansberg mountain range, Lajuma (1748 m above sea level). The landscape is rugged and forever changing, resulting in a high richness of habitat types within very limited spatial confines. It is associated with Glenrosa and Mispah Soil Forms (McVicar *et al.* 1991) of Land Types Fa641 and Ib362 derived from sandstone, quartzite and conglomerate of the Wyllies Poort Geological Formation (Botha 2004a). The Champagne Soil Form is found along the localized high lying wetlands.

The soils derived from the underlying sandstone and quartzites are extremely shallow and made up of coarse sands. Along the rugged and broken hillsides, these coarse sandy soils drain quickly, leading to leached and acidic soil conditions. However, the impermeable rock beds along the relatively flat plateaus often prevent water from draining away, leading to temporary flooded conditions of the shallow soils. The depth of the soil and the extent of rock-cover determine the vegetation structure and species composition within this vegetation type.

The higher lying crests and ridges within the mistbelt are exposed to strong winds. During the summer months, these winds carry moisture in from the Indian Ocean, covering the vegetation in mist on an almost daily basis, giving rise to an abundance of rock- and bark-lichens and bryophytes. The combination of frequent orographic rain and mist during the summer months leaves the available soil drenched and sometimes flooded for extended periods. During the prolonged dry season, the prevailing winds are dry, causing dehydration and desiccation of the soils and vegetation (Hahn 2002). These extreme and fluctuating environmental conditions have led to specialization among the plants and may explain the relatively high level of endemisity within this vegetation type (Hahn 2002). The deeper soils within the mistbelt can be regarded as sponge areas, which slowly release water to feed mountain streams over prolonged periods.

The amount of orographic rain associated with the southern ridges varies considerably in accordance to the changing landscape. The venturi effect caused by certain narrow gorges when mist is forced through them by orographic, anabatic and catabatic winds can lead to abnormally high and localised rainfall (Matthews 1991; Hahn 2002). The areas just below the escarpment crest, where atmospheric moisture can be trapped most effectively against the south-facing escarpment, generally yield the highest precipitation (Matthews 1991). Long-term average rainfall measured on the farm Ventersdorp (altitude 1370 m) for the period of 20 years (1934–1954) is 585 mm per annum (South African Weather Bureau). The recorded long-term average rainfall on the farm Hanglip (altitude 1719 m) for the period of 90 years (1913–2003) is 774 mm per annum (South African Weather Bureau). Long-term average rainfall measured on the farm Schyffontein (altitude 1370 m) for the period of 22 years (1964–1986) is 835 mm per annum (South African Weather Bureau). Apart from the spatial variation in rainfall, the area reveals a high temporal variation in recorded rainfall (Geldenhuys & Murray 1993). Mean annual rainfall fluctuated between 571 mm for the period 1965 to 1971 and 1 027 mm for the period 1979–1988 (South African Weather Bureau). Additionally to these rainfall figures, the amount of precipitation as a result of mist can be substantial (Schutte 1971). In the higher lying areas of the KwaZulu-Natal Drakensberg the orographic fog contribution at 1 800 m altitude is an additional 403 mm per annum, which amounts to one third of the mean annual precipitation (Matthews 1991). As with many mountainous areas, the daily weather of the higher altitude crests and summits of the Soutpansberg is very unpredictable, fluctuating between extremes within a matter of hours.

Structurally, the plant communities of the Mistbelt Major Vegetation Type are extremely diverse. It includes wetlands, low open grasslands and bush clumps of short thickets (Edwards 1983).

Diagnostic taxa

The diagnostic species for this group are presented in Species Group V (Table 1, Chapter 4). Due to the structural and floristic diversity within the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type, diagnostic species may be locally dominant, but very few have high constancy throughout the entire major vegetation type.

The diagnostic woody species include mainly dwarfed or stunted trees and shrubs, such as *Rhus rigida* var. *rigida, Ectadiopsis oblongifolia* and *Parinari capensis* subsp. *capensis, Olea capensis* subsp. *enervis, Syzygium legatii, Rotheca myricoides, Euclea linearis, Rhus tumulicola* var. *meeuseana, Olinia rochetiana, Combretum moggii, Vangueria soutpansbergensis, Tarenna supra-axillaris, Protea caffra* subsp. *caffra, Elephantorrhiza elephantina, Tetradenia riparia, Apodytes dimidiata* subsp. *dimidiata, Protea roupelliae* subsp. *roupelliae, Lopholaena coriifolia, Tarenna zimbabwensis, Ekebergia pterophylla* and *Myrsine africana.*

Diagnostic herbaceous species include *Fadogia homblei, Helichrysum kraussii, Rhynchosia monophylla, Commelina erecta, Vernonia natalensis, Dicoma anomala, Gnidia cuneata, Wahlenbergia undulata, Hypoxis argentea* var. *argentea, Eulophia ensata, Aristea woodii, Vernonia oligocephala, Pentanisia prunelloides* subsp. *prunelloides, Anthospermum welwitschii, Ipomoea oblongata, Schistostephium* *crataegifolium* and *Asparagus falcatus*, as well as the succulent herbaceous species *Senecio barbertonicus, Aloe arborescens, Crassula swaziensis, Khadia borealis, Plectranthus neochilus, Kalanchoe sexangularis, Sarcostemma viminale, Senecio oxyriifolius,* the fern species *Pteridium aquilinum,* and the parasitic species *Viscum rotundifolium* on woody plants.

Diagnostic grass species include *Melinis nerviglumis, Brachiaria serrata, Setaria sphacelata* var. *torta, Trachypogon spicatus* and *Elionurus muticus*.

Diagnostic sedge species include *Coleochloa setifera, Cyperus obtusiflorus* var. *obtusiflorus* and *Bulbostylis contexta*.

Dominant / prominent taxa

The most prominent grass species within this collection of diverse communities is *Loudetia simplex* (Species Group F).

Dominant woody species include *Combretum molle* (Species Group C), *Rhus magalismontanum* subsp. *coddii* (Species Group F), *Englerophytum magalismontanum* (Species Group F), *Mimusops zeyheri* (Species Group F), and *Maytenus undata* (Species Group F).

1. *Viteco rehmannii–Syzygietum legatti* ass. nov., hoc loco.

Nomenclatural type: Relevé 78 (holotypus)

Alternative name: *Vitex rehmannii–Syzygium legatti* Mistbelt Low Thickets and Bush Clumps

This association should be classified as part of the *Englerophyto magalismontani–Acacietea caffrae* Savanna Class described by Winterbach *et al*. (2000).

Environmental data

The vegetation structure of the *Viteco rehmannii–Syzygietum legatti* can be described as Low Thicket (Edwards 1983) or short bush clumps (Matthews 1991). The topography is one of rugged quartzite mountain slopes and terraces. Soils are sandy, coarse, shallow and leached by the relatively high precipitation from orographic summer rain. Soil clay content is below 10%. Among the rock fragments, plates and boulders are patches of deeper soil where these bush clumps and thickets proliferate. Surface rock cover varies between 20–60%. The Land Types associated with this community, Fa, Ab and Ib, are derived from the sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004b). Soils are mostly of the Mispah Soil Form (McVicar *et al.* 1991). Altitude ranges between 1 400 and 1 700 m. This mistbelt association is situated high on the southern slopes of the southern ridges of the western Soutpansberg, which are frequently dampened by orographic mist during the summer months.

Diagnostic taxa

This association is characterised by the diagnostic species represented by Species Group A (Table 8). The most prominent diagnostic woody species include *Syzygium legatii, Olea capensis* subsp. *enervis, Vitex rehmannii, Euclea linearis, Kalanchoe sexangularis, Lopholaena festiva, Xerophyta retinervis, Aloe arborescens, Crassula swaziensis, Senecio barbertonicus, Khadia borealis, Combretum moggii, Apodytes dimidiata* subsp. *dimidiata, Vangueria parvifolium, Vangueria soutpansbergensis, Viscum rotundifolium, Diospyros whyteana, Rhoicissus revoilii, Aloe sessiliflora, Psychotria capensis* subsp. *capensis, Sericanthe andongensis* var. *andongensis, Ekebergia pterophylla, Maytenus acuminata* var. *acuminata, Tetradenia riparia* and *Chionanthus battiscombei*.

The grass layer is generally poorly developed, with *Enneapogon cenchroides* as the only weak diagnostic species for this group.

Diagnostic herbaceous species include *Mystacidium braybonae, Commelina benghalensis, Selaginella dregei* and *Anthospermum welwitschii,* as well as the succulent species *Kalanchoe sexangularis*, the sedge *Cyperus denudatus* and the parasitic species on woody plants *Viscum rotundifolium.*

Dominant / prominent taxa

Many of the dominant woody species are also diagnostic species and include *Syzygium legatii* (Species Group A)*, Olea capensis* subsp. *enervis* (Species Group A), *Englerophytum magalismontanum* (Species Group C), *Rhus magalismontana* subsp. *coddii* (Species Group F), *Rhus rigida* var. *rigida* (Species Group F), *Euclea linearis* (Species Group A), *Vitex rehmannii* (Species Group A), *Apodytes dimidiata* subsp. *dimidiate* (Species Group A), *Diospyros whyteana* (Species Group A), *Xerophyta retinervis* (Species Group A), *Combretum molle* (Species Group A), *Hyperacanthus amoenus* (Species Group C) and *Olinia rochetiana* (Species Group C).

Prominent grass species within the weak grass layer include *Loudetia simplex* (Species Group F), *Brachiaria serrata* (Species Group F) and *Melinis nerviglumis* (Species Group F).

Dominant herbaceous species include *Mystacidium braybonae* (Species Group A), *Helichrysum kraussii* (Species Group F), *Asparagus falcatus* (Species Group F), as well as the succulent species *Kalanchoe sexangularis* (Species Group A), *Senecio oxyriifolius* (Species Group C), *Crassula swaziensis* (Species Group F), *Senecio barbertonicus* (Species Group F), *Khadia borealis* (Species Group F) and the sedge species *Coleochloa setifera* (Species Group F) and the parasitic species on woody plants *Viscum rotundifolium* (Species Group A). A strong presence of lichens and bryophytes were noted within this association during the time of vegetation sampling.

The larger bush clumps within this association contain many forest tree species. It may therefore seem to be an early successional stage of forest community. However, the size of the available soil pockets and the generally shallow nature of the soil will prevent it from turning into forest. The *Viteco rehmannii–Syzygietum legatti* and the *Heteropyxo natalensis–Combretetum mollis* of the SC mistbelt share numerous species (Species Group C). Both these associations share their most dominant species with the *Combretum molle–Coleochloa setifera* open woodland and the *Combretum molle–Heteropogon contortus–Rhus dentata* closed woodland variation of the *Combretum molle–Heteropogon contortus* closed and open woodlands described by Westfall (1981, 1985) of the Waterberg Mountain Range. It is therefore suggested that these associations and communities be classified into a single syntaxon of higher hierarchical status, such as an alliance or an order.

The *Diplorhynchus condylocarpon–Englerophytum magalismontanum* Rocky Slope Community of the Waterberg Biosphere (Henning 2002) share some limited floristic elements with the *Viteco rehmannii–Syzygietum legatti*. Although they share a very similar landscape, the *Diplorhynchus condylocarpon–Enlerophytum magalismontanum* Rocky Slope Community of the Waterberg contain more xeric species, while the *Viteco rehmannii–Syzygietum legatti* of the Soutpansberg mistbelt contains more mesic species.

2. *Heteropyxo natalensis–Combretetum mollis* ass. nov., hoc loco.

Nomenclatural type: Relevé 164 (holotypus)

Alternative name: *Heteropyxis natalensis–Combretum molle* Mistbelt Low Thicket and Bush Clumps

Classified under the *Englerophyto magalismontani–Acacietea caffrae* Savanna Class described by Winterbach *et al*. (2000).

Environmental data

The vegetation structure of the *Heteropyxo natalensis–Combretetum mollis* can be described as Low Thicket (Edwards 1983) or short bush clumps (Matthews 1991). It is situated between 1 400 and 1 600 m above sea level and falls within the confines of the mistbelt. This plant community occurs in close proximity of the *Viteco rehmannii–Syzygietum legatti*. The *Heteropyxo natalensis–Combretetum mollis*, however, occupies the warmer and drier northern aspects with its gentle slopes. It shares the same Land Types as the *Viteco rehmannii–Syzygietum legatti* namely Fa, Ab and Ib, derived from the sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004b). Soils are mostly of the Mispah Soil Form (McVicar *et al.* 1991). Soil clay content is below 10%. Surface rock cover varies between 20–60%.

Diagnostic taxa

This association is characterised by the diagnostic species represented in Species Group B (Table 8). Most prominent diagnostic woody species include *Heteropyxis natalensis, Rhus pentheri, Coddia rudis, Orthosiphon labiatus, Lagynias dryadum, Erythrina lysistemon, Dombeya rotundifolia* var. *rotundifolia, Pavetta schumanniana, Rhoicissus tridentata* subsp. *tridentata* and *Tecoma capensis*.

No diagnostic grass species were recorded.

Only a few weak diagnostic herbaceous species were recorded for this association namely *Felicia muricata, Senecio venosus, Pseudognaphalium luteo-album* and *Lantana rugosa*.

Dominant / prominent taxa

Prominent trees and shrubs include *Heteropyxis natalensis* (Species Group B), *Englerophytum magalismontanum* (Species Group C), *Maytenus undata* (Species Group C), *Rhus pentheri* (Species Group B), *Coddia rudis* (Species Group B), *Orthosiphon labiatus* (Species Group B), *Combretum molle* (Species Group C), *Hyperacanthus amoenus* (Species Group C), *Rotheca myricoides* (Species Group C) and *Vangueria infausta* subsp. *infausta* (Species Group E).

A weak grass layer is dominated by *Loudetia simplex* (Species Group F) and *Melinis nerviglumis* (Species Group F).

Dominant herbaceous species include *Myrothamnus flabellifolius* (Species Group C), *Ectadiopsis oblongifolia* (Species Group F) and *Corchorus kirkii* (Species Group F).

The *Heteropyxo natalensis–Combretetum mollis* and the *Viteco rehmannii–Syzygietum legatti* of the SC mistbelt share numerous species (Species Group C). As mentioned previously, both these associations share their most dominant species with the *Combretum molle–Coleochloa setifera* open woodland and the *Combretum molle–Heteropogon contortus–Rhus dentata* closed woodland variation of the *Combretum molle–Heteropogon contortus* closed and open woodlands described by Westfall (1981, 1985) of the Waterberg Mountain Range. It is therefore suggested that these associations and communities be classified into a single syntaxon of higher hierarchical status, such as an alliance or an order. The *Burkea africana–Englerophytum magalismontanum* variation of the of the *Burkea africana–Setaria lindenbergiana* Low Thicket of the *Burkea africana–Setaria lindenbergiana* Major Community (Van Staden 2002; Van Staden & Bredenkamp 2006) share some limited floristic elements of the *Heteropyxo natalensis–Combretetum mollis* of the SC.

3. *Proteo caffrae–Setarietum sphacelatae* ass. nov., hoc loco.

Nomenclatural type: Relevé 127 (holotypus)

Alternative name: *Protea caffra–Setaria sphacelata* var *torta* High Altitude Low Closed Grassland

This association should be classified as part of the *Loudetio simplicis–Alloteropsidetea semialatae* Grassland Class described by Matthews *et al.* (1994).

Environmental data

The vegetation structure of the *Proteo caffrae–Setarietum sphacelatae* can be classified as Low Closed Grassland (Edwards 1983). Some authors have referred to these high lying grasslands as "Fynbos" (Van Wyk & Smith 2001) due to the high incidence of Fynbos floristic elements within this plant community. However, this association is dominated by grass species and share structural similarities with the *Diheteropogono amplectentis–Proteetum gaguedi* described by Matthews (1994) as part of the relatively low altitude grasslands of the North-eastern Mountain Sourveld of the Limpopo and Mpumalanga escarpment. It should therefore, be regarded as part of the Afromontane grasslands of the Afro-alpine Phytochorion (White 1978) and part of the North-eastern Mountain Grassland of the Grassland Biome (Deall *et al.* 1989; Matthews *et al.* 1992b; 1993; Burgoyne 1995; Bredenkamp *et al.* 1996). Numerous other *Protea*-dominated grassland communities have been described by Acocks (1953) from the Bankenveld, Coetzee (1974, 1975) from the Magaliesberg area, Bredenkamp and Theron (1978) from the Suikerbosrand, Behr and Bredenkamp (1988) from the Witwatersrand, Hattingh (1991) from the hills of the Voortrekker Monument in Pretoria, Bezuidenhout *et al.* (1994) from the Gatsrand area in North-West Province, Coetzee *et at.* (1995), Bredenkamp and Brown (1998a; 1998b) from the natural areas of the Western Metropolitan Local Council, Grobler *et at.* (2002), from various natural open spaces in Gauteng, and Bredenkamp and Van Rooyen (1996b) from the rocky hills and ridges in the Witwatersrand, Magaliesberg, Suikerbosrand, Gatsrand and Vredefort Dome areas.

The shallow coarse-grained sandy soils of this association are highly leached and dominated by the Glenrosa Soil Form (McVicar *et al.* 1991). Soil clay content is below 10%. Water drainage is good. It is associated with the Fa, Ab and Ib Land Types derived from the sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004b). The landscape is a mosaic of grassland patches and rocky quartzite outcrops within a heterogeneous rugged terrain. The low closed grassland (Edwards 1983) patches cover the flat and undulating areas where shallow sandy soils have accumulated to sustain a dense grass layer. These low grasslands with their shallow soils are prone to soil erosion and very sensitive to overgrazing and trampling. The rocky outcrops cover between 10 and 45% of the surface area. Fynbos associated floristic elements tend to increase as surface rock cover increases, while the percentage of relative grass cover decreases. The vegetation is predominantly situated at high altitudes (1 500–1 748 m) high against the southern slopes of the southern most ridges of the mountain and exposed to strong winds. The woody vegetation is generally dwarfed and low growing.

Diagnostic taxa

This association is characterised by the diagnostic species represented in Species Group D (Table 8). The most prominent diagnostic woody species include *Protea caffra* subsp. *caffra, Elephantorrhiza elephantina, Protea roupelliae* subsp. *roupelliae, Faurea saligna, Rhus rigida* var. *rigida, Rhus magalismontana* subsp. *coddii*, *Parinari capensis* subsp. *capensis, Schistostephium crataegifolium* and *Ectadiopsis oblongifolia*.

Diagnostic grass species are *Setaria sphacelata* var. *torta, Trachypogon spicatus, Elionurus muticus* and *Andropogon chinensis*.

The herbaceous layer is relatively rich in species and contains diagnostic species such as *Dicoma anomala, Wahlenbergia undulata, Vernonia oligocephala, Hypoxis argentea* var. *argentea, Eulophia ensata, Hypoxis hemerocallidea, Gnidia cuneata, Aristea woodii, Ipomoea oblongata, Scabiosa columbaria* and *Vernonia capensis*, as well as sedge species *Bulbostylis contexta, Bulbostylis burchellii* and *Cyperus obtusiflorus* var. *obtusiflorus*.

Dominant / prominent taxa

The woody layer is sparse with isolated and often prominent individuals of *Protea caffra* subsp. *caffra* (Species Group D), *Elephantorrhiza elephantina* (Species Group D), *Protea roupelliae* subsp. *roupelliae* (Species Group D), *Schistostephium crataegifolium* (Species Group D) and *Faurea saligna* (Species Group D).

Dominant grass species include *Setaria sphacelata* var. *torta* (Species Group D), *Trachypogon spicatus* (Species Group D), *Elionurus muticus* (Species Group D), *Andropogon chinensis* (Species Group D), *Loudetia simplex* (Species Group F) and *Brachiaria serrata* (Species Group F).

The rich herbaceous layer is dominated by species such as *Dicoma anomala* (Species Group D), *Wahlenbergia undulata* (Species Group D), *Vernonia oligocephala* (Species Group D), *Hypoxis argentea* var. *argentea* (Species Group D), *Eulophia ensata* (Species Group D), *Hypoxis hemerocallidea* (Species Group D), *Helichrysum kraussii* (Species Group F) and *Fadogia homblei* (Species Group H).

Combretum molle–Agyrolobium transvaalense open woodland community described by Westfall (1981, 1985) of the Waterberg Mountain Range share some floristic and structural properties with the *Proteo caffrae–Setarietum sphacelatae* of the SC. However, the *Combretum molle–Agyrolobium transvaalense* open woodland community is associated with higher soil nutrient status and is dominated by *Themeda triandra*. Both of these are regarded as grasslands, and not as woodlands. *Proteo caffrae–Setarietum sphacelatae* of the SC also share some species with the *Combretum molle–Heteropogon contortus–Chaetacanthus costatus* open woodland variation of the *Combretum molle–Heteropogon contortus* closed and open woodlands described by Westfall (1981, 1985) of the Waterberg Mountain Range. However, the *Combretum molle–Heteropogon contortus–Chaetacanthus costatus* open woodland variation contains more woody species and is regarded as woodland and not a grassland. The *Combretum molle–Protea caffra* open woodland described by Westfall (1981) and Westfall *et al.* (1985) of the Waterberg Mountain Range share limited florist links (but few structural links) with the *Proteo caffrae–Setarietum sphacelatae*. Some limited floristic links exist between the *Andropogon* *appendiculatus–Eragrostis pallens* grassland of the Waterberg Mountain Range (Westfall 1981; Westfall *et al.* 1985) and the *Proteo caffrae–Setarietum sphacelatae*.

Strong floristic links exist between the *Protea roupellia–Helichrysum nudifolium* sparse woodland and the *Trachypogon spicatus–Eragrostis racemosa* grassland of the Waterberg (Westfall 1981; Westfall *et al.* 1985) and the *Proteo caffrae–Setarietum sphacelatae* of the SC. However, the *Trachypogon spicatus–Eragrostis racemosa* grassland of the Waterberg is more comparable to the lower altitude high rainfall grassland patches further to the east within the Soutpansberg. These communities are generally rich in herbaceous species, and are often referred to as types of "fynbos" (Van Wyk & Smith 2001). However, based on the dominance of grass species within these plant communities, they are regarded as grassland containing limited fynbos floristic elements.

The *Protea caffra–Loudetia simplex* Major Community of the Marakele National Park (Van Staden 2002) compares to the communities described by Westfall (1981) and Westfall *et al.* (1985) for the Waterberg Mountain Range, and share some species with the *Proteo caffrae–Setarietum sphacelatae*.

The system is quite stable and fairly predictable without much change caused by normal droughts or grazing. However, if overgrazed or disturbed to such an extent that degradation proceeds beyond a threshold, then recovery is very slow, due to reduced nutrient cycling and decreased nutrient availability, and the vegetation may change to another domain of attraction (Bredenkamp *et al. in press*), which will be different from the original climax vegetation, representing a plagioclimax. A change back to the original domain of attraction is unlikely if not impossible in the short and medium term (Bredenkamp *et al. in press*). Due to the quartzitic derived shallow nutrient poor soils these systems are sensitive and intolerant to frequent impacts such as heavy grazing, ploughing, trampling.

4. *Cypero albostriati–Pennisetetum glaucocladii* ass. nov., hoc loco.

Nomenclatural type: Relevé 75 (holotypus)

Alternative name: *Cyperus albostriatus–Pennisetum glaucocladum* High Altitude Wetlands and Peatlands

The *Cypero albostriati–Pennisetetum glaucocladii* association falls within the Limpopo Plain and Central Highland Peatland Eco-regions described by Marneweck *et al.* (2001).

The *Cypero albostriati–Pennisetetum glaucocladii* wetlands can be described as azonal plant communities, whose distribution is governed by the occurrence of permanent wet patches. Within the high altitude areas of the Soutpansberg, these wetlands are very localised and limited to small areas. Some of the high altitude wetlands sampled revealed characteristics of peat wetlands and bogs. As a broad estimate, a soil may be considered a peat soil if it has more than 20–35% organic matter on a dry weight basis (Mitsch and Gosselink 1986). This is by no means a strict definition and there is still considerable debate among wetland scientists as to what actually defines a peat soil (Smuts 1992). Peatlands are some of the most rare wetland types in South Africa and only 1 % of the peatlands of the world occur in Africa and South America (Marneweck *et al.* 2001; Grundling & Grobler 2005).

At least three internationally recognised peatlands occur within the SC, namely the Bluegumspoort Peatland, the Lajuma East Peatland and the Lajuma West Peatland (Marneweck *et al.* 2001). They form part of the Limpopo Plain and the Central Highlands Peatland Eco-regions described by Marneweck *et al.* (2001). Wetlands and peatlands are protected in accordance with the Conservation of Agricultural Resources Act (Act 43 of 1983). The National Water Act, 36 of 1998 further states that it is a criminal offence to mine peatlands or to divert, impede or alter the course or characteristics of water flow within wetlands without the proper authorisation (Winstanley 2001). These wetlands are of great ecological and economical value and should be conserved for their biodiversity, ecosystem functioning and the irreplaceable ecological services they provide to the humans depending on them (Costana *et al.* 1997).

Even though the six wetlands sampled within the SC differed considerably with regard to vegetation structure, it was decided to bind them into a single association based on their floristic similarities and their ecological functionality as wetlands. This phenomenon of great structural and floristic differences between different individual wetland stands were also observed by Cilliers *et al.* (1998), Marneweck *et al.* (2001), Myburg & Bredenkamp (2004) and Grundling & Grobler (2005) However, more work is needed in order to understand and conserve the variety of different wetlands and peatlands within the western Soutpansberg effectively.

Environmental data

The topography of the six high altitude wetlands sampled varies considerably. Some are long and narrow, following the sharp bottomlands of small and isolated valleys. Others are polygons of low-lying depressions within isolated "amphitheatres". The topography of a wetland affects the potential water depth, speed of water flow and the drainage of the wetland. Due to the strong rainfall gradients experienced within the Soutpansberg, the geographical position of the wetland will influence the potential amount of rain it receives. Likewise, the size of the wetland's catchment area will affect the potential amount of water it may receive. In turn, these factors affect the structure and composition of the vegetation of a given wetland. With so much variation in local topography, catchment area size and local precipitation, the dynamics of the different wetlands and peatlands vary accordingly.

In general, the vegetation structure can be described as medium to tall closed grass-and-sedge wetlands, with a very high biomass production. Similarly structured vegetation has been described for the bogs and mires of Lesotho (Granger & Bredenkamp 1996; Marneweck *et al.* 2001). The high biomass production at the relatively cool temperatures of these high altitudes, together with seasonally waterlogged conditions have led to the build-up of organic matter within the available soil. Under these cold anaerobic conditions, organic decomposition is often very slow, which leads to the build-up of organic matter in the soil (Marneweck *et al*. 2001). Over prolonged periods this process may lead to the formation of peatlands. Some of the wetlands sampled reveal localised accumulation of fine-grained peat, and can therefore considered as peatlands. Elsewhere, the dominant soil form within these wetlands may be classified as the Champagne Soil Form (McVicar *et al.* 1991).

Although the surface rock cover within the wetlands is below 1 %, continuous quartzite banks often demarcate the edges of the wetlands.

It occurs in a variety of Land Types, such as Fa, Ab and Ib (Botha 2004a). All of these Land Types are associated with sandstone and conglomerate of the Wyllies Poort Formation. Soils from the surrounding slopes are shallow and comprise mainly of coarse sands, which drain well and are highly leached. Water from the small catchments of these isolated plateaus drain into the lower lying depressions to form these wetlands. The underlying water-impermeable rock prevents water from draining away vertically. This leads to either stagnant waterlogged conditions, in the case where the wetland has no outlet, or slow horizontal draining to lower ground, in the case where the wetland has an outlet.

Diagnostic taxa

The diagnostic species for this group are presented in Species Group G (Table 8). The most prominent diagnostic grass species characterising this association are *Pennisetum glaucocladum, Alloteropsis semialata* and *Andropogon eucomus*.

Diagnostic sedges include *Cyperus albostriatus, Cyperus sphaerospermus, Bulbostylis hispidula, Pycreus polystachyos* and *Cyperus solidus*.

Two locally prominent ferns were recorded as diagnostic species namely *Thelypteris confluens* and *Pteridium aquilinum*.

Some of the diagnostic herbaceous species include *Persicaria decipiens, Gunnera perpensa, Drimia robusta, Kniphofia* species, *Schoenoplectus brachyceras, Dissotis canescens, Chironia purpurascens, Psoralea pinnata* and *Chironia palustris.*

Dominant / prominent taxa

The grass species *Pennisetum glaucocladum* (Species Group G) dominates the peripheral drier zone of this association.

Fern species *Thelypteris confluens* (Species Group G) and *Pteridium aquilinum* (Species Group G) dominate the moist zone.

Members of the Cyperaceae family *Cyperus albostriatus, Cyperus sphaerospermus, Bulbostylis hispidula, Pycreus polystachyos* and *Cyperus solidus* dominate the permanently wet core area. The only herbaceous species worth mentioning as potentially dominant is *Persicaria decipiens* (Species Group G), which is confined to the wetter core area.

Due to the scale at which sampling have been done, the wetlands of the SC have been described as a single association. However, the various zones of wetness within theses wetlands should be described and delineated as unique variations, sub-associations or even separate associations. Each of these zones has a distinctly different floristic composition and ecological functioning (Marneweck *et al.* 2001). More work is needed with regard to these different zones within the wetlands of the SC.

Ordination

The *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type represents those associations restricted to the mistbelt zone of the SC. Although one can describe these associations as structurally and floristically diverse, they all share an affinity and dependence on the moisture laden-air, fog-drip and orographic rain associated with the mistbelt. These sources of moisture are predictable and create relatively moist conditions within the context of the SC. The mistbelt associations rely on and are primarily driven by this relative abundance of plant-available moisture. High percentage atmospheric moisture during the warm and often dry summer months further reduces transpiration and water-loss during critically dry periods of the growing season.

The scatter diagram (Figure 12) displays the distribution of relevés along the first and second ordination axes. The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental conditions. The first axis (eigen value = 0.957), orientated along the x-axis, represents soil depth, percentage surface rock cover, soil texture, clay percentage and soil moisture content. Those associations along the left of the diagram represent bush clump vegetation with shallow soils, relatively little organic soil matter, high percentages surface rock cover, relatively low soil moisture values and low soil clay fractions. The cluster of relevés on the right represents a wetland association with deep peat soils with a high percentage of organic soil matter, low percentages surface rock cover, permanently flooded conditions and high soil clay fractions.

The second axis (eigen value = 0.455), orientated along the y-axis, represents aspect and solar radiation. The relevés closer to the x/y-intercept represent the plant communities situated on southern aspects, while the relevés further from the x/y-intercept represent the plant communities situated along the northern aspects. Due to the inclination if the sun during winter in the southern hemisphere, and the inclination of the under lying rock plates, the northern aspects receive much more perpendicular radiation than the southern aspects. The southern slopes are steeper, causing the sun's rays to reach this aspect at a shallow angle, dispersing the intensity and amount of radiation experienced by the vegetation. The southern aspects can therefore be regarded as cooler than the northern aspects of the mountain.

It is clear from the distinct groupings in the above ordination scatter plot that there are distinct differences between these four associations. According to the classification done on the mistbelt vegetation data, each of these associations contain a large number of unique diagnostic species. These distinct separations among the mistbelt associations of the SC strengthen the notion that these associations may belong to different syntaxonomic classes.

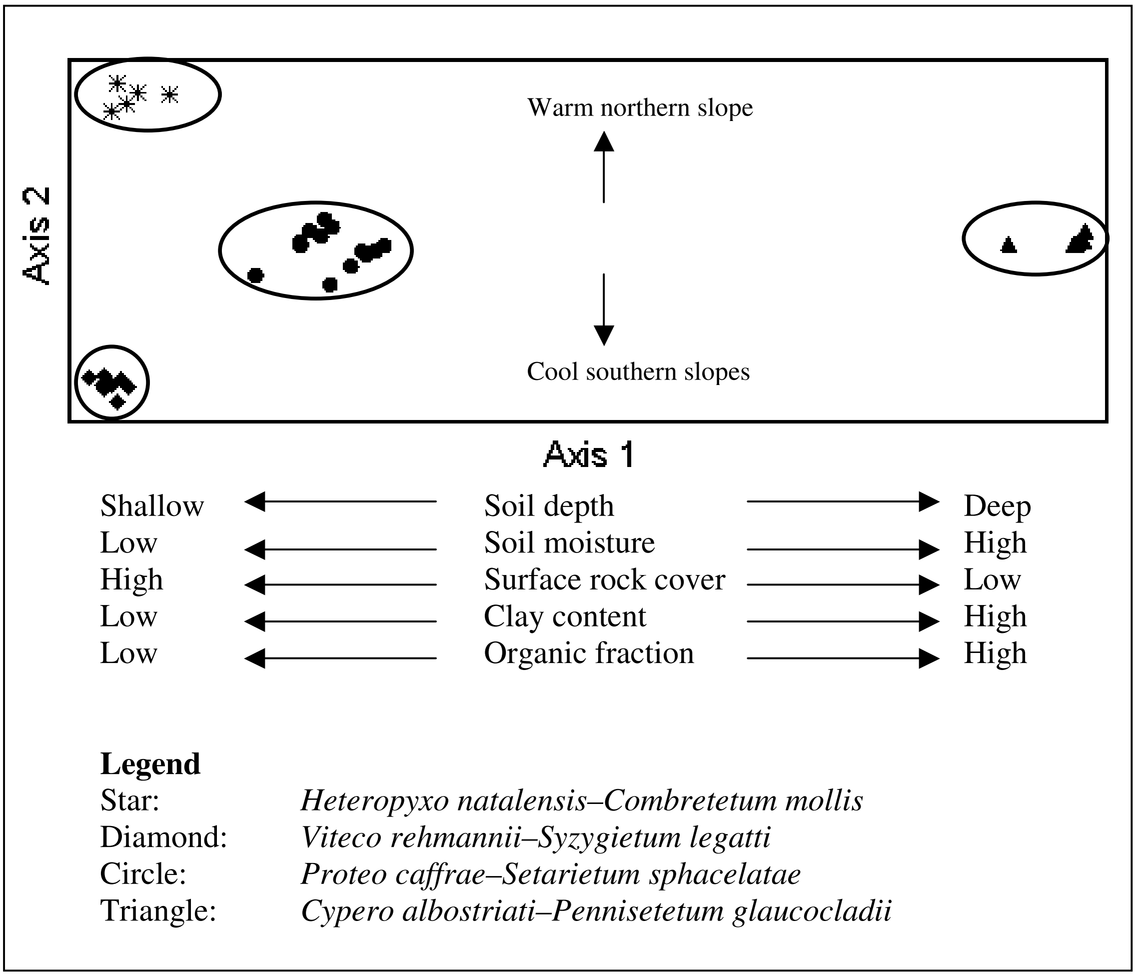

Figure 12. Relative positions of all the relevés along the first and second axis of the ordination of the *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type

Forests of the Soutpansberg Conservancy

South Africa's temperate inland forests are highly valued and extensively utilised for their hardwood species and general biodiversity. Afromontane, or rather Afrotemperate Forest is considered as an extremely vulnerable vegetation type (Cawe 1990; Lawes *et al.* 2000; Seydack 2000; Obiri 2002) and is protected under the National Forests Act (Act No 84 of 1998). Unfortunately, most of the western Soutpansberg's forest patches were converted to commercial plantations of exotic timber species before legislation came into effect (Geldenhuys & Murray 1993). Selective logging of the eighteenth and nineteenth century have also had long-term impacts on forest species composition (Obiri 2002).

A number of attempts have been made to create a comprehensive classification for South Africa's remaining forest types (White 1978a; Geldenhuys 1987; Geldenhuys 1992; Shackleton *et al.* 1999; Von Maltitz *et al.* 2003). The recent classification by Von Maltitz *et al.* (2003) lumped the forest communities of the Blouberg, Soutpansberg, North Eastern Escarpment, Mariepskop and Barberton regions under the name "Northern Mistbelt Forest". These Afrotemperate forests have been described by numerous authors and under various different names; Afromontane forest (Cooper 1985, White 1978), Temperate, Transitional and Scrub Veld Types (Acocks 1953), Uplands Vegetation (Edwards 1967; Moll 1976), Interior Forests (MacDevette *et al*. 1989), Montane *Podocarpus* Forest (Cooper 1985; Edwards 1967; Moll 1976), Highland Sourveld (Acocks 1953), Mist Belt Mixed *Podocarpus* Forest (Cooper 1985; Edwards 1967; Moll 1976) and Natal Mist Belt Ngongoni Veld (Acocks 1953).

The Afrotemporate Forest vegetation type has a highly fragmented distribution pattern and ranges from Knysna in the south to the Soutpansberg in the north (Whyte 1978; Van Wyk & Smith 2001). These forests are generally confined to the mountainous regions of the Drakensberg (*sensu latu)* along sheltered pockets (relatively frost- and snow-free) of the escarpment (Acocks 1953). It is associated with areas of high plant-available water (Rutherford and Westfall 1986), which in tern is a function of amount of precipitation, seasonality of precipitation, evapotranspiration, soil structure and availability of groundwater (Von Maltitz *et al.* 2003).

Forest should be seen as dynamic ecosystems that owe their persistence and resilience to fundamentally different processes of plant regeneration ecology (Bond & Midgley 2001). While late succession species have seeds that can germinate and establish under a mature forest canopy, early succession species establish in larger forest gaps or at the forest fringe (Midgley *et al.* 1995; Brokaw & Busing 2000). Depending on the type and frequency of disturbance within a forest, a dynamic equilibrium between early and late successional species can fluctuate between extremes (Denslow 1987). Due to this dynamic nature of especially forest edges, the associated communities tend to shift in space over time as ecological events and disturbances alter the forest margin. Even though these communities associated with the forest margin may be seen as ecotonal and spatially temporal, they play such an important role in the integrity and stability of the core forest areas, that they should be considered as functional and structural vegetation entities in their own right. The current patterns of distribution and composition of forest species are the result of many factors, such as historical events, dispersal pathways, management, successional stage, dispersal mechanisms, habitat requirements, establishment requirements, biotic interactions and disturbance events and regimes (Von Maltitz *et al.* 2003).

All the forest communities of the Soutpansberg have not yet been described and classified. Geldenhuys & Murray (1993) provided a comprehensive description of one of the larger remaining forest patches within the western Soutpansberg, the Hanglip State Forest. This data, together with some newly collected data from further west within the SC, were classified in order to create a more comprehensive image of the forest communities of the SC. Some measures had to be taken to enhance compatibility of the old and new data, which are discussed in detail under the heading "Methods". The aim of this classification is to provide conservation agencies with a yardstick by which forests types can be identified, evaluated, managed, protected and monitored. Without a scientifically based classification, conservation authorities will not be able to report meaningfully on the state of the forest resources, nor set and adapt conservation priorities (Von Maltitz *et al.* 2003). It is vital to understand the floristic characteristics and ecology of these remaining pockets of forest within the SC in order to affectively conserve, protect and manage them.

Until the work of Von Maltitz *et al.* (2003), there has been no attempt to co-ordinate an objective classification system for all forests in South Africa (Shackleton *et al.* 1999). However valuable their classification, it did not produce a formal syntaxonomic hierarchy of the southern African forests. Due to the geographical restriction of the data used in the classification of the Soutpansberg forests, vegetation could only be described up to the association level. This is also true for some previous formal syntaxonomic descriptions of forest vegetation (Matthews *et al.* 1992a; Van Staden & Bredenkamp 2006).

***Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type**

Environmental data

The *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type is confined the southern slopes of the southern most ridges of the mountain. The higher lying quartz escarpment forms part of the Wyllies Poort Geological Formation, while the lower lying igneous rock forms part of the Sibasa Geological Formation (Brandl 2002). Dominant soil forms include the Glenrosa, Mispah and Shortlands Soil Forms (McVicar *et al.* 1991) of Landtype Fa535 derived from basalt, tuff, sandstone, and conglomerate of the Sibasa Geological Formation (Von dem Bussche 1984; Botha 2004a; Patterson & Ross 2004a), as well as the Glenrosa and Mispah Soil Forms (McVicar *et al.* 1991) of Landtype Ib349 derived from sandstone and conglomerate of the Wyllies Poort Formation (Botha 2004a; Patterson & Ross 2004a). According to Louw *et al*. (1994) the soils derived from the igneous rock are highly weathered, fertile red ferrallitic soils with a high clay fraction. The A-horizon is often a complex mixture of quartzitic sand from the higher lying Wyllies Poort Formation and clay from the local Sibasa Formation, as well as high quantities of organic matter from the forest vegetation. Defining the geology and soil formations is often difficult and problematic along this ruptured section of the mountain where the upper sedimentary plates have torn and mixed with volcanic material (Barker 1979, 1983; Bumby 2000, Bumby *et al.* 2001). When vegetation is removed, soil erosion becomes a major problem along the steep slopes with its relatively shallow soils and high rainfall.

As with the other Afrotemperate Forest types, the *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type is dependant on the orographic rain and mist driven onto the southern slopes by a south-easterly wind during summer. Rainfall varies dramatically with regard to topographical positioning of individual forest patches. Variability in annual precipitation is further complicated by cyclical dry and wet periods of which we understand precious little of. Von Maltitz *et al.* (2003) estimated the average annual rainfall at approximately 1500 mm. Temperatures range from below 0 °C in winter to above 30 °C in summer and increases from higher altitudes to the foothills (South African Weather Bureau).

The evergreen high forests are confined to the mistbelt of the mountain, which reaches down as far as 1380 m above sea level (Geldenhuys & Murray 1993). Deciduous shrub forest forms a fire resistant ecotone of thickets, which extend to below the mistbelt zone of the southern slopes. Within the Soutpansberg mistbelt plants often rely on 'fog drip' for moisture (Cawe 1994).

Geldenhuys and Venter (2002) identified the Soutpansberg forests as relatively high in species richness, recording 195 trees, 79 shrubs, 34 lianes, 21 vines, 43 ferns, 13 graminoids, 9 geophytes, 20 epiphytes, 32 herbs and 4 other growth forms. The vegetation structure of the *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type can be described as closed high forest (Edwards 1983).

Diagnostic taxa

The diagnostic species for the *Xymalos monospora–Rhus chirendensis* Western Soutpansberg Forest Major Vegetation Type are presented in Species Group V (Table 1, Chapter 4). They include the woody species *Xymalos monospora, Zanthoxylum davyi, Celtis africana, Nuxia floribunda, Rhoicissus tomentosa, Kiggelaria africana, Vepris lanceolata, Rapanea melanophloeos, Rothmannia capensis, Brachylaena discolor, Ficus craterostoma, Combretum kraussii, Trichilia dregeana, Trimeria grandifolia, Drypetes gerrardii* and *Oxyanthus speciosus* subsp. *gerrardii*.

Dominant / prominent taxa

Prominent species within this major vegetation type include the woody species *Xymalos monospora*, *Celtis africana, Nuxia floribunda, Rhoicissus tomentosa, Vepris lanceolata, Rapanea melanophloeos, Rothmannia capensis* (Species Group V), *Diospyros whyteana* (Species Group W), *Rhus chirindensis* and *Cussonia spicata* (Species Group X).

Table 9 Phytosociological table of the plant communities of the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

Association number	1											2													
Variant number																									
Releve number	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206
Species Group A																									
Diagnostic species of the *Acacio ataxacanthae–Rhoetum chirindensis*																									
Acacia ataxacantha	4	2	2	2	2	3	3	3	1	1	1	1													
Acacia sieberiana		1			1	2																			
Erythrina lysistemon	1									1		1													
Species Group B																									
Rhus chirindensis	1	3	4	2	2	2	2	2	2	3	3	2	2	4	4	4	4	3	3	2	2	1	3	3	3
Brachylaena discolor	1	2	1					2	2	3		1		1		1		3		4	1		1		
Vepris lanceolata				1	2	2	3			2	3	2	2	1		2	1	1	2			2		2	
Halleria lucida			2									1	1	3				2			2	2			
Curtisia dentata		1									1					1			1		1	2			
Pittosporum viridiflorum					2		1	1											2	2					
Species Group C																									
Diagnostic species of the *Ocoteo kenyensis–Xymaloetum monosporae*																									
Xymalos monospora					1				2		2		3	2		1								1	
Rhoicissus tomentosa					1																				
Chionanthus foveolatus																							2		

Association number	3																											
Variant number	3.1								3.2																			
Releve number	210	211	212	213	214	215	216	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238
Species Group A																												
Acacia ataxacantha																												
Acacia sieberiana																												
Erythrina lysistemon																												
Species Group B																												
Rhus chirindensis	2	3	2								1							1	1	1						1	2	
Brachylaena discolor	1	2				1							1															
Vepris lanceolata						1				2	1																	
Halleria lucida																												
Curtisia dentata																												
Pittosporum viridiflorum																												
Species Group C																												
Xymalos monospora	3	5		3	3	3	3	2	3	2	3	3	3	3	3	2	3	4	3	3	3	3	2	2	2	2	3	2
Rhoicissus tomentosa		2	1	1		2	1	1	2	1	2			2	1	1				3		1	1	1				
Chionanthus foveolatus				1		1	1	1																				

Association number	3									4			
Variant number	3.3												
Releve number	239	240	241	242	243	131	132	133	134	68	69	70	71
Species Group A													
Acacia ataxacantha													
Acacia sieberiana													
Erythrina lysistemon													
Species Group B													
Rhus chirindensis						1			2				
Brachylaena discolor													
Vepris lanceolata													
Halleria lucida													
Curtisia dentata													
Pittosporum viridiflorum													
Species Group C													
Xymalos monospora	3	4	2	3	2	1	2	3	2				
Rhoicissus tomentosa	1							1					
Chionanthus foveolatus	2	2					1						

Species Group D
Diagnostic species of the *Olea capens* ssp. *macrocarpa* variant

Drypetes gerrardii		2	1 2 2 2 1 2	2 2	2 1
Olea capens ssp. *macrocarp*		1	2 2 1 1 1 1	1 2	1

Species Group E
Diagnostic species of the *Rothmannia capensis* variant

Rothmannia capensis				2 2 3 3 2 2 2 1 2 3 1 1 1 1 2 1 2 1	1
Oxyanthus speciosus ssp *gerardii*			1 1	1 2 1 1 3 1 2 2 2 1 1	1 1
Calodendrum capense	1	1	1	1 1 1 1	
Trichilia emetica			1	1 1 1 1	1

Species Group F
Diagnostic species of the *Ocotea kenyensis* variant

Ocotea kenyensis				1 1 1	1 2 2 1 2 2 1 2 3
Podocarpus falcatus					1 3 1
Podocarpus latifolius					1 4 1

Species Group G

Celtis africana	1 1 2	2 1 1	1 2 1 1 1 1	1 2 2 1 1	3 2 1 2 2 1 1
Nuxia floribunda	2 1 3 3	3 3 2 2 2 1 1 2 2 1	1 1	2 1 4 3 2	1 1
Cussonia spicata	1 2 2 2 2 2 2 3	3 3 1 1 1 2 1 2	2 2	2 1 2 1 1	
Zanthoxylum davyi	1	2 1 1 1 1 1 2	1 1 1 1	2 1 1 1 2 1 1 2	1 1 1
Maesa lanceolata	1 2 2 1	1 1 2 2 2 3 2	1	1 1 1	2 3 1
Kiggelaria africana	1 2 1 2	1 2	1 2 1 1 2	1 1 2 1	1 1
Maytenus undata	3 4 1 1 1	2	2 3 2	2 1 2 1 1 1 2 1	
Trichilia dregeana	1 3	1 1 1 2 1 1	1	1 1 1 2	1 1 1 1
Rapanea melanophloeos	1 1 1	2 2 3 2 4 4 3 4	1	1 1 1	
Ficus crateostoma		1 1	1 1	2 1 1 1 1 2	1 1 1 3
Combretum kraussii	1 1	2 1 3 1 1 1		1 1	1 1
Timeria grandifolia	2 1	1 1 1 1	1	1	1 1
Prunus africana	1 1 2	2	1 2 1	1	
Ochna holstii	1 1			1 1 2	2 1 1
Cassipourea geradii	1	2		1 1	2 1 1
Rhus leptodictya	1 1 1		2 1		

Clausena anisata		1 2	1			
Vepris reflexa		2	1			
Species Group H						
Diagnostic species of the *Diospyro whyteanae–Widdringtonietum nodiflorae*						
Widdringtoni nodiflora						3 3 2 2
Myrsine africana						2 2 1 2
Rhoicissus revoilii						2 1 2 1
Clutia pulchella v. pulchella						1 1 2 1
Rumoha adiantiformis						1 1 1 1
Kalanchoe crundallii						1 – 1 1
Species Group I						
Diospyros whyteana	1 1	1 2 1 2 1	1	2 3 1 2	4 2 2 2	2 2 2

1. *Acacio ataxacanthae–Rhoetum chirindensis* ass. nov., hoc loco.

Nomenclatural type: Relevé 182 (holotypus)

Alternative name: *Acacia ataxacantha–Rhus chirindensis* early regrowth forest (Geldenhuys & Murray 1993)

The *Acacio ataxacanthae–Rhoetum chirindensis* shows some floristic similarities with the *Acacio ataxacanthae–Celtidetum africanae* described by Matthews *et al.* (1992a). Their syntaxonomic relationships are currently not clear.

Environmental data

Early regrowth forest occurs mainly along the forest margin where disturbances have driven the vegetation back to early successional stages. These disturbances can either be historical, such as the removal of timber from the one mature forest patches, or may recent or regular, such as fire damage to the forest margin. Disturbance regimes are the main driving forces behind the establishment and maintenance of these early regrowth forest patches. Other environmental factors, such as geology and soil type, play only minor parts in the dynamic nature of the early regrowth forests. Due to the dynamic nature of this vegetation type, it is not geographically restricted or stagnant and will disappear as the forest is given the opportunity to recover to mature forest. The vegetation structure can be described as short to tall forest (Edwards 1983).

Diagnostic taxa

The diagnostic species for the *Acacio ataxacanthae–Rhoetum chirindensis* are presented in Species Group A (Table 9). They include the woody species *Acacia ataxacantha, Acacia sieberiana* and *Erythrina lysistemon*.

Dominant / prominent taxa

Acacia ataxacantha (Species Group A) and *Vepris lanceolata* (Species Group C) regenerate profusely in the early regrowth forests. Other prominent woody species include *Rhus chirindensis* (Species Group C), *Brachylaena discolor* (Species Group C), and *Cussonia spicata* (Species Group H). Where light manages to penetrate to the forest floor through forest canopy openings, the grass species *Oplismenus hirtellus* occurs. These patches are dependent on disturbance events, such as a fallen canopy tree, and are only of a temporary nature within this vegetation type.

2. *Rapaneo melanophloei–Rhoetum chirindensis* ass. nov., hoc loco.

Nomenclatural type: Relevé 199 (holotypus)

Alternative name: *Rapanea melanophloes–Rhus chirindensis* advanced regrowth forest (Geldenhuys & Murray 1993)

Environmental data

Advanced regrowth forest generally occurs away from the forest margin, and is located between early regrowth forest and mature forest. Just as with the early regrowth forests, the advanced regrowth forests are dynamic in their structure and species composition. Again, disturbance regimes are the main driving forces behind its establishment, with other environmental factors of less importance regarding its dynamic nature. The vegetation structure can be described as high forest (Edwards 1983).

Diagnostic taxa

The diagnostic species for the *Rapaneo melanophloei–Rhoetum chirindensis* are presented in Species Group B (Table 9). According to the plots sampled, this association only contains a single diagnostic woody species *Rapanea melanophloes*. *Rapanea melanophloes* regenerate abundantly in advanced regrowth forests, but is relatively absent from the early regrowth forests. The *Rapaneo melanophloei–Rhoetum chirindensis* is characterised more redily by the absence of those species presented in Species Groups A, C, D, E, F and H. Since this plant community occupies the transitional state of succession between pioneer stages and mature forest, it shares species with both the *Acacio ataxacanthae–Rhoetum chirindensis* (early regrowth forest) and the *Ocoteo kenyensis–Xymaloetum monosporae* (mature forest). Tree species shared with the early regrowth forest include *Brachylaena discolour, Vepris lanceolata, Halleria lucida, Curtisia dentata*, *Pittosporum viridiflorum* and *Rhus chirindensis*. However, individuals of these trees are much larger within the advanced regrowth forests, and fewer individuals of a specific species contribute to the estimated cover value. *Zanthoxylum davyi* (Species Group H) is more or less restricted to the advanced regrowth forest and mature forest.

Dominant / prominent taxa

These communities have higher species richness then those of the more mature forest communities. This is typical for areas of intermediate disturbance regimes or for early successional stages where competition for the available resources and niches are still fierce, with no domination by any single species yet. Prominent or dominant tree species within the advanced regrowth forests include *Rhus chirindensis* (Species Group C), *Brachylaena discolor* (Species Group C), *Vepris lanceolata* (Species Group C), *Maesa lanceolata* (Species Group C), *Halleria lucida* (Species Group C), *Maesa lanceolata* (Species Group D), *Nuxia floribunda* (Species Group H), *Cussonia spicata* (Species Group H) and *Zanthoxylum davyi* (Species Group H). Again, those trees shared with the early regrowth forest are much larger within the advanced regrowth forests, and fewer individuals of a specific species contribute to the estimated cover value.

3. *Ocoteo kenyensis–Xymaloetum monosporae* ass. nov., hoc loco.

Nomenclatural type: Relevé 113 (holotypus)

Alternative name: *Ocotea kenyensis–Xymalos monospora* mature forest

Environmental data

Dominant soil forms include the Glenrosa, Mispah and Shortlands Soil Forms (McVicar *et al.* 1991) of Landtype Fa derived from basalt, tuff, sandstone, and conglomerate of the Sibasa Geological Formation (Von dem Bussche 1984; Botha 2004a; Patterson & Ross 2004a). However, A-horizon is often a complex mixture of quartzitic sand washed in from the higher lying Wyllies Poort Formation and clay from the local Sibasa Formation, as well as high quantities of organic matter from the forest vegetation. These nutrient rich soils, with their high organic matter content and high plant available moisture content, are very productive. Unfortunately, these favourable conditions have been exploited by commercial forestry, which converted large areas of indigenous high forest to exotic plantations of Pine and Eucalyptus trees. The remaining patches of natural forest can be described as high forest (Edwards 1983).

Diagnostic taxa

Diagnostic tree species of the *Ocoteo kenyensis–Xymaloetum monosporae* (mature forest) are presented in Species Group C, D, E and F (Table 9), and include *Xymalos monospora, Rhoicissus tomentosa, Chionanthus foveolatus* (Species Group C)*, Drypetes gerrardii, Olea capens* subsp. *macrocarpa* (Species Group D)*, Trichilia emetica, Rothmannia capensis, Oxyanthus speciosus* subsp. *gerardii, Calodendrum capense* (Species Group E)*, Ocotea kenyensis, Podocarpus falcatus* and *Podocarpus latifolius* (Species Group F).

Dominant / prominent taxa

Prominent tree species of the mature forest include *Xymalos monospora, Rhoicissus tomentosa* (Species Group C)*, Drypetes gerrardii, Olea capens* subsp. *macrocarpa* (Species Group D)*, Rothmannia capensis, Oxyanthus speciosus* subsp. *gerardii* (Species Group E)*, Ocotea kenyensis, Podocarpus falcatus, Podocarpus latifolius* (Species Group F) and *Celtis africana* (Species Group G).

Some localised patches of mature forest contained *Rhus chirendensis* as a common species. However, the individuals in the mature forest are considerably larger then those in the regrowth forests. This indicates an advanced stage of recovery after a disturbance (Geldenhuys & Murray 1993). These plots may therefore have been placed in non-homogeneous vegetation units.

Three variations within the *Ocoteo kenyensis–Xymaloetum monosporae* (mature forest) were identified based on the classification (Table 9). These include 3.1 *Olea capens* subsp. *macrocarpa* dominated stands, 3.2 *Rothmannia capensis* dominated stands and 3.3 *Ocotea kenyensis* dominated stands. However, the environmental variables recorded for these three variations showed no obvious differences. These variations could therefore not be interpreted ecologically. This may indicate that the variation in floristics noted is due to different successional stages of the vegetation, or that the environmental data gathered did not reflect the true driving factors of the vegetation. More fieldwork may shed some light on this issue.

The *Ocoteo kenyensis–Xymaloetum monosporae* shares very limited floristic links with the *Celtis africana–Erythrina lysistemon* kloof forest described by Westfall

(1981, 1985) of the Waterberg Mountain Range and the *Clauseno–Podocarpus latiflii* of the *Podocarpetalia latifolii* described by Du Preez *et al.* (1991) for the eastern Free State. The *Podocarpus latifolius–Rothmannia capensis* Tall Forest (Van Staden 2002; Van Staden & Bredenkamp 2006) resembles the *Rothmannia capensis* dominated stands of the *Ocoteo kenyensis–Xymaloetum monosporae*. The *Olea europaea–Calpurnea aurea* Tall Closed Woodland (Van Staden 2002; Van Staden & Bredenkamp 2006) share a few species with the *Olea capens* subsp. *macrocarpa* dominated stands.

4. *Diospyro whyteanae–Widdringtonietum nodiflorae* ass. nov., hoc loco.

Nomenclatural type: Relevé 68 (holotypus)

Alternative name: *Diospyros whyteana–Widdringtonia nudiflora* quartzite cliff forest

Very few studies of cliff vegetation have been done in southern Africa. Because they are so difficult to reach and so little is known about their associated species, vegetation scientists often choose to ignore them. The cliff forests of South Africa are no exceptions. The *Diospyro whyteanae–Widdringtonietum nodiflorae* is therefore a first attempt to describe a cliff forest community formally and syntaxonomically.

Environmental data

The *Diospyro whyteanae–Widdringtonietum nodiflorae* is situated against the steep south facing cliffs and narrow ledges of the southern most ridges of the Soutpansberg. These high lying sandstone and quartzite scarps form part of the Wyllies Poort Geological Formation (Botha 2004a; Patterson & Ross 2004a). As warm moisture laden air rises from the southern plains, it cools down, drenching the cliffs in thick mist and fine orographic rain on a frequent basis during the summer months. These moist conditions are conducive to the growth of many bryophytes and lichens. Over thousands of years, these wet sponges have trapped enough dust particles to form skeletal soils along the narrow ledges and cracks of the cliffs. It is these skeletal soils that maintain the cliff forest recorded in this study. Some of the soil pockets contain thick layers of highly weathered organic material, which aid in the absorption and retention of atmospheric moisture. Throughout most of the rainy season these sponge-like soils are saturated with moisture, slowly releasing water through gravity. It is plain to see how sensitive and vulnerable the soils of this system are to potential disturbances. The vegetation structure can be described as short forest (Edwards 1983).

Diagnostic taxa

The diagnostic specie of the *Diospyro whyteanae–Widdringtonietum nodiflorae* are presented in Species Group I (Table 9). They include the woody species *Widdringtoni nodiflora, Myrsine africana, Rhoicissus revoilii* and *Clutia pulchella* var. *pulchella*.

Diagnostic herbaceous species include the fern species *Rumoha adiantiformis* and the succulent herbaceous species *Kalanchoe crundallii*.

Dominant / prominent taxa

This association is entirely dominated by the tree species *Widdringtoni nodiflora* (Species Group I). Other dominant woody species include *Myrsine africana* (Species Group I), *Rhoicissus revoilii* (Species Group I) and *Diospyros whyteana* (Species Group J).

The most dominant fern species is *Rumoha adiantiformis* (Species Group I), while *Kalanchoe crundallii* (Species Group I) could be considered the most prominent herbaceous species.

The *Widdringtonia nodiflora–Podocarpus latifolius* Short Forest of the Marakele National Park (Van Staden 2002; Van Staden & Bredenkamp 2006) share some species with the *Diospyro whyteanae–Widdringtonietum nodiflorae*. However, this community of Marakele is much richer in species, containing a species complex are abscent from the *Diospyro whyteanae–Widdringtonietum nodiflorae* of the SC. While the *Widdringtonia nodiflora–Podocarpus latifolius* Short Forest is associated with deep moist kloofs and ravines, the *Diospyro whyteanae–Widdringtonietum nodiflorae* is associated with exposed steep cliffs. Both these communities are however, seasonally drenched in moisture. The differences in species composition and ecosystem functioning between these two communities suggest that they differ enough to be concidered seperate associations. The *Diospyro whyteanae–Widdringtonietum nodiflorae* shares some very limited floristic affinities with the

Trachypogon spicatus–Eragrostis racemosa grassland described by Westfall (1981, 1985) for the Waterberg Mountain Range.

Ordination

The forests of the SC can firstly be categorised as sheltered high forests and exposed cliff forests. These two types are structurally and floristically very different. Both the classification and ordination done on the vegetation dataset showed this to be the case. For this reason, vegetation data from the relatively sheltered high forest were subsequently ordened separately. This created some distance between the relevés in the scatter plot, enhancing the ability to detect and identify groupings.

The scatter diagram (Figure 13) displays the distribution of relevés along the first and second ordination axes. The vegetation units are represented as groups and their distribution on the scatter diagram corresponds with certain physical environmental conditions. The first axis (eigen value = 0.859), orientated along the x-axis, represents the degree of succession in which a particular vegetation sample plot was at the time of recording. This was taken as an indication of the frequency and / or degree of disturbance the vegetation has been submitted to in the relatively recent past (>100 years). Those associations along the left of the diagram represent forest vegetation that is still in the early stages of succession after some disturbance events in the past. These associations include the *Acacio ataxacanthae–Rhoetum chirindensis* early regrowth forest and the *Rapaneo melanophloei–Rhoetum chirindensis* advanced regrowth forest. The relevés further to the right in the scatter plot represent vegetation sample plots associated with forest patches that are in late successional stages, which have reached a climax state. These relevés represent the *Ocoteo kenyensis–Xymaloetum monosporae* mature forest. Due to a number of reasons, these forest patches have escaped the disturbances of high intensity timber mining, or sufficient time have passed for their recovery after the last major disturbance event.

The second axis (eigen value = 0.565), orientated along the y-axis, does not reflect the succession gradient seen along the x-axis. None of the recorded environmental variables could be linked to the distribution gradient displayed by the relevés along y-axis.

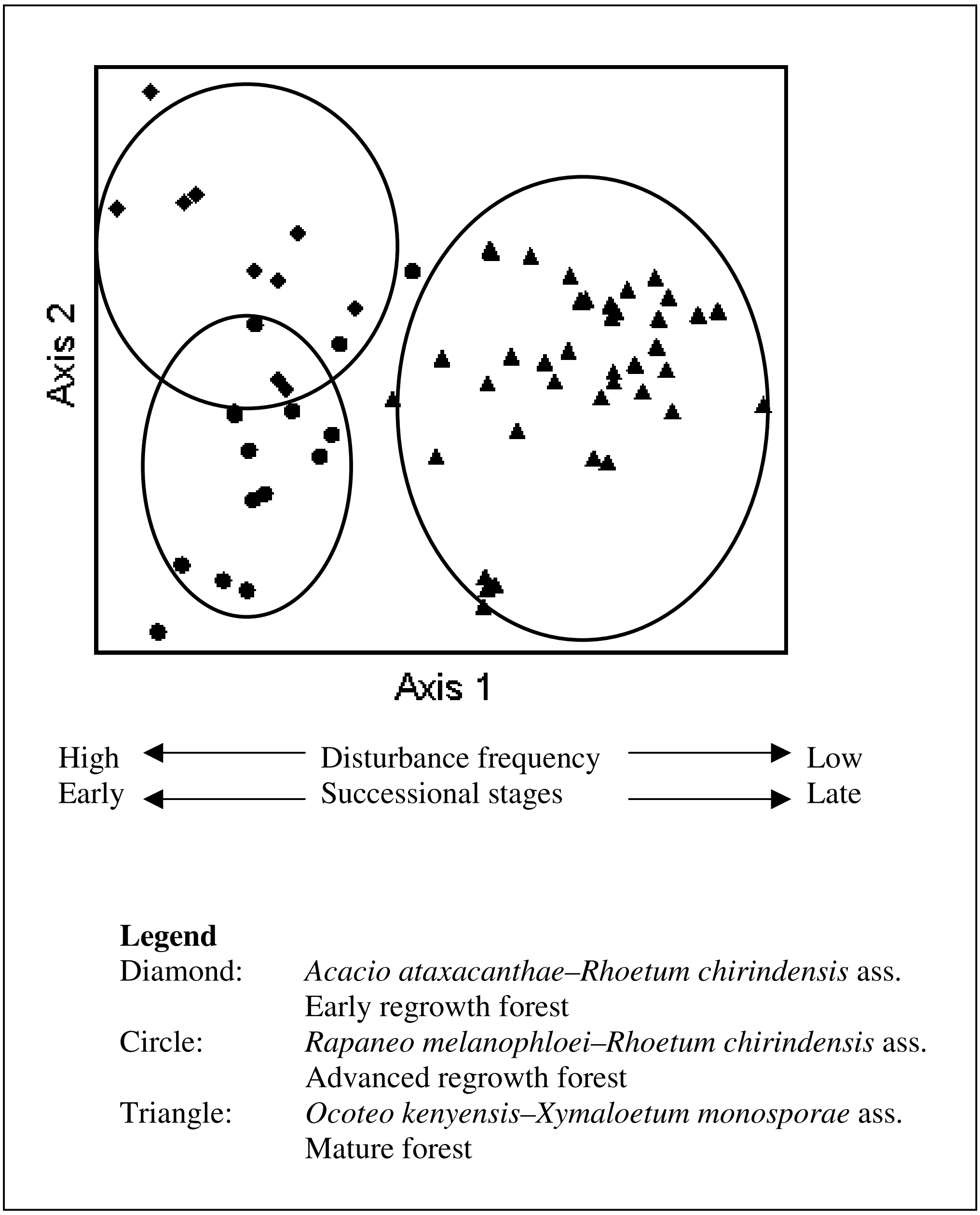

Figure 13. Relative positions of all the relevés along the first and second ordination axes of the of the *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type

SYNTAXONOMIC SUMMARY

To assist in giving a clear concise account of the syntaxa identified within the eight Major Vegetation Types of the Soutpansberg Conservancy and the Blouberg Nature Reserve, the following summary is presented (communities of the BNR were not formally named):

4. *Eragrostis lehmanniana* var. *lehmanniana–Sclerocarya birrea* subsp. *caffra* BNR Northern Plains Bushveld Major Vegetation Type
   4.1 *Spirostachys africana–Sclerocarya birrea* subsp. *caffra* community
   4.2 *Solanum panduriforme–Sclerocarya birrea* subsp. *caffra* community
   4.3 *Terminalia prunioides–Sclerocarya birrea* subsp. *caffra* community

5. *Euclea divinorum–Acacia tortilis* BNR Southern Plains Bushveld Major Vegetation Type
   5.1 *Acacia nilotica–Acacia tortilis* community
   5.2 *Combretum apiculatum–Acacia tortilis* community
   5.3 *Rhus leptodictya–Acacia tortilis* community

6. *Englerophytum magalismontanum–Combretum molle* BNR Mountain Bushveld Major Vegetation Type
   6.1 *Pseudolachnostylis maprouneifolia–Combretum molle* community
   6.2 *Hyperacanthus amoenus–Combretum molle* community

7. *Adansonia digitata–Acacia nigrescens* Soutpansberg Arid Northern Bushveld Major Vegetation Type
   7.1 *Commiphoro tenuipetiolatae–Adansonietum digitatae*
   7.2 *Ledebourio ovatifoliae–Commiphoretum mollii*
   7.3 *Phyllantho reticulati–Acacietum nigrescentis*
   7.4 *Tinneo rhodesianae–Combretetum apiculati*
   7.5 *Dichrostachyo cinereae–Spirostachyetum africani*
   7.6 *Themedo triandrae–Pterocarpetum rotundifolii*
   7.7 *Cypero albostriati–Syzygietum cordatum*

7.8 *Sesamothamno lugardii–Catophractetum alexandri*

8. *Catha edulis–Flueggia virosa* Soutpansberg Moist Mountain Thickets Major Vegetation Type
   - 8.1 *Euphorbio ingentis–Cathetum edulis*
   - 8.2 *Bridelio micranthae–Carissetum edulis*
   - 8.3 *Cussonio natalensis–Acacietum karroo*
   - 8.4 *Olea europaeoe–Buddlejetum salviifoliae*

9. *Diplorhynchus condylocarpon–Burkea africana* Soutpansberg Leached Sandveld Major Vegetation Type
   - 9.1 *Myrothamno flabellifolii–Hexalobetum monopetali*
   - 9.2 *Burkeo africanae–Pseudolachnostylietum maprouneifoliae*
   - 9.3 *Terminalio sericea–Burkeetum africanae*
   - 9.4 *Androstachyetum*

10. *Rhus rigida* var. *rigida–Rhus magalismontanum* subsp. *coddii* Soutpansberg Cool Mistbelt Major Vegetation Type
    - 10.1 *Viteco rehmannii–Syzygietum legatti*
    - 10.2 *Heteropyxo natalensis–Combretetum mollis*
    - 10.3 *Proteo caffrae–Setarietum sphacelatae*
    - 10.4 *Cypero albostriati–Pennisetetum glaucocladii*

11. *Xymalos monospora–Rhus chirendensis* Soutpansberg Forest Major Vegetation Type
    - 11.1 *Acacio ataxacanthae–Rhoetum chirindensis*
    - 11.2 *Rapaneo melanophloei–Rhoetum chirindensis*
    - 11.3 *Ocoteo kenyensis–Xymaloetum monosporae*
    - 11.4 *Diospyro whyteanae–Widdringtonietum nodiflorae*

CONCLUSION

The results also revealed a high diversity of unique and distinct plant communities within this relatively small geographical area. The observed diversity in vegetation patterns is the result of the region's high spatial variation (topography, geology, pedology, extreme localised climate patterns) as well as the region's high temporal variability (irregular climatic cycles, periodic stochastic events) (Gibson *et al.* 2004). In addition to the environmental factors influencing the observed vegetation and floristic patterns, certain regions of the study area have been altered through intense anthropogenic activities over prolonged periods of time (Moleele & Mainah 2003). The stochasticity with which humans have impacted on this environment has led to even higher levels of spatial and temporal variation in habitat heterogeneity. Numerous stone tools and artefacts indicate that humans have occupied the region on a periodic basis since the Early Stone Age (Coles & Higgs 1975). More recent times have seen cultures and civilisations such as the Khoisan (Eloff 1979), the people of Mapungubwe (Huffman 1996), the Vhenda people (Nemudzivhadi 1985), and European settlers utilizing the region for hunting, livestock farming and the cultivation of crops (Voigt & Plug 1984).

The major vegetation patterns seen among the plant communities of the SC and BNR are primarily related to the availability of soil–moisture and the rate of environmental desiccation. Within the region, the underlying geology and soils, as well as temperature along altitude gradients seem to play only secondary roles in the vegetation structure and species composition of these ecosystems. Soil moisture availability for plants within the study area is governed mainly by four environmental factors: 1) the amount of precipitation of atmospheric moisture, 2) the rate of water loss through evaporation 3) the soil's ability to capture and keep moisture within reachable depth of the plant roots, 4) as well as the available soil water capacity (Kramer 1969; Scott & Le Maitre 1998). White (1995) defines the available soil water capacity as the amount of water in a soil that is available for plant growth. The upper limit is set by the soil's field capacity (water-saturated soil), while the lower limit is set by the volumetric water content value at which plants lose turgor and wilt, referred to as the permanent wilting point.

The study area, especially the SC, can be divided into areas of predictable and regular precipitation, and areas of highly unpredictable and localised rainfall events. The southern slopes of the Soutpansberg receive regular seasonal orographic rain and mist. This predictability and relative abundance of water has led to ecosystems of relative stability that are close to equilibrium (Tainton & Hardy 1999). Classical succession models can be used to describe the ecology of these systems (Ellis & Swift 1988). However, these southern slopes of the Soutpansberg represent only a small fraction of the total surface area of the SC and BNR.

Rainfall within most of the study area, especially the semi-arid and arid components, is spatially and temporally highly irregular. The amount of precipitation and atmospheric moisture, or the apparent lack thereof, seems to overshadow all of the other factors regulating plant available moisture. The area is also prone to prolonged and severe droughts. This unpredictability of rainfall has therefore led to event-driven ecosystems that are non-equilibrial in its nature, constantly occurring in a state of transition in reaction to the most recent event (Westoby 1979; De Angelis & Waterhouse 1987; Westoby *et al.* 1989; Mentis *et al.* 1989; Laycock 1991; Behnke & Scoones 1993; Dodd 1994; Bredenkamp & Brown *in prep.*). Events, as well as the reaction of the vegetation on these events, are unpredictable. The dynamics of these ecosystems are not dependent on biotic factors, such as the density of grazing animals, but rather on abiotic factors, often events of drought (Noy-Meir 1975; Wiens 1984). The low rainfall governs the establishment and maintenance of vegetation. The field layer practically disappears during dry periods, leaving the soil surface bare and exposed to severe desiccation (Bredenkamp & Brown *in prep.*). However, in the event of rainfall, the herbaceous layer responds very quickly. The soil texture and clay content have secondary and localised influences on the vegetation through water infiltration, water retention, the degree of nutrient leaching and the duration of moisture availability to the plants (White 1995). Biomass production is generally low and fire plays a minor role within these systems, especially the sweet-veld areas where grazing pressures are higher and biomass accumulation is low. The dynamics of these semi-arid and arid ecosystems are totally dependant on rainfall and the intensities and duration of drought periods, and are therefore considered to be event-driven, non-equilibrium systems.

Conservation and Management recommendations

The Soutpansberg Concervancy and the Blouberg Nature Reserve are surrounded by many poverty stricken informal settlements of rural Venda. These people rely on the savanna, forest and wetland plant communities to supply grazing, firewood, timber, thatching material and agricultural produce. Approximately 58% of the province's land area is used for grazing, and 22% used for agriculture (Hoffman & Ashwell 2000). The Limpopo Province contributes considerably to the formal economy through its ecotourism, livestock, mining, timber and export fruit and vegetable industries (Adams *et al.* 2000). Sadly though, this culturally, historically and naturally rich and diverse province of South Africa is a poverty stricken region (Shackleton & Shackleton 2000). The province's rural communities are often in a struggle for survival against the frequent and severe droughts. This has led to a culture where "if it does not pay, it does not stay" (Goudie 2000). In addition, the ever–expanding population of South Africa is making increasing demands on the natural resources of the Limpopo region, especially refugees from the northern and eastern southern African countries. This will inevitably lead to the expansion of agriculture and industry into agriculturally marginal and ecologically sensitive areas. In order for the government to plan development, management and conservation sensibly, we need sound ecological knowledge of the area. Without this baseline information and insight on the region's driving ecological processes and patterns, the much–needed development of the Limpopo Province's infrastructure and the utilization of its natural resources will be unsustainable, with only limited short–term benefits for a few selected individuals.

With regard to the ecotourism industry, the vegetation of the SC and BNR can be divided into mainly two land-use types. The first is the broad-leaved sour veld of the higher lying mountainous regions. This include vegetation along steep slopes, rugged rocky terrain, leached sandy soils along high lying terraces, mistbelt forests, short grasslands along the high lying crests and summits, and high altitude wetlands. These plant communities encompass most of the SC (>80%), and approximately a third of the BNR. Due to the low palatability and nutritional value of this vegetation, commercial game ranching for tourism and hunting should be avoided within these mountainous areas. The vegetation of these sour-veld communities is generally sensitive to intense herbivory and trampling. The associated soils are prone to erosion. Where bulk grazers, such as zebra, wildebeest, eland and white rhinoceros, have been introduced to the high altitude grasslands, destruction of the natural vegetation and soil erosion followed within very short periods of time, leading to severe habitat degradation. The once floristically rich grasslands with its numerous Fynbos floristic elements have been reduced to species poor and badly trampled anthropogenic systems. The ability to produce palatable fodder for grazers and browsers has been degraded to such an extent that current game populations have to be fed year-round in order to survive. Meanwhile the trampling and over utilisation continues to inflict irreversible damage to these unique systems.

However, what these landscapes lack in large mammal carrying capacity, they make up for in spectacular scenery and ecosystem diversity. Tourism aimed at scenic landscapes, floristic and ecosystem diversity and solitude are highly recommended. Hiking trails, birding and botanical tours have huge potential as ecotourism possibilities.

The second land-use type is the semi-arid and arid sweet bushveld. These plant communities are restricted to the relatively flat plains below the foot-slopes of the SC and BNR. Most of these communities showed a relatively high potential for the production of palatable grazing and browsing fodder. Commercial game ranching for tourism and hunting should be restricted to this vegetation type.

However, care will have to be taken when calculating appropriate herbivore stocking rates (Pulina *et al.* 2004). These are event-driven systems, frequently affected by severe droughts. Long-term average rainfall figures should be used with extreme caution (Liversidge & Berry 2002). The accurate estimation of grazing and browsing capacities will depend on factors such as the previous season's rainfall, together with the resulting fodder production and consumption thereof, as well as projections for the expected rainfall for the coming growing season. These factors should merely be used as guidelines to estimate conservative stocking rates, and should not be used in set recipes for the absolute calculation of stocking rates. The plant communities of the Soutpansberg-Blouberg area are not very forgiving towards over ambitious game and livestock farmers (Moleele & Mainah 2003). The penalties for overstocking are severe and are usually paid with the starvation of the animals involved. The key to successful wildlife and livestock farming within these event-driven ecosystems is adaptive management (Liversidge & Berry 2002; Moleele & Mainah 2003).

The need for a holistic focus on vegetation classification

It is important to identify and to understand the primary ecological processes driving different ecosystems in order to conserve and manage southern Africa's last remaining pockets of wilderness effectively (Wessels *et al.* 2003). Without a deeper understanding of ecosystem functioning, all of our conservation efforts will simply revert to futile attempts to preserve single species or to freeze-frame southern Africa's dynamic and ever-changing event-driven ecosystems.

In southern African savannas a number of phytosociological studies have focussed on the relationships between plant communities within the various proposed savanna vegetation classes (Winterbach 1998; Du Plessis 2001). However, little has been done to describe the ecological and floristic relationships between the syntaxonomic classes of the savannas (Winterbach *et al.* 2000). With the lack of experience in formal syntaxonomy in South Africa, it often happened that floristically similar relevés were assigned to different syntaxonomical classes because they were classified in isolation of one another as localised studies.

Du Plessis (2001) found this to be the case during a synopsis of the southern African Mopaneveld. This is why earlier phytosociologists, e.g. Werger (1974) warned against compiling a formal syntaxonomy too early, before adequate data over larger areas were available. Detailed local classifications could lead to a proliferation and duplication of community types under different names (Coetzee 1983), creating false and overcomplicated images of the vegetation patterns. Mueller-Dombois & Ellenberg (1974) consider it useful to maintain an unsystematic status for abstract communities in all cases where the emphasis is on intensive local vegetation studies. They add that a hierarchical scheme becomes very desirable where the emphasis lies on developing a vegetation synopsis at a more extensive geographical scale. This useful approach was re-emphasized by Coetzee (1983) and could reserve the rank of association for its original practical purpose in southern Africa (Barkman 1988).

The solution for this problem is to classify all the existing relevés within a given biome as an integrated unit. Unfortunately, the classification of such large datasets is fraught with its own set of complicated problems that tend to discourage vegetation scientists from doing so (Du Plessis 2001). The two-step vegetation classification method proposed by Van Der Maarel *et al*. (1987) and the three-step method proposed by Bredenkamp & Bezuidenhout (1995), as well as the advent of powerful numerical data processing computer software (Westhoff 1979; Schamineé & Stortelder 1996; Tichý 2002, 2005) have enabled phytosociologists to classify such large datasets.

Phytosociology should aim at holistic classification (Schamineé & Stortelder 1996; Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001). While it is extremely useful for conservation and management to describe the lower ranking syntaxa at local spatial scale, it is often difficult to explain ecosystem functioning holistically within geographically small areas in the savannas of southern Africa. When emphasis is placed on complete integration of vegetation knowledge of the southern African savanna biome, complexity is dispersed, resulting in a simplified view of the same ecosystem (Du Plessis 2000).

In the light of these arguments for holistic vegetation studies, a schematic diagram is presented to depict the complex interrelationships between the numerous proposed zonal vegetation classes of the savannas associated with the central bushveld and Lowveld areas of South Africa (Figure 14). This is merely a simple two-dimensional representation of a very complex multi-dimensional distribution and overlap of vegetation in virtual space.

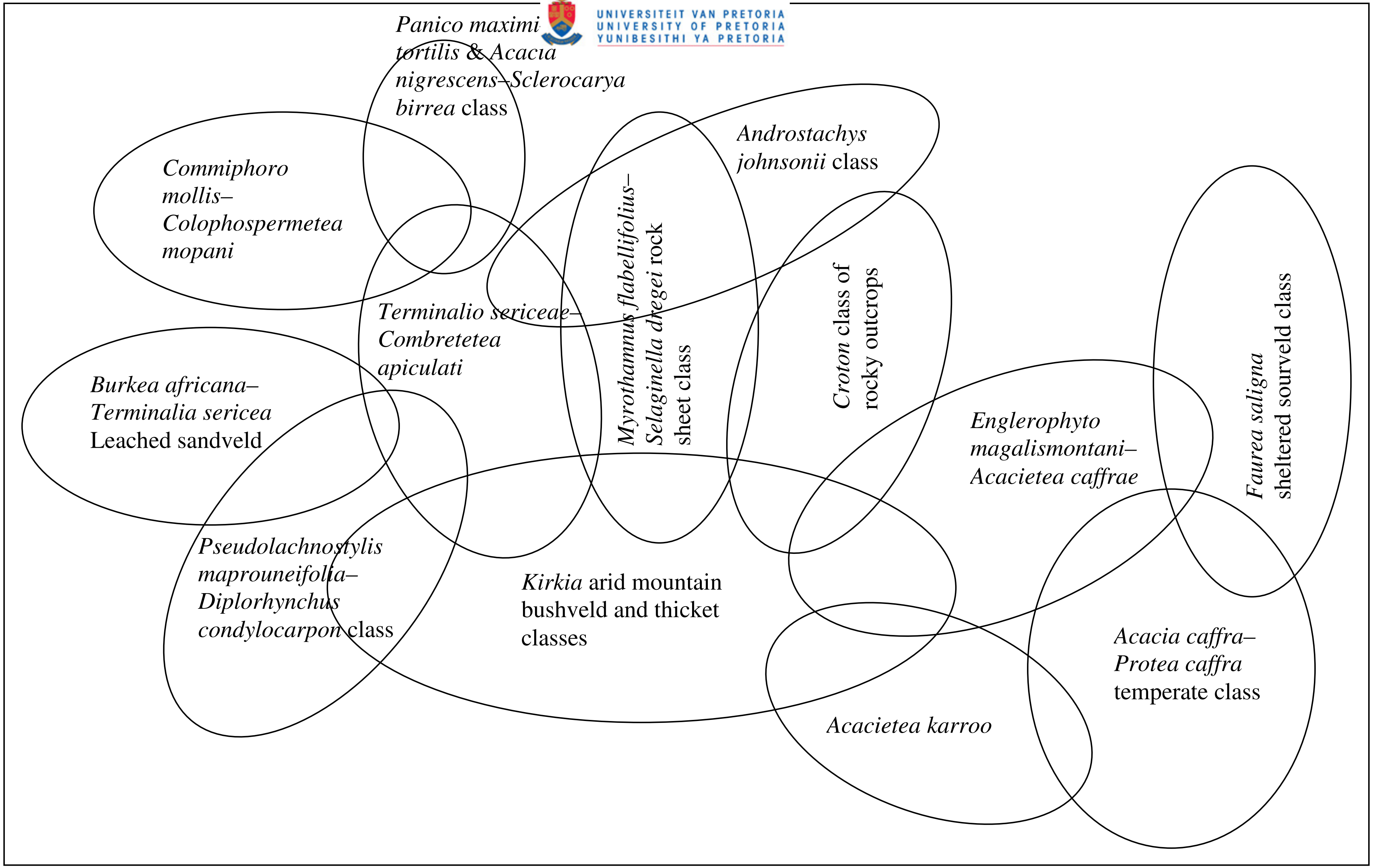

Figure 14. A schematic representation of the interconnected floristic relationships between some of the proposed zonal vegetation classes of the savannas associated with the central, northern and Lowveld bushveld areas of South Africa.

It is suggested that the following classes could exist in the central, northern and arid Lowveld bushveld of southern Africa. Though some of these classes were previously suggested by different authors, some are suggested here for the first time. These suggested classes have, however, not yet been described formally. A total of 14 vegetation classes are presented, which include:

1. *Panico maximi–Acacietea tortilis* (Winterbach *et al.* 2000)
2. *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld (suggested)
3. *Commiphoro mollis–Colophospermetea mopani* (Winterbach *et al.* 2000; Siebert *et al*. 2003b)
4. *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)
5. *Burkea africana–Terminalia sericea* leached sandveld class (suggested)
6. *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class (suggested)
7. *Kirkia* arid mountain bushveld and thicket classes (suggested)
8. *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*)
9. *Androstachys johnsonii* class (suggested)
10. *Croton* class of rocky outcrops (Mostert *et al*. *in prep*)
11. *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000)
12. *Acacietea karroo* (Du Preez & Bredenkamp 1991)
13. *Acacia caffra–Protea caffra* class of temperate areas (suggested)
14. *Faurea saligna* class of sheltered sourveld areas (suggested)

1. *Panico maximi–Acacietea tortilis* (Winterbach *et al.* 2000)

The *Panico maximi–Acacietea tortilis* of the Transvaal Plateau Basin (Winterbach 1998; Winterbach *et al.* 2000) is associated with dark coloured heavy clayey soils. This class shares floristic links with the *Commiphoro mollis–Colophospermetea mopani* of arid and semi-arid regions (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003b), the *Terminalio sericeae–Combretetea apiculati* (Winterbach 1998; Winterbach *et al.* 2000), and the *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld. It usually occurs as extensive homogeneous vegetation units, such as those described from the central bushveld.

2. *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld (suggested)

The *Acacia nigrescens–Sclerocarya birrea* class of the semi-arid and sub-tropical Lowveld and northern bushveld areas is associated with eutrophic soils, ranging from heavy clayey soils to nutrient rich un-leached sands of arid areas. These classes share floristic links with the *Commiphoro mollis–Colophospermetea mopani* of arid and semi-arid regions (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al*. 2003b), the *Terminalio sericeae–Combretetea apiculati* (Winterbach 1998; Winterbach *et al.* 2000), and the *Panico maximi–Acacietea tortilis* of the central bushveld (Winterbach *et al.* 2000). They may either occur as extensive homogeneous vegetation units, such as those described from the basaltic plains of the Lowveld and the arid sandy plains of the northern bushveld, or may occur as a mosaic of patches occupying the clayey bottomlands of the undulating granitic landscape of the Lowveld.

3. *Commiphoro mollis–Colophospermetea mopani* (Winterbach *et al.* 2000; Siebert *et al*. 2003b)

The *Commiphoro mollis–Colophospermetea mopani* (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al*. 2003b) is restricted to the semi-arid and arid frost-free regions of southern Africa, covering extensive tracts of land. Due to its homogeneous nature, this class and its communities are generally easy to delineate geographically.

4. *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000)

Winterbach (1998) and Winterbach *et al.* (2000) proposed a *Terminalio sericeae–Combretetea apiculati* from the central and north-western South African savannas. However, this class has proven to be extremely complex, with communities from the rugged basaltic Lowveld, the undulating granitic Lowveld and the morphologically and geologically complex arid mountain bushveld areas. Although communities are often easily described, their syntaxonomic positions are unclear. Numerous species are shared with the *Commiphoro mollis–Colophospermetea mopani* of arid and semi-arid regions (Winterbach 1998; Winterbach *et al.* 2000; Du Plessis 2001; Siebert *et al.* 2003b), the *Acacia nigrescens–Sclerocarya birrea* class of the arid northern and Lowveld bushveld, the *Panico maximi–Acacietea tortilis* of the central bushveld

(Winterbach 1998; Winterbach *et al.* 2000), and the *Kirkia* arid mountain bushveld and thicket classes of various low lying mountainous regions. This vegetation class generally occurs as mosaic patches, occupying the gravely uplands of the undulating landscape of the Lowveld, or as relatively small units along suitable habitat within topographically complex mountainous areas. Species composition and vegetation structure are constantly changing along the ever-changing topography of the landscape, making the geographic delineation of these small pockets of vegetation impractical at regional scale.

5. *Burkea africana–Terminalia sericea* leached sandveld class (suggested)

Communities of the *Burkea africana–Terminalia sericea* leached sandveld class have been described by a number of authors (Coetzee 1976; Van Der Meulen 1979; Winterbach 1998; Henning 2002; Van Staden 2002). It is associated with deep nutrient poor leached sandy soils and shares strong floristic links with the *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class. Some limited floristic overlap occurs with the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000) where soils become shallower and coarser. The leached sandveld class communities generally form relatively large homogeneous vegetation units that can be delineated geographically at regional scale.

6. *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class (suggested)

Communities of the *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class have been described by a number of authors (Coetzee 1976; Van Der Meulen 1979; Winterbach 1998; Henning 2002; Van Staden 2002). It is associated with shallow coarse nutrient poor leached sandy soils and shares numerous floristic links with the suggested *Burkea africana–Terminalia sericea* leached sandveld class, the *Terminalio sericeae–Combretetea apiculati* and the suggested *Kirkia* arid mountain bushveld and thicket classes. Its association with the topographically diverse mountainous landscapes cause communities to occupy relatively small areas as mosaics with other classes, making the regional delineation of this class difficult.

7. *Kirkia* arid mountain bushveld and thicket classes (suggested)

The *Kirkia* arid mountain bushveld and thicket classes are highly diverse, occupying the geomorphically diverse landscapes associated with mountains. The syntaxonomic statuses and positions of the various potential classes are poorly understood and are in need of much research. Numerous floristic links are shared with the suggested *Pseudolachnostylis maprouneifolia–Diplorhynchus condylocarpon* class, *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000), *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*), *Croton* class of rocky outcrops (Mostert *et al. in prep*), *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) and the *Acacietea karroo* (Du Preez & Bredenkamp 1991).

8. *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep.*)

The proposed *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep.*) are associated with the vegetation of highly exposed rock sheets. This vegetation relies on skeletal soil within the cracks, fissures and depressions of the rock sheets. Plant species are often dwarfed and highly specialised due to the harsh growing conditions. Many endemic species are associated with the more isolated rocky environments of the southern African savannas (Siebert *et al.* 2003c). This vegetation class share floristic links with the suggested *Kirkia* arid mountain bushveld and thicket classes, *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000), the suggested *Androstachys johnsonii* class and the *Croton* class of rocky outcrops (Mostert *et al. in prep.*).

9. *Androstachys johnsonii* class (suggested)

Coetzee (1983) and Van Rooyen *et al.* (1981) described some communities of the *Androstachys johnsonii* class associated with rocky environments. However, little is known about the phytosociology of the *Androstachys* woodlands associated with the sandy plains of Mozambique. More research is needed for a more comprehensive picture of this class. Existing vegetation descriptions indicate floristic links with the *Terminalio sericeae–Combretetea apiculati* (Winterbach *et al.* 2000), *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*), and the *Croton* class of rocky outcrops (Mostert *et al. in prep*).

10. *Croton* class of rocky outcrops (Mostert *et al. in prep*)

The proposed *Croton* class of rocky outcrops (Mostert *et al. in prep.*) is associated with the relatively sheltered environments among the boulders and large rocks of rocky outcrops and rugged geological shear zones. Its distribution is widespread, ranging from the sheltered gorges and escarpment of the Highveld, to the granitic outcrops of the Lowveld. This vegetation class share floristic links with the *Myrothamnus flabellifolius–Selaginella dregei* rock sheet class (Mostert *et al. in prep*), the suggested *Androstachys johnsonii* class, the *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) and the suggested *Kirkia* arid mountain bushveld and thicket classes.

11. *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000)

The *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) is restricted to the more temperate and cooler high lying slopes of mountainous areas. The terrain is generally rugged and topographically diverse with a wide variety of micro-habitats. It shares floristic links with the *Croton* class of rocky outcrops (Mostert *et al. in prep*), the suggested *Faurea saligna* class of sheltered sourveld areas, the suggested *Acacia caffra–Protea caffra* temperate class, *Acacietea karroo* (Du Preez & Bredenkamp 1991) and the suggested *Kirkia* arid mountain bushveld and thicket classes. Its association with the topographically diverse mountainous landscapes cause communities to occupy relatively small areas as mosaics with other classes, making the regional delineation of this class difficult.

12. *Acacietea karroo* (Du Preez & Bredenkamp 1991)

The *Acacietea karroo* of temperate areas have been described by Du Preez & Bredenkamp (1991) primarily as an azonal component of the grassland biome of South Africa. However, Acocks (1953) also described communities associated with this class along the floodplains of numerous prominent rivers of the Highveld and central plateau bushveld. It is a complex vegetation class with uncertain syntaxonomic status, sharing floristic links with the suggested *Kirkia* arid mountain bushveld and thicket classes, the suggested *Acacia caffra–Protea caffra* class of temperate areas and *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000).

13. *Acacia caffra–Protea caffra* class of temperate areas (suggested)

The *Acacia caffra–Protea caffra* class of temperate areas is associated with the transitional zone between the primary grasslands and the savanna biome of southern Africa. Du Preez & Bredenkamp (1991) described some components of this proposed class. Acocks (1953) described this vegetation as Bankenveld, while Bredenkamp & Van Rooyen (1996) described it as Rocky Highveld Grassland. Despite the relatively cool and frost prone landscapes, the rocky nature of these areas create suitable habitat for the establishment of a sparse woody layer within a sour grassveld. This class shares floristic links with other temperate savanna classes such as the *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000), *Acacietea karroo* (Du Preez & Bredenkamp 1991) and the suggested *Faurea saligna* sheltered sourveld class.

14. *Faurea saligna* class of sheltered sourveld areas (suggested)

The proposed *Faurea saligna* class of sheltered sourveld areas is associated with cool kloof areas of relatively high rainfall that are relatively frost-free conditions. Soils are relatively well developed along these moderately steep grassy slopes. It shares floristic links with the *Englerophyto magalismontani–Acacietea caffrae* (Winterbach *et al.* 2000) and the suggested *Acacia caffra–Protea caffra* temperate savanna class. Its association with moderate to steep slopes cause communities to occupy relatively small areas as mosaic patches with communities from other classes, making the regional delineation of this class difficult.

During a visit to the Nylsvlei Nature Reserve in the Limpopo Province, the late Professor Victor Westhoff, pioneer in conservation and vegetation science, was asked to define the concept of a syntaxon, with particular reference to the association within the very complex southern African savannas. His reply was simple yet eloquent: “Associations (or syntaxa) are useful stepping stones in the swamp of (vegetative) variation” (Bredenkamp, G.J. *pers. com.*).

Until we have a reasonably complete dataset, representing all the major variations within the southern African savannas, we will have to accept those syntaxonomically “grey” areas where relevés may belong to two or more vegetation classes at the same time. In the meanwhile, vegetation scientists should keep on describing and classifying those “useful stepping stones”, avoiding the premature description and classification of formal syntaxa based on those relevés representing the “swamp of variation”.

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Acknowledgements

Thanks are due to the following institutions and persons for their valuable contributions in the preparation of this thesis:

- Prof. George Bredenkamp for guidance and mentorship;
- Liesl Mostert for her encouragement and assistance with the vegetation classification;
- Norbert Hahn for providing invaluable knowledge on the floristics of the study area and his guidance during the fieldwork phase;
- Prof. Braam van Wyk for assistance with species identification;
- The South African Weather Bureau and the Institute for Soil, Water and Climate for supplying rainfall and temperature data for the study area;
- All the landowners within the SC and management of the BNR for access to the study area;
- Goro Lodge, Lajuma Mountain Retreat, Medike Mountain Reserve, and the Soutpansberg Herbarium for accommodation during fieldwork;
- The National Research Foundation for funding this project.