

# Plant communities of the forests, woodlands and thickets in northern KwaZulu-Natal

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An analysis of the woody vegetation of northern KwaZulu-Natal is presented. Relevés were compiled in 102 stratified random sample plots. A TWINSPLAN classification, refined by Braun-Blanquet procedures, revealed 24 plant communities, also referred to as vegetation units. For each of these vegetation units, the species richness was determined. Four associations were identified which have a conservation importance. An ordination (DECORANA), based on floristic data, revealed the position of the syntaxa on environmental gradients.

Key words: classification, community, conservation, new syntaxa, species richness, vegetation unit.

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## Introduction

Although several studies have been conducted on various forest and woodland types of South Africa (Bews 1917; Killick 1963; Edwards 1967; Moll 1968; Acocks 1953, 1975, 1988) there are still areas which remain to be classified and described in more detail. The mountainous areas of the Paulpietersburg-Vryheid-Louwsburg region display relics of indigenous forests, woodlands and/or thickets which still need to be described. These isolated vegetation patches are usually restricted to specific topographical positions. It is believed that large areas, which are presently grassland, were originally covered by forests and woodlands, but due to the increased use of fire, these forests and woodlands have been reduced in size and restricted to areas that are more protected against fires (Moll 1968; White 1983; Acocks 1988). However, this notion is refuted nowadays, with strong archaeological evidence suggesting that the grasslands must have been the long-standing component (Meadows & Linder 1989). This is also manifested in the higher levels of endemism in grassland species. Edwards (1967) distin-

guished various woody vegetation types in the Tugela River Basin, which includes a portion of the western part of this study area. The forests and woodlands are classified by Edwards (1967) under 'Uplands Vegetation'. Acocks (1988) used the label 'Inland Tropical Forest Types', and 'Temperate and Transitional Forest and Scrub Types' for the relevant forests and woodlands found in the area. The woody vegetation which will be described here will subsequently include forests and woodlands described by Edwards (1967).

This paper forms part of an investigation on the vegetation of northern KwaZulu-Natal. It is envisaged that descriptions, formal classifications, and a syntaxonomy of the various vegetation units will result from this investigation. The vegetation units will be described as newly derived syntaxa which will make an important contribution to the knowledge on the vegetation of KwaZulu-Natal. The alpha diversity was also determined for each vegetation unit, which assisted the identification of potential conservation areas. Eventually, a synthesis in the form of a synoptic table, will be presented as a summa-

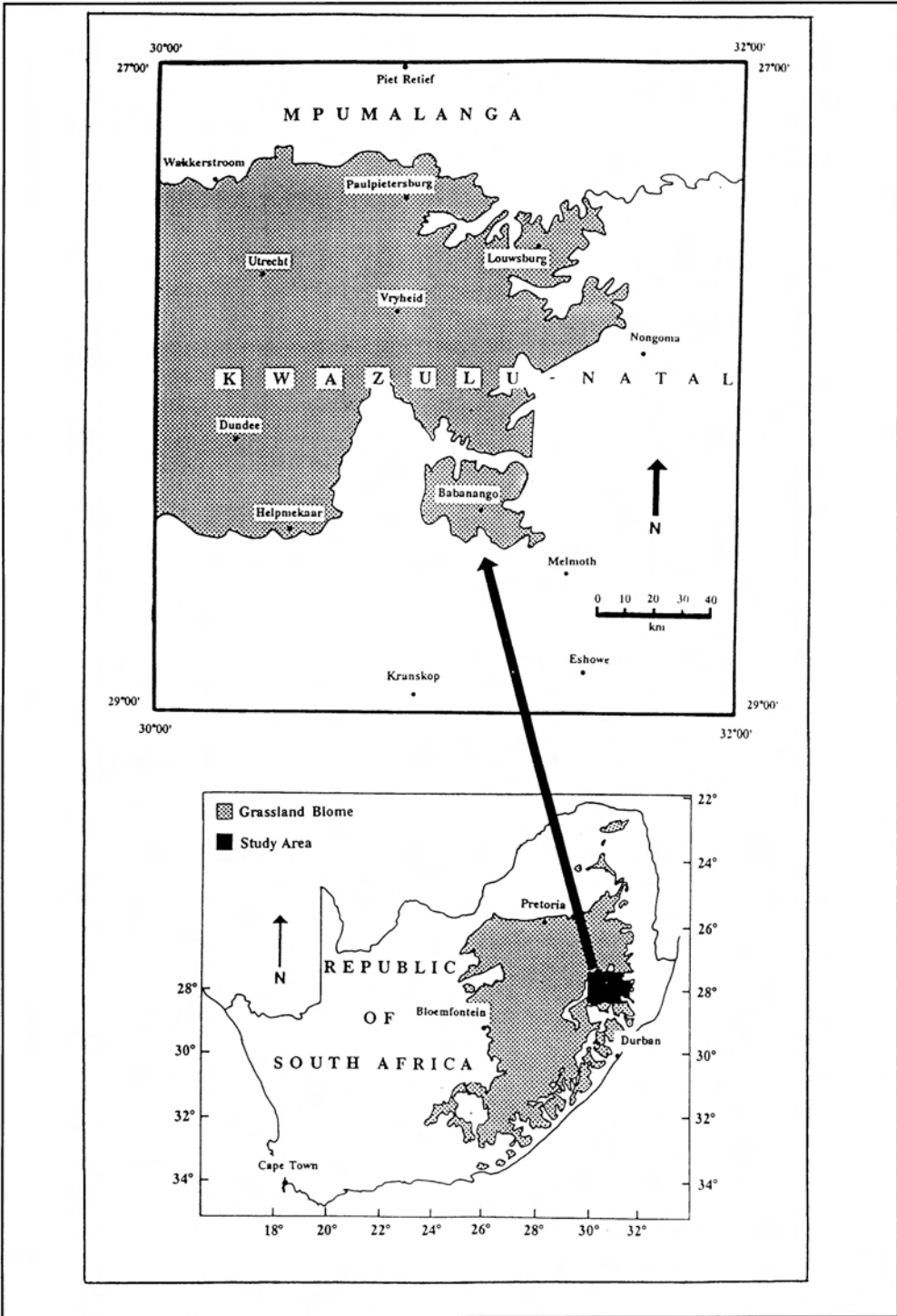


Fig. 1. Map indicating the location of the study area within the Grassland Biome.

ry of the major vegetation types found in the entire northern KwaZulu-Natal.

Finally, the results of this study are to be incorporated into a comprehensive synecological and syntaxonomical synthesis of the Grassland Biome of South Africa (see also Bredenkamp *et al.* 1989; Bezuidenhout & Bredenkamp 1990; Kooij 1990; Du Preez 1991; Matthews 1991; Smit 1992; Eckhardt 1993; Fuls 1993).

## Study area

The study area is situated in central-northern KwaZulu-Natal (Land Type Survey Staff 1986, 1988) between latitude 27°16'S–28°31'S and longitude 30°00'E–31°38'E (Fig. 1). The area covers 14 366 km<sup>2</sup> and comprises a variety of physiographic regions (Turner 1967). The predominant characteristic regions are basins, plains, plateaux and slopes. The difference in altitude between the two most extreme locations is approximately 1 500 m. The study area lies in the summer rainfall region, with the annual precipitation averaging about 850 mm. The rainfall pattern is strongly influenced by the topography of the area, varying from 700 mm in the low-lying river basins to 1 200 mm per annum in the highlands (Schulze 1982). The average annual temperature varies from 13 °C to 19 °C at different localities within the area, also correlating strongly with the physiographic regions, being higher for lower-lying river basins and plains, and lower for high-lying plateaux and mountains. Minimum temperatures of below freezing point are usually reached in the high-lying areas. The geology roughly consists of the Pongola and Karoo Sequences, the latter comprising more than three quarters of the total area (SACS 1980; Linström 1987). Sandstone and shale of the Vryheid Formation, as well as scattered occurrences of post-Karoo dolerite, constitute a large part of the geology.

## Methods

The data on the forests, woodlands and thickets have been derived from 102 stratified random sample plots. Stratification was based on terrain units and aspect. Plot sizes were fixed at 200 m<sup>2</sup> (Bredenkamp 1982) in contrast to the 100 m<sup>2</sup> for grassveld (Scheepers 1975). Within each sample plot, all species were recorded and a cover-abundance value assigned to each according to the Braun-Blanquet scale (Mueller-Dombois & Ellenberg 1974). Taxon names conform to those of Arnold & De Wet (1993).

Although not strictly adhered to, the structural classification system of Edwards (1983) has been used as a criterion for an approximation of the structure of the woody vegetation. Environmental data recorded in a sample plot include terrain unit, aspect, slope, geology, soil type and depth, soil texture, rockiness of the soil surface and degree of erosion.

The first approximation of a vegetation classification, based on the total floristic data set was obtained by the application of the default Two-Way Indicator Species Analysis (TWINSPAN) (Hill 1979b). This first step of a classification procedure identified six different vegetation types. This output was then used to subdivide the data set into six phytosociological tables, each one of which was again subjected to TWINSPAN. The resultant classifications were then further refined by using Braun-Blanquet procedures (Westhoff & Van der Maarel 1978; Behr & Bredenkamp 1988; Bredenkamp & Bezuidenhout 1994). One of the phytosociological tables (Table 1) produced by this classification technique, represents the woody vegetation, described in this paper. The other tables represent grassland and wetland communities which will be dealt with separately.

The ordination algorithm DECORANA (Hill 1979a) (Fig. 3) was applied to determine gradients in vegetation and possibly the relationship between these plant communities and the physical environment.

In order to facilitate the identification of potential conservation areas, the alpha diversity of the different plant communities was determined. The alpha diversity (species richness) is defined as the number of species per unit area within a homogeneous community or the total number of species per community (Whittaker 1977). The 100 m<sup>2</sup> sample plots were taken as the unit area within a homogeneous community.

## Results and discussion

The woody vegetation can be classified into forests, woodlands and thickets (Edwards 1983). Two orders were clearly distinguished, namely the *Leucosideetalia sericeae* (Order 1) and the *Acacietalia karroo* (Order 2). The former order is generally restricted to steep slopes (>20°–90°) at higher altitudes, which are characterised by moister conditions and lower temperatures. The forests of the North-eastern Mountain Sourveld, Highland Sourveld and Dohne Sourveld (Acocks 1953, 1975, 1988) fall under this order (Order 1). Although not strongly present throughout the order,

*Leucosidea sericea* is considered the diagnostic species because of its restriction to and best characterisation of this order (Table 1). Grasses are virtually absent and are replaced by a well-developed forb-layer. The *Acacietaalia karroo* is restricted to lower-lying areas, which are characterised by hotter and drier conditions, and more clayey soils. The diagnostic species for this order is *Acacia karroo*. The grass stratum is well represented by prominent species such as *Eragrostis curvula*, *Hyparrhenia hirta*, *Cymbopogon excavatus*, *Themeda triandra* and *Heteropogon contortus* (Table 1). This order most probably belongs to the *Acacia karroo* Class, described by Du Preez & Bredenkamp (1991).

It is very interesting to find that the average number of species per sample plot for both orders is very similar (29.1:30.7) (Fig. 2, horizontal lines represent the respective averages for the two orders). However, the total number of species for the *Acacietaalia karroo* (79.1) strongly exceeds that of the *Leucosideetalia sericeae* (59) (Fig. 2).

## Classification

The analysis resulted in the following hierarchical classification of the *Leucosideetalia sericeae* and the *Acacietaalia karroo*:

### 1. *Leucosideetalia sericeae*

- 1.1 *Stachyo kuntzei-Leucosidion sericeae*
  - 1.1.1 *Helichryso hypoleucum-Leucosideetum sericeae*
    - 1.1.1.1 *Helichryso hypoleucum-Leucosideetum sericeae solanetosum retroflexum* (vegetation unit 1)
    - 1.1.1.2 *Helichryso hypoleucum-Leucosideetum sericeae stachyetosum kuntzei* (vegetation unit 2)
  - 1.1.2 *Rhamno prinoidis-Podocarpodetum latifolii* (vegetation unit 3)
- 1.2 *Trimerio grandifoliae-Greyion sutherlandii*
  - 1.2.1 *Buddlejo salviifoliae-Podocarpodetum latifolii* (vegetation unit 4)

- 1.2.2 *Plectrantho grallati-Dalbergietum obovatae* (vegetation unit 5)
- 1.2.3 *Plectrantho grallati-Canthietum mundianum* (vegetation unit 6)
- 1.2.4 *Combreto kraussiana-Greyietum sutherlandii* (vegetation unit 7)
- 1.2.5 *Plectrantho fruticosi-Trimerietum grandifoliae* (vegetation unit 8)
- 1.2.6 *Rapano melanophloe-Greyietum sutherlandii* (vegetation unit 9)
- 1.2.7 *Clauseno anisatae-Greyietum sutherlandii* (vegetation unit 10)
- 1.3 *Maeso lanceolatae-Euclion crispae*
  - 1.3.1 *Hyparrhenio dregeanae-Dombeyetum rotundifoliae* (vegetation unit 11)
  - 1.3.2 *Hyparrhenio cymbariae-Diospyretum lycioidis* (vegetation unit 12)

### 2. *Acacietaalia karroo*

- 2.1 *Eragrostio curvulae-Acacion caffrae*
  - 2.1.1 *Panico maximum-Clerodendretum glabrum* (vegetation unit 13)
  - 2.1.2 *Aloo maculatae-Rhoetum pentherii* (vegetation unit 14)
  - 2.1.3 *Stipo dregeanae-Rhoetum pyroidis* (vegetation unit 15)
  - 2.1.4 *Rhoo pentherii-Acacietyum caffrae* (vegetation unit 16)
- 2.2 *Trachypogo spicati-Diospyrion lycioidis*
  - 2.2.1 *Trichoneuro grandiglumis-Canthietum mundianum* (vegetation unit 17)
  - 2.2.2 *Conyzo bonariensis-Cymbopogonetum validi* (vegetation unit 18)
  - 2.2.3 *Cymbopogono validi-Acacietyum karroo* (vegetation unit 19)
- 2.3 *Brachiario eruciformis-Acacietyum karroo*
  - 2.3.1 *Brachiario eruciformis-Acacietyum karroo themedetosum triandrae* (vegetation unit 20)
  - 2.3.2 *Brachiario eruciformis-Acacietyum karroo bothriochloetosum insculptae* (vegetation unit 21)

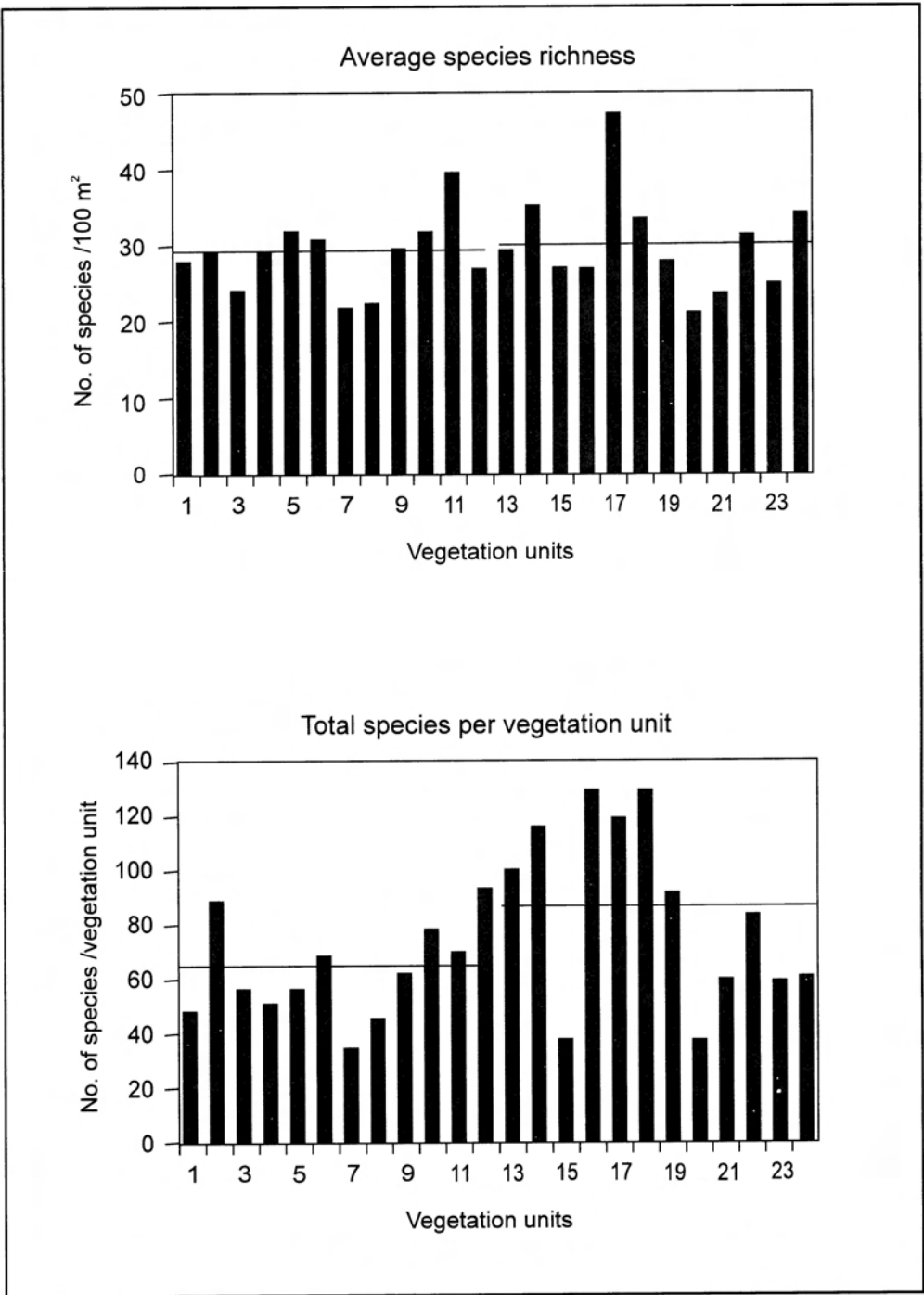


Fig. 2. Average species richness and total number of species of each vegetation unit. Horizontal lines represent the averages for the two respective orders: *Leucosideetalia sericeae* and *Acacietalia karroo*.

- 2.4 *Sporobolo pyramidalis-Acacietaum sieberianae* (vegetation unit 22)
- 2.5 *Eragrostis plana-Acacia karroo* Thicket (vegetation unit 23)
- 2.6 *Setaria sphacelata-Acacia karroo* Thicket (vegetation unit 24)

## Description of the plant communities

### 1. *Leucosideetalia sericeae* order nov.

Nomenclatural type: *Stachyo kuntzei-Leucosidion sericeae* (holotypus)

This order represents forests, woodlands and thickets of high altitudes, usually restricted to protected ravines and steep (20°-90°) mainly south-facing slopes. Cool, moist, high rainfall conditions prevail, with mist clouds often enfolding the mountains. These isolated patches of woody vegetation, surrounded by grassland, are considered by some ecologists as relics of woody vegetation which has originally covered larger areas (Edwards 1967; see also Moll 1968). However, as mentioned earlier on, this notion has been refuted now (Meadows & Linder 1989). This order is related to the *Podocarpetalia latifolii* described by Du Preez *et al.* (1991), but only a syntaxonomical synthesis will confirm this. Generally shallow (<200 mm) soils of the Glenrosa-Mispah complex, often covered by a humus layer, are typical of these slopes. These soils display a relatively low clay content of 15-20 %.

Tropical forest types within the study area are confined to the mountains between Nongoma and Vryheid and to the Louwsburg area, at altitudes between 1 000-1 500 m, receiving an annual rainfall of 900-1 950 mm. These forests are a component of North-eastern Mountain Sourveld (Acocks 1953, 1975, 1988). Temperate and transitional forest and woodland types found in the study area are outliers of similar physiognomic units which extend from the Upper Plateau of the Drakensberg between Mont-Aux-Sources and Volksrust down to the east-

ern slopes and foothills (Acocks 1953, 1975, 1988). Altitude varies from 1 500-2 200 m, and heavy frosts occur during the winter months. Mean annual rainfall varies between 750 mm and 1 500 mm.

Although absent from the tropical forest and woodland types, *Leucosidea sericea* is considered a character species for this order for reasons mentioned earlier on (species group M, Table 1). Both *Leucosidea sericea* and *Buddleja salviifolia* are important precursors to Upland Forests (Edwards 1967). These species will tolerate very frequent fires and in the absence of burning, conditions become favourable for initial forest species, gradually replacing the heliophytic species. Principal initial (early successional) (Edwards 1967) forest species are *Podocarpus latifolius*, *Dalbergia obovata*, *Combretum kraussii*, *Cryptocarya woodii*, *Allophylus africanus*, *Xymalos monospora*, *Heteropyxis natalensis*, *Rapanea melanophloeos*, *Scolopia oreophila*, *Trimeria grandifolia* and *Apodytes dimidiata*. Species of wider occurrence are listed under species group AE (Table 1).

#### 1.1 *Stachyo kuntzei-Leucosidion sericeae* all. nov.

Nomenclatural type: *Helichryso hypoleucum-Leucosideetum sericeae* (holotypus)

This alliance represents a transition from precursor forest or woodland to initial forest types and would be classified as seral woody forest communities according to Moll (1968). It occurs on relatively moderate to steep slopes (20°-45°) with a predominant southerly aspect. The clay content of the soils varies from 15-20 %. Larger rocks are scattered on the slopes, covering from 2-20 % of the surface.

Species group C contains diagnostic species, which are dominated by the forb *Stachys kuntzei* (Table 1). The graminoid *Poa annua* (species group T, Table 1) is very prominent and often forms a dense ground cover. The absence of heliophytic species (species groups AA and AO) is very evident.

1.1.1 *Helichryso hypoleucum-Leucosideetum sericeae* ass. nov.

Nomenclatural type: relevé 165 (holotypus)

Although it is not clear to what extent geology influences the vegetation, it is interesting to note that this short closed woodland (Edwards 1983) association occurs only on sandstone, shale and mudstone of the Estcourt Formation.

Diagnostic species are represented by species group A (Table 1).

Two sub-associations are recognised under this association:

1.1.1.1 *Helichryso hypoleucum-Leucosideetum sericeae solanetosum retroflexum* sub-ass. nov.

Nomenclatural type: relevé 122 (holotypus)

This sub-association occurs on relatively deep (200-500 mm) soils of the Glenrosa Form.

It is characterised by the diagnostic species group B (Table 1).

The average number of species encountered per sample plot is 28.3, with the total number of species for this sub-association being 44 (Fig. 2).

1.1.1.2 *Helichryso hypoleucum-Leucosideetum sericeae stachyetosum kuntzei* sub-ass. nov.

Nomenclatural type: relevé 165 (holotypus)

The soils of this sub-association are of the Glenrosa-Mispah complex and between 200 and 300 mm deep.

There are no diagnostic species which characterise this sub-association. It is distinguished from the former sub-association by the presence of species groups L, S, AB and AI, and by the absence of species group B (Table 1). Prominent species are *Stachys*

*kuntzei*, *Rhamnus prinoides*, *Leucosidea sericea*, *Poa annua* and *Euclea crispata*.

Although a total of 82 species was encountered, the average species richness is only 29.7 (Fig. 2), indicating a high degree of variation in the species composition of this sub-association.

1.1.2 *Rhamno prinoidis-Podocarpodetum latifolii* ass. nov.

Nomenclatural type: relevé 237 (holotypus)

According to Moll (1968), this association would be included under climax forest. *Podocarpus latifolius* is the character species (species group D, Table 1), which clearly distinguishes this association from the *Helichryso hypoleucum-Leucosideetum sericeae*. These two associations are, however, related to each other by species group C (Table 1). This association represents an initial tall forest type, with *Leucosidea sericea* being gradually replaced or forced to forest margins by typical forest species as succession progresses. Frequent fires can reverse the succession process, thereby enhancing the establishment of *Leucosidea sericea* and the disappearance of subclimax or climax forest species. Prominent species are *Stachys kuntzei*, *Podocarpus latifolius*, *Rhamnus prinoides*, *Leucosidea sericea* and *Buddleja salviifolia* (Table 1). The forb species *Watsonia latifolia* was found in relevé 226 and is classified as rare by Hall *et al.* (1980).

A total of 52 species was found, with the average number per sample plot being as low as 24.2 (Fig. 2).

1.2 *Trimerio grandifoliae-Greyion sutherlandii* all. nov.

Nomenclatural type: *Rapano melanophloeii-Greyietum sutherlandii* (holotypus)

This alliance represents the typical initial forest and true forest types (Edwards 1967) encountered in the whole of the study area. This includes tropical and temperate forests

Table 1

Synoptic table of the forests, woodlands and thickets of northern KwaZulu-Natal, South Africa

Order	1	1	1	2	1
Alliance	1.1	1.2	1.3	2.1	2.2
Association	11.1.1	11.1	11.1	11.1	11.1
Subassociation	11.1	11.1	11.1	11.1	11.1
Community	11.1	11.1	11.1	11.1	11.1
Species group A					
<i>Helichrysum hypoleucum</i>	15	14	1	1	13
<i>Cheilanthes quadripinnata</i>	15	14	1	1	12
<i>Printzia pyrifolia</i>	14	14	1	1	12
<i>Taraxacum officinale</i>	14	13	1	1	1
<i>Sparrmannia ricinocarpa</i>	14	12	1	1	12
<i>Cliffortia nitidula</i>	12	13	1	1	12
<i>Helichrysum melanacme</i>	1	14	1	1	1
<i>Helichrysum splendidum</i>	12	12	1	1	1
Species group B					
<i>Solanum retroflexum</i>	15	1	12	1	1
<i>Phalaris arundinacea</i>	14	11	1	1	1
<i>Solanum aculeatissimum</i>	14	11	1	1	1
<i>Galinsoga parviflora</i>	14	1	1	1	1
<i>Dioscorea retusa</i>	14	1	1	1	12
Species group C					
<i>Stachys kuntzei</i>	15	15	14	14	1
<i>Dryopteris inaequalis</i>	15	13	13	1	12
<i>Clusia affinis</i>	14	15	12	1	1
<i>Rubia horrida</i>	15	15	11	1	1
<i>Myrsiphyllum asparagoides</i>	14	14	13	12	1
<i>Bromus catharticus</i>	15	13	12	1	1
<i>Schoenoxiphium rufum</i>	12	14	13	1	1
<i>Thalictrum rhynchocarpum</i>	14	1	13	1	12
Species group D					
<i>Podocarpus latifolius</i>	1	1	13	15	1
Species group E					
<i>Dalbergia obovata</i>	1	1	1	15	1
Species group F					
<i>Plectranthus grallatus</i>	1	1	1	15	15
Species group G					
<i>Combretum kraussii</i>	1	1	1	13	15
<i>Cryptocarya woodii</i>	1	1	1	12	1
<i>Hypoestes aristata</i>	1	1	1	13	1
Species group H					
<i>Plectranthus fruticosus</i>	1	1	1	1	15
<i>Allophylus africanus</i>	1	1	1	13	1
<i>Xymalos monospora</i>	1	1	1	1	14
<i>Heteropyxis natalensis</i>	1	1	1	1	12
<i>Dicliptera zeylanica</i>	1	1	1	13	1
Species group I					
<i>Usnea trichoides</i>	1	1	1	1	12
<i>Rapanea melanophloeos</i>	1	1	1	1	15



Table 1 (continued)

<i>Cephalanthus natalensis</i>	15     12
<i>Pterocelastrus echinatus</i>	14   12             12
<i>Scolopia oreophila</i>	14
Species group J	
<i>Trimeria grandifolia</i>	12   13   12   13   14   14   13         12
<i>Carissa bispinosa</i>	12   13   12   13   13   14   15
<i>Apodytes dimidiata</i>	13   13   13   13   14   12   13
Species group K	
<i>Asplenium aethiopicum</i>	14   13   13         12   15   14   12   15   12
<i>Dioscorea sylvatica</i>	14   13   15   12     12     13
<i>Senecio tamoides</i>	14   13   13     13   12     14   12           11   11
<i>Scadoxus puniceus</i>	14     11   14     12   13   12         12                 11
<i>Zantedeschia albomaculata</i>	14     11         13     12   12
Species group L	
<i>Rhamnus prinoides</i>	15   15   14   13   11       14   14   13   14     11             12
<i>Myrsine africana</i>	15   15   12   13   11         15   13   13
<i>Mohria caffrorum</i>	14   13   15     11   15       13   14     11   11         12
<i>Maytenus mossambicensis</i>	11   12           13   13       13     11         11   11
Species group M	
<i>Leucosidea sericea</i>	15   15   14   14   15   13     12   12   13   14       11
Species group N	
<i>Greya sutherlandii</i>	14   13   14   15   12   15   15   15   13   11   11           11   12
<i>Cheilanthes viridis</i>	12           13   12   13   12   12   13   13   13   12           12
<i>Cassinopsis ilicifolia</i>	13   11       13     13   13     11           11
Species group O	
<i>Maesa lanceolata</i>	13   11             14   13                 11
<i>Canthium ciliatum</i>	12         12   12   13   15
<i>Hyparrhenia cymbaria</i>	15         12           14                 11
<i>Halleria lucida</i>	12   12     12   13
Species group P	
<i>Panicum maximum</i>	13                 12   14       11   12
<i>Vepris lanceolata</i>	12
<i>Ficus abutilifolia</i>	12
<i>Hypoestes forskoolii</i>	12         11
<i>Isoglossa eckloniana</i>	12     12   11   13
Species group Q	
<i>Commelina africana</i>	11   11   12     11             12     14   13     11   11     11   14         12   15
<i>Aloe maculata</i>	11                     12     12   14     11             12
<i>Dombeya burgessiae</i>	13   12   11   15
Species group R	
<i>Rhus chirindensis</i>	11         12     14     12   12     11   12
<i>Stipa dregeana</i>	13   13         15
Species group S	
<i>Buddleja salviifolia</i>	12   13   14   15   13   13     14   15   13   14     11   13   13
<i>Clausena anisatha</i>	11   13   15     13   15   15     15   13     14   12   13   11
<i>Heteromorpha trifoliata</i>	14   12   14   15   15   13   12   14   15   13   12     11   11   13

Table 1 (continued)

Species group T																				
<i>Poa annua</i>	15	15	15	12	13	11	13	12	12	13	12	15								
<i>Achyranthes aspera</i>	14	12	14	15	13	11	15	12	12	15	12	13	14	15			11	11		
<i>Buddleja auriculata</i>	12	1	13	15	13	14	1	12	12	13	1	11	12	1						
<i>Protasparagus setaceus</i>	12	11	11	14	1	15	1	15	1	12	12	11	1			11	1			
<i>Celtis africana</i>	1		11	12	11	13	13	1	1	12	1				11	1				
Species group U																				
<i>Acacia caffra</i>				13	1					12	15	12	13	15	1					
<i>Rhus pentheri</i>				15	1					1	14	14	15	15	1	11	12	1		
<i>Scutia myrtina</i>			11				13	1		14	11	15	12	1						
<i>Grewia occidentalis</i>			12	11	1					12	13	15	13	11	11	14	12	1		
<i>Aloe marlothii</i>			14	1				12	1	12	1	13	11	1		12	1			
<i>Olea europaea</i>										12	11	12	1							
<i>Ipomoea ommaneyi</i>										12	12	11	11	11	1	1	1	1	13	1
Species group V																				
<i>Trichoneura grandiglumis</i>													14	1			13	1		
<i>Indigofera velutina</i>													13	11		12	1			
<i>Felicia mossamedensis</i>													13	1						
<i>Hypoxis iridifolia</i>													13	1						
<i>Ficus ingens</i>								12	1		13	11	1	12	1					
<i>Andropogon schirensis</i>											13	11	1							
<i>Barleria obtusa</i>											13	1	12	1						
<i>Pavetta edentula</i>					12	1					13	1								
<i>Hyparrhenia filipendula</i>											12	1								
<i>Erythrina latissima</i>											12	1								
<i>Hyperthelia dissoluta</i>											12	11	1							
<i>Erythrina lysistemon</i>											11	12	11							
Species group W																				
<i>Canthium mundianum</i>				15	14	15	12	14	13	12	12	13	11	14	1					
<i>Zanthoxylum capensis</i>				15	12	15	14	12	12	12	12	11	12	11						
Species group X																				
<i>Conyza obscura</i>		11	1						14	12	1	11	11	15	11	1	13	1		
Species group Y																				
<i>Cheilanthes</i> sp.				12	12	1	13	12	1		11	14	13	12	1	12	1			
<i>Hippobromus pauciflorus</i>			12	1					12	1	14	13	12	12	1					
<i>Trachypogon spicatus</i>									11	11	12	13	13	1						
<i>Pellaea calomelanos</i>			14	1					12	12	11	14	13	11	1					
<i>Helichrysum nudifolium</i>							12	1	11	11	13	13	1	12	13					
<i>Chamaecrista stricta</i>										13	13	11	1	13	12	1				
<i>Tapiphyllum parvifolium</i>				11	12	1				14	11	11	1							
<i>Brachiaria deflexa</i>							12	1	11	1	13	11	12	1						
<i>Aloe zebrina</i>										11	13	11	1	12	1					
<i>Tetraselago natalensis</i>										12	11	12	1							
Species group Z																				
<i>Athrixia phyllicoides</i>			12	11	1		13	12	13	12	12	13	14	1	12	1				
<i>Melinis nerviglumis</i>			12	11	1		13	12	11	11	11	12	13	13	1	1	13	1		
<i>Leonotis ocyimifolia</i>			14	1			12	11	11	15	11	12	11	11	1	12	1	13	1	1
Species group AA																				
<i>Cussonia spicata</i>			15	15	15	15	15	14	14	15	14	15	12	15	13	14	12	1		
<i>Clerodendrum glabrum</i>			14	13	11	15	12	13	13	15	12	12	15	11	13	1	1	1		

Table 1 (continued)

<i>Protasparagus virgatus</i>	2   13   14   13   13   12   12   1   1   12   1   13
<i>Cymbopogon validus</i>	1   1   1   13   14   14   12   11   11   13   15   15   1   1   1   1
<i>Aloe arborescens</i>	1   1   1   13   14   15   13   15   12   12   1   1   1   15   11   12   1   1   1   1
<i>Plectranthus madagascariensis</i>	1   1   11   1   11   13   12   13   12   1   11   1   1   12   13   1   1   1   1   1
<i>Dombeya rotundifolia</i>	1   1   1   1   12   1   1   14   12   1   1   11   11   1   12   1   1
Species group AB	
<i>Clematis oweniae</i>	1   13   12   12   13   14   14   12   13   12   12   13   12   15   12   11   11   13   1   1   1   1   1
<i>Dais cotinifolia</i>	1   13   14   14   15   11   12   12   13   13   12   11   13   11   13   13   1   1   1   1   1   1
Species group AC	
<i>Brachiaria eruciformis</i>	1   1   1   1   1   1   1   1   1   1   11   1   1   1   1   15   14   12   1
<i>Zinnia peruviana</i>	1   1   1   1   1   1   1   1   1   1   12   1   11   11   1   15   13   12   1
<i>Stachys natalensis</i>	1   1   1   1   1   1   1   1   1   1   1   1   11   1   1   12   13   1   13
<i>Urochloa panicoides</i>	1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   14   12   1   1   1
Species group AD	
<i>Diheteropogon amplectens</i>	1   11   1   1   1   1   1   1   12   1   11   11   13   14   13   11   12   1   13
Species group AE	
<i>Rhus pyroides</i>	15   15   13   14   15   15   14   15   15   12   13   11   15   11   12   11   13   1   1   1
<i>Diospyros whyteana</i>	1   13   13   12   13   15   14   15   13   13   12   12   11   1   15   11   11   14   1   1   1
Species group AF	
<i>Sporobolus pyramidalis</i>	1   1   1   1   1   1   1   1   12   1   1   1   1   1   1   12   15   1   1
<i>Acacia sieberiana</i>	1   1   1   1   1   1   12   1   1   1   1   1   1   11   11   1   15   13
<i>Hermannia depressa</i>	1   1   1   1   1   1   1   1   1   1   1   1   12   1   1   1   14   12   13
Species group AG	
<i>Bothriochloa insculpta</i>	1   1   1   1   1   1   1   1   1   1   1   1   11   11   1   14   13   1   1
Species group AH	
<i>Lippia javanica</i>	1   1   1   12   13   1   1   1   1   12   12   14   13   15   14   14   12   13   1   14   12   1
<i>Ziziphus mucronata</i>	1   1   1   1   1   1   1   1   1   12   12   14   13   15   14   11   12   11   14   14   13
<i>Sporobolus africanus</i>	1   1   1   1   1   1   1   1   1   13   12   13   11   13   13   12   12   1   13   15   12   13
<i>Hyparrhenia dregeana</i>	1   1   1   13   12   1   12   14   14   1   1   11   11   12   13   1   12   13
<i>Vangueria infausta</i>	1   1   1   1   1   1   1   1   1   12   12   12   11   11   12   1   11   1   13   1   1
Species group AI	
<i>Euclea crispa</i>	1   14   15   15   15   14   13   14   15   13   15   13   15   15   1   14   14   13   13   14   13   1   1
<i>Rhoicissus tridentata</i>	1   13   12   14   15   15   13   12   15   15   13   15   14   15   13   13   14   13   15   13   12   1   1
<i>Maytenus heterophylla</i>	1   12   13   14   1   1   1   12   15   12   12   12   15   14   15   12   12   14   15   14   1   1
Species group AJ	
<i>Eragrostis plana</i>	1   11   1   1   1   1   1   1   13   1   1   1   1   11   11   14   13   14   1
<i>Schkuhria pinnata</i>	1   1   1   1   1   1   1   1   1   1   12   11   11   11   1   13   14   14   1
<i>Cynodon dactylon</i>	1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   13   12   12   1
Species group AK	
<i>Melinis repens</i>	1   1   1   1   1   1   1   1   1   12   11   11   11   13   13   11   15   14   14   12   1
<i>Eragrostis pseudosclerantha</i>	1   1   1   1   1   1   1   1   1   1   1   1   1   11   13   11   13   13   12
Species group AL	
<i>Helichrysum rugulosum</i>	1   1   1   1   1   1   1   1   1   12   1   11   11   11   11   13   13   1   15   14   15
<i>Aristida congesta</i>	1   1   1   1   1   1   1   1   1   1   12   1   11   13   11   1   13   13   14   15
<i>Berkheya onopordifolia</i>	1   1   1   1   1   1   1   1   1   1   11   1   11   11   12   13   14   15

Table 1 (continued)

Species group AM																									
<i>Acacia karroo</i>											14	13	15	15	12	15	15	15	14	15	15				
<i>Bidens tilosa</i>		2			2							2	13	13	13	12	12	11	12	14	13	12	12		
<i>Setaria sphacelata</i>												2	11	13	13	1		11	15	13	12	1	15		
<i>Aristida bipartita</i>													11	1	14	11		12	13	1	14	1	1		
Species group AN																									
<i>Eragrostis curvula</i>		12									2	12	15	15	15	14	15	14	14	14	15	14	15	15	1
<i>Hyparrhenia hirta</i>					2						3	13	11	12	1	14	14	15	14	12	14	15	15	15	1
<i>Cymbopogon excavatus</i>				2								1	2	12	13	13	15	14	14	1	14	15	14	15	1
<i>Themeda triandra</i>		12									13	13	12	1	13	13	13	15	12	13	15	15	15	1	1
<i>Heteropogon contortus</i>		11										2	12	1	13	13	1	1	12	13	13	12	13	1	1
Species group AO																									
<i>Diospyros lycioides</i>		11	11	14	15	12	13	12	1	13	14	15	15	15	15	14	15	15	14	14	14	1	1	1	1
<i>Rhus dentata</i>		11	1	14	1	2	1				13	12	14	14	15	13	15	13	13	15	14	1	14	13	1

(Acocks 1988). Soils are of the Glenrosa-Mispah complex and generally <200 mm deep, with a clay content usually less than 15 %. Large surface rocks are often present, covering more than 20 % of the surface area. Slopes are steep to very steep (20°-90°) and facing mainly southward.

Diagnostic species are included in species group J (Table 1). Other prominent species include: *Greyia sutherlandii*, *Canthium mundianum*, *Cussonia spicata*, *Rhus pyroides* and *Euclea crispa*. Altogether seven forest associations are recognised under this alliance.

#### 1.2.1 *Buddlejo salviifoliae*-*Podocarpod-etum latifolii* ass. nov.

Nomenclatural type: relevé 299 (holotypus)

This association is a temperate initial, short forest type (Edwards 1967) and is sometimes exposed to fires. It is suspected that the mixed woody communities referred to by Moll (1968), are similar to this association but as he did not use Braun-Blanquet procedures, this could not be confirmed. This association occurs on shale and sandstone of the Volksrust Formation. Huge boulders

cover more than 20 % of the surface area of the slopes.

This association is characterised by *Podocarpus latifolius* (species group D, Table 1). Other prominent species are *Leucosidea sericea*, *Buddleja salviifolia*, *Clausena anisata* and *Heteromorpha trifoliata*.

The average number of species per sample plot is 29.5 (Fig. 2), which is nearly the average for the *Leucosideetalia sericeae*. The total number of species are 47 (Fig. 2), which is well below the average.

#### 1.2.2 *Plectrantho grillati*-*Dalbergietum obovatae* ass. nov.

Nomenclatural type: relevé 591 (holotypus)

This association occurs on relatively sandy soils (<15 % clay), derived from sandstones, shales and mudstones of the Vryheid Formation. Although the two sample plots, which represent this association, are situated on a north and a south-facing slope, the species compositions suggest a tropical element in both relevés. This unit is subsequently classified as a low to short tropical forest type (Edwards 1983; Acocks 1988).

Two character species are recognised (species group E & F, Table 1). Other sometimes prominent species include *Apodytes dimidiata*, *Rhamnus prinoides*, *Cassinopsis ilicifolia*, *Canthium mundianum*, *Dais cotinifolia*, *Rhus pyroides* and *Euclea crispa*.

This association has 32 species per sample plot (Fig. 2), which is well above the average (29.1). The total number of species is 52, which is below the average of 59 (Fig. 2).

### 1.2.3 *Plectrantho grallati-Canthietum mundianum* ass. nov.

Nomenclatural type: relevé 544 (holotypus)

This low to short forest type (Edwards 1983) occurs on very steep (30°-90°), northerly, easterly and west-facing slopes. Surface rocks cover more than 20 % of the soil surface. Drier conditions are prevalent due to direct and relatively long exposure to sunlight, creating more suitable conditions for the establishment of heliophytic grasses. Even east-facing slopes receive more radiation than southerly-facing slopes.

This association is characterised by the diagnostic species *Plectranthus grallatus* (species group F, Table 1), through which it is related to the *Plectrantho grallati-Dalbergietum obovatae*. Conspicuous and dominant species are *Greyia sutherlandii*, *Canthium mundianum*, *Rhus pyroides* and *Diospyros whyteana*. Also very prominent are the tall grass *Cymbopogon validus* and the succulent shrub *Aloe arborescens*.

A total of 64 species was recorded within this association, with an average of 31 species per sample plot (Fig. 2).

### 1.2.4 *Combretum kraussianae-Greyietum sutherlandii* ass. nov.

Nomenclatural type: relevé 469 (holotypus)

This association occurs on dolerite and mainly sandstone of the Vryheid Formation. The soils are very rocky (>20 %), have a low

clay content (<15 %) and are mainly of the Mispah Form. Much organic material has accumulated, transforming gradually to humus. The gradients of the slopes vary from 25°-45°, facing southerly.

This short forest type (Edwards 1983) has a strong tropical element and is characterised by species group G (Table 1). A clear feature of this association is the absence of *Leucosidea sericea*, *Rhus pyroides* and *Diospyros whyteana*. Because *Leucosidea sericea* is considered a precursor species which disappears under climax conditions, it can be assumed that this species was present in an earlier successional stage. Other prominent species are *Greyia sutherlandii*, *Apodytes dimidiata*, *Canthium mundianum* and *Cussonia spicata*.

Only 22 species per sample plot were recorded on average, the total for the whole vegetation unit being 31 (Fig. 2).

### 1.2.5 *Plectrantho fruticosi-Trimerietum grandifoliae* ass. nov.

Nomenclatural type: relevé 563 (holotypus)

This short to tall tropical forest type (Edwards 1983; Acocks 1988) falls within the North-eastern Mountain Sourveld (Acocks 1953, 1975, 1988), where extensive patches of it still occur. These patches are usually restricted to south-facing slopes with cool moist prevailing conditions. It is especially this association, as well as the *Plectrantho grallati-Dalbergietum obovatae*, which are seriously threatened by exotic plantations of mainly *Eucalyptus* spp. and wattles (*Acacia mearnsii*).

The diagnostic species occur within species group H (Table 1). Other prominent species include *Trimeria grandifolia*, *Apodytes dimidiata*, *Celtis africana* and sometimes *Rhamnus prinoides* and *Euclea crispa*. These forests also lack *Leucosidea sericea* and *Greyia sutherlandii*.

Only 42 species were recorded in this relatively species poor forest type, the average

number of species per sample plot being 22.7 (Fig. 2).

1.2.6 *Rapano melanophloei-Greyietum sutherlandii* ass. nov.

Nomenclatural type: relevé 600 (holotypus)

This low to short forest type (Edwards 1983), also characterised by a strong tropical element, occurs on very steep (30°-90°) slopes, facing all major aspects.

Diagnostic species are listed under species group I (Table 1) and include the moss *Usnea trichodeoides*. *Scolopia oreophila* is a rare species which is endemic to northern KwaZulu-Natal (Hall *et al.* 1980). Other prominent species include: *Rhamnus prinoides*, *Leucosidea sericea*, *Greyia sutherlandii*, *Buddleja salviifolia*, *Rhus pyroides*, *Diospyros whyteana* and *Euclea crispa*.

The average number of species per sample plot is 30, with the total number for the whole vegetation unit being 56 (Fig. 2), which is slightly less than the average of 79.1.

1.2.7 *Clauseno anisatae-Greyietum sutherlandii* ass. nov.

Nomenclatural type: relevé 462 (holotypus)

This short to tall forest type (Edwards 1983), which occurs only on south-facing slopes, has a temperate to tropical nature. It is assumed that it is closely related to the *Plectrantho fruticosi-Trimerietum grandifoliae* because of the very similar habitat conditions. It is also possible that not all species of this association have been recorded, thus causing these two forest types to be separated in this study. The association has no diagnostic species group and is therefore considered a separate type. Prominent species are: *Trimeria grandifolia*, *Apodytes dimidiata*, *Greyia sutherlandii*, *Buddleja salviifolia*, *Celtis africana*, *Canthium mundianum*, *Cussonia spicata* and the graminoid *Poa annua*.

This vegetation unit has a high species richness (32.3) and a total of 72 species (Fig. 2).

1.3 *Maeso lanceolatae-Euclion crispae* all. nov.

Nomenclatural type: *Hyparrhenio dregeanae-Dombeyetum rotundifoliae* (holotypus)

This alliance represents short thicket (Edwards 1983) or isolated bush clumps at an altitude above the *Acacia caffra* zone (1 200-1 600 m), above which *Acacia caffra* is absent (Edwards 1967). These thickets are widely scattered, usually occurring as isolated islands throughout the grassland and are not restricted exclusively to steep slopes (3°-90°). Soils are shallow (200-300 mm) and have a clay content of 15-25 %. Superficial rocks cover 5 % to more than 20 % of the soil surface.

The diagnostic species are listed under species group O (Table 1), including the tall grass *Hyparrhenia cymbaria* which is very conspicuous and indicative of more suitable conditions for the grass stratum. Other grasses also very prominent are *Cymbopogon validus*, *Hyparrhenia dregeana*, *H. hirta* and *Eragrostis curvula*. This alliance was often found to have been invaded by silver wattle (*Acacia dealbata*) and black wattle (*A. mearnsii*).

Two associations are recognised under this alliance:

1.3.1 *Hyparrhenio dregeanae-Dombeyetum rotundifoliae* ass. nov.

Nomenclatural type: relevé 516 (holotypus)

This association occurs mainly on north-facing slopes with gradients of between 30° and 90°. It can be considered equivalent to the forests on the southern slopes but, due to different climatical conditions, species composition and structure are different. The vegetation is dominated by a short (Edwards 1983) woody stratum with a well-developed substratum grass cover. Sandstone of the Vryheid Formation and dolerite are the pre-

dominant geological components underlying the soils of these slopes.

No diagnostic species are characteristic for this thicket, but nevertheless it is constituted of several prominent and sometimes dominant species such as *Rhamnus prinoides*, *Leucosidea sericea*, *Canthium ciliatum*, *Dombeya rotundifolia*, *Euclea crispa* and the tall grass species *Cymbopogon validus* and *Hyparrhenia dregeana* (Table 1).

A very high species richness of 39.7 species per sample plot was recorded, with 72 species in total for the association (Fig. 2).

### 1.3.2 *Hyparrhenio cymbariae-Diospyretum lycioidis* ass. nov.

Nomenclatural type: relevé 416 (holotypus)

This association has a patchy distribution, being generally restricted to small ravines and rocky outcrops.

No diagnostic species are recognised, but the most prominent are *Greyia sutherlandii*, *Maesa lanceolata*, *Clerodendrum glabrum*, *Ziziphus mucronata*, *Diospyros lycioides* and the tall grasses *Hyparrhenia cymbaria* and *Hyparrhenia dregeana* (Table 1).

This association is clearly distinguished from the *Hyparrhenio dregeanae-Dombeyetum rotundifoliae* by the absence of species groups L and M.

Despite the large number (87) of species found in this vegetation unit, the species richness (27.5) is even below the average of 29.1 (Fig. 2).

## 2. *Acacietalia karroo* order nov.

Nomenclatural type: *Eragrostio curvulae-Acacion caffrae* (holotypus).

The *Acacietalia karroo* occurs at altitudes lower than the *Leucosideetalia sericeae*, characterised by higher average annual temperatures and milder winters. These are woodlands and thickets (Edwards 1983) with a patchy distribution, mostly restricted to

slopes and midslopes with widely differing gradients (3°-35°). They are mainly associated with the Northern and Southern Tall Grassveld and the Natal Sour Sandveld (Acocks 1953, 1975, 1988). The most frequent soil encountered is the Glenrosa Form, being 300 mm deep on average, but which sometimes reaches depths of up to 500 mm. Clay content varies from 15-35 %, but on average is between 15-20 %. Although surface rocks are absent in some cases, they usually cover more than 20 % of the surface area, with rock size generally exceeding 500 mm in diameter. The geology is characterised by sandstone of the Vryheid Formation, and post Karoo dolerite. The more clayey soils are derived mainly from dolerite.

The diagnostic species is *Acacia karroo* (species group AM, Table 1), but other character species closely associated with this species, are the alien weed *Bidens pilosa*, and the grasses *Setaria sphacelata* and *Aristida bipartita*. Other species which are very prominent and often dominant according to their cover-abundance values, include the grasses *Eragrostis curvula*, *Hyparrhenia hirta*, *Cymbopogon excavatus*, and the woody species *Diospyros lycioides* and *Rhus dentata*. Overgrazed grasslands adjoining these woodlands or thickets, are often found to be invaded by shrubs and trees of *Acacia karroo*.

### 2.1 *Eragrostio curvulae-Acacion caffrae* all. nov.

Nomenclatural type: *Rhoo pentheri-Acacietum caffrae* (holotypus)

This vegetation unit is found in the area around Dundee, Utrecht and directly north of Vryheid. Around Dundee it covers smaller koppies, whereas in the Utrecht area, it is restricted to the slopes of the Belelasberg, representing Valley Bushveld (Acocks (1953, 1975, 1988).

The character species for this alliance are listed under species group U (Table 1). Other prominent, and often dominant, species are

the woody *Ziziphus mucronata*, *Euclea crispa*, *Acacia karroo*, *Diospyros lycioides*, *Rhus dentata*, and the graminoids *Eragrostis curvula* and *Cymbopogon excavatus*.

2.1.1 *Panico maximum-Clerodendretum glabrum* ass. nov.

Nomenclatural type: relevé 179 (holotypus)

This association can be classified as short closed woodland (Edwards 1983) with a well-developed grass layer. It occurs exclusively on sandstone of the Vryheid Formation, and dolerite. The predominant soil type is the Glenrosa Form, although a combination of the latter and the Mispah Form are occasionally encountered.

Diagnostic species are listed under species group P (Table 1). Other important species include *Clausena anisatha*, *Acacia caffra*, *Rhus pentheri*, *Scutia myrtina*, *Clerodendrum glabrum*, *Rhus pyroides*, *Acacia karroo*, *Diospyros lycioides* and *Eragrostis curvula*.

The average number of species recorded per sample plot is 30.4, with the total number for the whole vegetation unit being 94 (Fig. 2).

2.1.2 *Aloo maculatae-Rhoetum pentheri* ass. nov.

Nomenclatural type: relevé 54 (holotypus)

This association of a low to short closed woodland (Edwards 1983) occurs on moderate (3°-20°) slopes as well as on crests of smaller koppies. Aspect seems to play no role in determining the occurrence of this vegetation. No diagnostic species are recognised, but conspicuous and often dominant species include *Rhus pentheri*, *Ziziphus mucronata*, *Euclea crispa*, *Acacia karroo*, *Rhus dentata* and the grass *Eragrostis curvula* (Table 1). This association is closely related to the *Panico maximum-Clerodendretum glabrum* and is only distinguished from the latter by the absence of species group P.

The total 107 species recorded in this woodland type is very high, with an equally high

species richness of 35.4 (Fig. 2), which is the second highest for all vegetation units of the forests, woodlands and thickets found in this study area. These high values are ascribed to the heterogeneous nature of the koppies.

2.1.3 *Stipo dregeanae-Rhoetum pyroidis* ass. nov.

Nomenclatural type: relevé 262 (holotypus)

This low to short closed woodland (Edwards 1983) occurs on southern slopes, with gradients of between 15°-20°. Rock cover is less than 2 %.

No character species are distinguished (Table 1). The most dominant and conspicuous species are *Acacia caffra*, *Rhus pentheri*, *Rhus pyroides*, *Ziziphus mucronata*, *Maytenus heterophylla*, *Acacia karroo*, *Diospyros lycioides*, the forb *Achyranthes aspera*, and the grasses *Stipa dregeana*, *Poa annua*, *Sporobolus africanus*, *Eragrostis curvula* and *Cymbopogon excavatus*. The species *Poa annua*, *Sporobolus africanus* and *Eragrostis curvula* are indicators of disturbance, the causes for which are not known. This association is closely related to the *Aloo maculatae-Rhoetum pentheri* and is only distinguished from the latter by the absence of species group Q.

Only 34 species were recorded within this woodland type, with the species richness being only 27 (Fig. 2).

2.1.4 *Rhoos pentheri-Accacietum caffrae* ass. nov.

Nomenclatural type: relevé 185 (holotypus)

This low to short closed woodland (Edwards 1983) occurs in a variety of habitats, ranging from dongas to relatively steep (30°) slopes. Such slopes are mainly south-facing, but sometimes face west- or eastward.

No diagnostic species could be identified, but nevertheless prominent species are *Acacia caffra*, *Rhus pentheri*, *Ziziphus mucronata*, *Euclea crispa*, *Acacia karroo*, *Diospyros lycioides*, *Rhus dentata*, and the



grasses *Eragrostis curvula*, *Hyparrhenia hirta*, *Cymbopogon excavatus* and *Themeda triandra* (Table 1). The more disturbed parts of this community are recognised by higher cover-abundance values of *Eragrostis curvula* and lower values or even absence of *Themeda triandra*. Although related to the three previously described associations, the absence of species groups R, S and T is very eminent. This clearly indicates somewhat warmer and drier prevailing conditions.

An exceptionally large total number of 120 species was recorded, with the average number of species per sample plot being 26.8 (Fig. 2).

## 2.2 *Trachypogo spicati-Diospyrion lycioidis* all. nov.

Nomenclatural type: *Trichoneuro grandiglumis-Canthietum mundianum* (holotypus)

This alliance occurs at 1 250-1 500 m above sealevel and shows wide differences in structure and species composition. Although it generally occurs as a low thicket, at some places the structure and composition of the vegetation are such that these situations can be classified as low to short closed woodland (Edwards 1983).

Character species for this alliance are listed under species group Y (Table 1). These diagnostic species, however, display only low cover-abundance values, in contrast to the high values of species such as *Diospyros lycioides*, *Cymbopogon validus*, *Eragrostis curvula* and *Hyparrhenia hirta*.

### 2.2.1 *Trichoneuro grandiglumis-Canthietum mundianum* ass. nov.

Nomenclatural type: relevé 392 (holotypus)

This thicket is restricted to granitic outcrops. Soils are shallow (200-300 mm) and clay contents low (15-20 %). Soils are predominantly of the Glenrosa-Mispah complex. Surface rocks cover more than 20 % of the area, with granite sills, appearing above the

ground, constituting a large part of this cover.

The character species are included within species group V (Table 1). Other prominent and sometimes dominant species are *Canthium mundianum*, *Clerodendrum glabrum*, *Diospyros lycioides*, *Eragrostis curvula* and *Hyparrhenia hirta*. This thicket type is distinguished from the following two associations by the presence of species group W (Table 1). Although *Acacia karroo* was absent from the sample plots, widely distributed individuals may be observed.

Of all the vegetation units described in this paper, this association has the highest species richness (47.8), with the total number of species being 110 (Fig. 2).

### 2.2.2 *Conyso bonariensis-Cymbopogon- etum validi* ass. nov.

Nomenclatural type: relevé 421 (holotypus)

This low thicket (Edwards 1983) occurs on moderate to relatively steep (10°-30°) slopes, facing all four aspects.

The only character species is the forb *Conyza obscura* (species group X, Table 1), which displays low cover-abundance values and is consequently difficult to be observed. The most dominant species are: *Diospyros lycioides*, *Cymbopogon validus* and *Hyparrhenia hirta*. As already mentioned in the *Trichoneuro grandiglumis-Canthietum mundianum*, *Acacia karroo* is very sparsely distributed and has consequently only sometimes been recorded. In these cases low cover-abundance values were recorded for *Acacia karroo*.

A total number of 121 (Fig. 2) species was recorded for this association, which is the highest of all vegetation units described in this paper. The species richness (33.4) (Fig. 2) is also well above the average of 30.7.

### 2.2.3 *Cymbopogono validi-Acacietum karroo* ass. nov.

Nomenclatural type: relevé 400 (holotypus)

This low thicket (Edwards 1983) is generally restricted to slopes of between 5° and 35° and at some places is of such a nature that it could be classified as low closed woodland (Edwards 1983).

No diagnostic species are identified, but nevertheless prominent and often dominant species include: *Acacia karroo*, *Diospyros lycioides*, *Cymbopogon validus*, *Eragrostis curvula*, *Hyparrhenia hirta* and *Cymbopogon excavatus* (Table 1).

An average number of 28.8 species was recorded per sample plot, with the total number being 85 (Fig. 2).

### 2.3 *Brachiario eruciformis-Acacietaum karroo* ass. nov.

Nomenclatural type: relevé 48 (holotypus)

This low thicket (Edwards 1983) occurs on terrain units 2 and 3 with slopes ranging from 3°-25°. Soils are rich in clay (>35 %) and relatively deep (>300 mm).

The diagnostic species are listed under species group AC (Table 1). Although the two grass species *Brachiaria eruciformis* and *Urochloa panicoides* are indicative of heavy (clayey) soils, all four character species suggest a relatively high degree of disturbance. The woody stratum is dominated totally by *Acacia karroo*, with species such as *Eragrostis curvula*, *Themeda triandra* and *Bidens pilosa* very prominent and often dominant in the herbaceous stratum. Both *Eragrostis curvula* and *Bidens pilosa* are further indicators of disturbance.

Two sub-associations are recognised under this association:

#### 2.3.1 *Brachiario eruciformis-Acacietaum karroo themedetosum triandrae* sub-ass. nov.

Nomenclatural type: relevé 48 (holotypus)

This sub-association occurs on the slopes and crests of smaller koppies. The predominant soil type is the Mayo Form, with clay percentages well exceeding 35 %.

There are no diagnostic species, but species which are conspicuous and often dominant include: *Acacia karroo*, *Euclea crispa*, *Rhoicissus tridentata*, *Diospyros lycioides*, *Brachiaria eruciformis*, *Urochloa panicoides*, *Melinis repens*, *Themeda triandra* and *Bidens pilosa* (Table 1). *Melinis repens* and *Bidens pilosa* are both indicators of disturbance.

An average number of only 22 species was recorded per sample plot, the total number being only 35 (Fig. 2).

#### 2.3.2 *Brachiario eruciformis-Acacietaum karroo bothriochloetosum insculptae* sub-ass. nov.

Nomenclatural type: relevé 375 (holotypus)

This low thicket (Edwards 1983) occurs mainly on terrain unit 3 and is usually restricted to deep (>500 mm), clayey (>35 %) soils. Surface rocks are generally absent. This unit is an extension of the thickets of the slopes described earlier (2.3.1) in this order, with the woody component being represented mainly by *Acacia karroo*.

The diagnostic species which distinguish this sub-association from the *Brachiario eruciformis-Acacietaum karroo themedetosum triandrae*, are listed under species group AG and AJ (Table 1), all indicators of disturbance, whereas the two sub-associations are related to each other through species group AC (Table 1). Predominant species are *Acacia karroo*, *Aristida congesta* subsp. *barbicollis*, *Setaria sphacelata*, *Eragrostis curvula* and *Hyparrhenia hirta*.

An average number of 24.5 species was recorded per sample plot, the total being 55 species (Fig. 2).

#### 2.4 *Sporobolo pyramidalis-Acacietaum sieberianae* ass. nov.

Nomenclatural type: relevé 507 (holotypus)

This low thicket (Edwards 1983) sometimes occurs on rocky ridges, where the percentage surface rock cover normally exceeds 20 %, but is usually found on terrain unit 3 at lower

altitudes, where the percentage surface rock cover is lower than 5 %. Soil depths vary from 200-500 mm and clay percentages from 15-35 %.

The character species are the densely tufted grass *Sporobolus pyramidalis*, the small inconspicuous forb *Hermannia depressa* and *Acacia sieberiana* which can occur as a large tree (species group AF, Table 1). Other prominent and often dominant species include: *Acacia karroo*, *Bothriochloa insculpta*, *Eragrostis curvula* and *Hyparrhenia hirta*.

A total number of 77 species was recorded, the average number per sample plot being 31.8 (Fig. 2).

### 2.5 *Eragrostis plana*-*Acacia karroo* Thicket

This low thicket (Edwards 1983) is restricted exclusively to flat to gently sloping ( $0^{\circ}$ - $8^{\circ}$ ) midslopes with deep (>500 mm), clayey (>35 %) soils, derived mainly from dolerite but also from sandstone of the Vryheid Formation. Surface rocks are virtually absent.

This community has no diagnostic species (Table 1). The only woody species is *Acacia karroo* which, together with *Eragrostis plana*, *Eragrostis curvula*, *Hyparrhenia hirta* and *Themeda triandra*, largely constitutes this vegetation unit. This community has a strong affinity with grassland and can be considered a transition from thicket to grassland.

A total number of 55 species was recorded, with an average of 25.3 per sample plot (Fig. 2).

### 2.6 *Setaria sphacelata*-*Acacia karroo* Thicket

This low thicket (Edwards 1983) occurs on shallow (200-300 mm) soils of the Glenrosa Form with clay content varying from 15-20 %. Surface rocks cover more than 20 % of the area. The slopes are moderate ( $3^{\circ}$ - $10^{\circ}$ ), facing mainly eastward.

This community is closely related to the *Eragrostis plana*-*Acacia karroo* Community, displaying a very similar species composition, except for the absence of species groups AJ and AK (Table 1). The dominant species include: *Acacia karroo*, *Setaria sphacelata*, *Eragrostis curvula* and *Hyparrhenia hirta*. Smaller clusters of *Acacia sieberiana* are sometimes encountered.

The average species richness is 35 species per sample plot, with the total number of species being 56 (Fig. 2).

## Ordination

The scatter diagram displays the distribution of the relevés along the first and fourth axes (Fig. 3). The vegetation units are represented as groups, their distribution on the diagram corresponding with certain physical environmental conditions. The three gradients which are described by the first axis, are altitude, moisture regime and slope. These gradients correlate closely with each other and have a strong influence on the vegetation. Forests and woodlands of high altitudes, accompanied by a relatively high soil moisture content and steep slopes, occur to the right of the diagram. The high soil moisture content associated with high-lying steep slopes can be ascribed to the simultaneous effect of high rainfall and low evaporation figures. Low-lying woodlands and thickets, associated with a lower soil moisture content and less steep slopes, appear in the left hand side of the diagram. No clear gradient can be observed along the fourth axis which can explain the distribution of the relevés, yet this diagram gives a clearer presentation of the gradients than those diagrams displaying axes 2 and 3.

## Concluding remarks

The TWINSPLAN classification and its subsequent refinement by Braun-Blanquet procedures resulted in the delineation of 24 communities. These communities can be related to certain environmental factors the gradi-

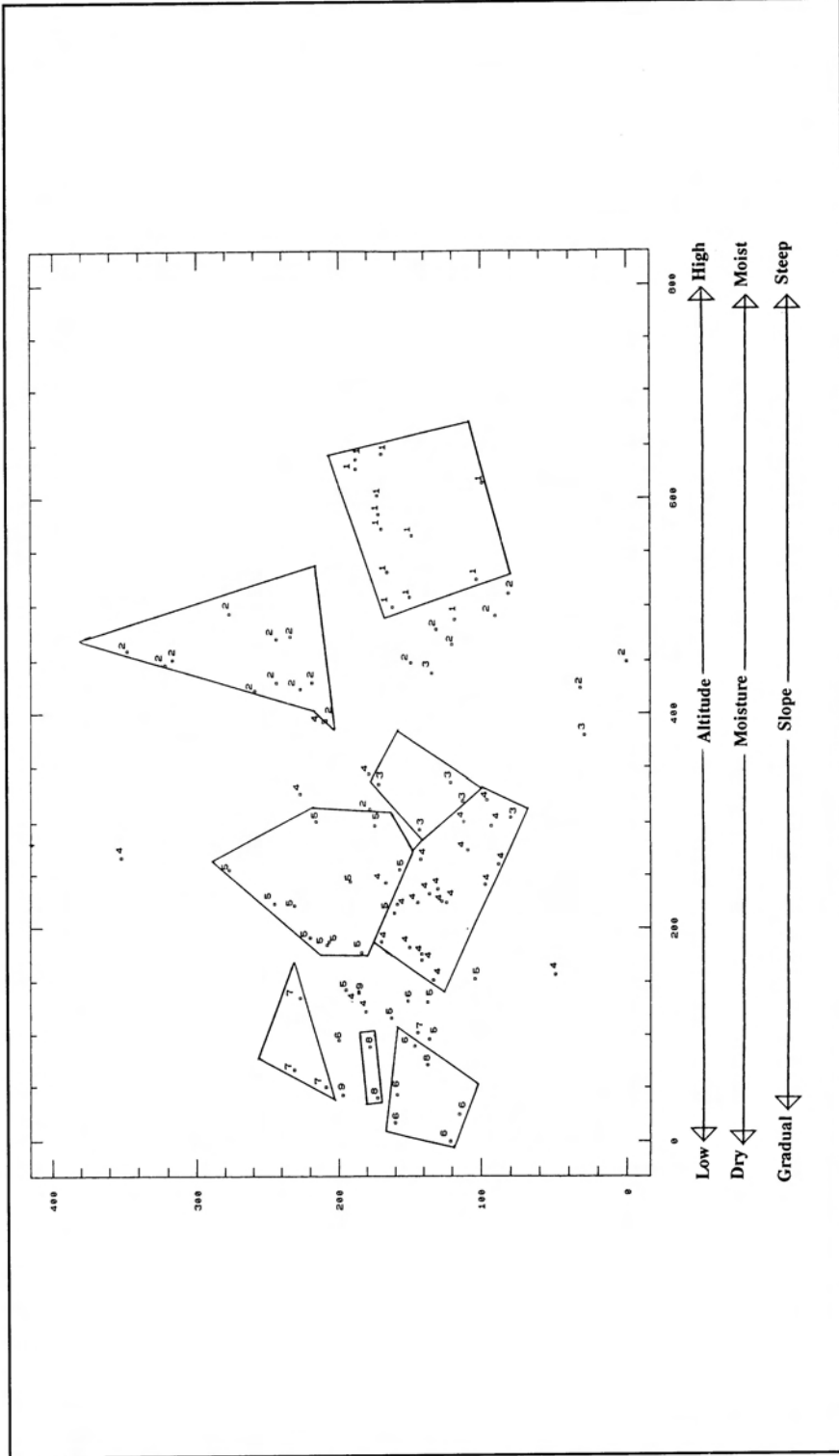


Fig. 3. The distribution of the relevés along the first and fourth axes of the ordination based on floristic data. 1. *Stachyo kuntzei-Leucosidion sericeae*. 2. *Trimerio grandifoliae-Greyton sutherlandii*. 3. *Maeso lanceolatae-Euclion crispae*. 4. *Eragrostis curvulae-Acacion caffrae*. 5. *Trachypogo spicati-Diospyrion lycioidis*. 6. *Brachiario eruciformis-Acacietaetum karroo*. 7. *Sporobolo pyramidalis-Acacietaetum sieberianae*. 8. *Eragrostis plana-Acacia karroo*. 9. *Setaria sphacelata-Acacia karroo*.

ents of which are illustrated in the DECO-RANA scatter diagram.

There are certain vegetation units or areas which need special attention and should be considered for conservational purposes. The *Rhamno prinoidis-Podocarpodetum latifolii* has conservation value in that the rare *Watsonia latifolia* (Hall *et al.* 1980) was found in relevé 226. The *Plectrantho grallati-Dalbergietum obovatae* of the Ntabankulu mountain north of Glückstadt and the *Plectrantho fruticosi-Trimerietum grandifoliae* of the mountain range north of Black Mfolozi are two associations which are not only in danger of being destroyed through replacement by eucalyptus and wattle plantations, but seed dispersal from adjacent plantations also holds a serious threat to these indigenous associations. The *Rapano melanophloei-Greyietum sutherlandii* is a community of conservation importance because of the presence of the rare and endemic woody species *Scolopia oreophila* (Hall *et al.* 1980). The *Hyparrhenio dregeanae-Dombeyetum rotundifoliae* of the northerly-facing slopes of the Ngcaka mountain at Lüneburg is also of conservation importance due to its high species richness. This association is however threatened in that it is often exposed to the destructive effect of veld fires. The *Trichoneuro grandiglumis-Canthietum mundianum* of the granitic outcrops on the farm Togekry near Lenjane Drift with its exceptionally high species richness, makes this association worthy of conservation.

It is hoped that the descriptions of the different vegetation units will make a significant contribution towards the understanding of these units but also of the vegetation of northern KwaZulu-Natal as a whole. Hopefully, the information can be meaningfully applied in the management and conservation of the respective areas with particular emphasis, however, on the forests and woodlands of higher altitudes which are threatened by exotic plantations. Proper and sound assessment of the woody vegetation, including aspects such as species richness, is a pre-

requisite before suggestions concerning conservation can be made. The high-lying woodlands and forests, although not extremely rich in species, are to be considered for inclusion in the Natural Heritage Programme because of certain potential factors which threaten to destruct these woodlands and forests.

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