The plant communities and species richness of the *Alepidea longifolia-Monocymbium ceresiiforme* High-altitude Grassland of northern KwaZulu-Natal

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As part of a vegetation survey of the grasslands of northern KwaZulu-Natal, this survey was conducted within the *Alepidea longifolia-Monocymbium ceresiiforme* grassland of high altitudes. Relevés were compiled in 156 stratified random sample plots. The data set was classified using TWINSPAN. Subsequent refinement by Braun-Blanquet procedures produced 15 plant communities. Species richness was determined for each community. According to naturalness and species richness two communities were selected as being of conservation importance. An ordination algorithm (DECORANA) was also applied to describe the relationships between the vegetation units and the physical environment.

Keywords: Braun-Blanquet method, classification, diagnostic species, grassland, species richness.

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Introduction

The grasslands of South Africa constitute one of the country's most important renewable natural resource regions. Many livestock farming enterprises depend entirely on the forage production of the grass layer. Yet, a closer look at the floristic composition of the grasslands as a whole, reveals a gradual degradation (Tainton 1981). Signs of degradation usually differ from one area to another. In the eastern higher rainfall areas of the country, retrogressive change in species composition takes place from subclimax/climax stages towards earlier successional stages, whereas a decline in cover and productivity of the grass layer can be witnessed mainly in the drier western parts of the grassland biome (Tainton 1981). In addition to this, large parts of the grassland have been destroyed to make place for the development of urban areas, afforestation, agriculture and mining (Mentis & Huntley 1982). Degradation of the natural environment, and the grasslands in particular, must be considered in the context of food production, which, for Africa as a whole, will have to be tripled during the next three decades, if predicted demands are to be met (Agricultural News 1995). Therefore, it is necessary to manage and conserve the remaining grasslands carefully if sustainable production is to be maintained. This, however, cannot be achieved without proper knowledge of the ecology of the various vegetation assemblages and of ecosystems at large (Pentz 1938; Bayer 1970; Edwards 1972; Bredenkamp & Theron 1991).

This paper forms part of an investigation of the vegetation of northern KwaZulu-Natal and deals in particular with the high-lying (>1 200 m above sea-level) grasslands of northern KwaZulu-Natal (see also Eckhardt *et al.* 1996). Considerable progress has been made with the syntaxonomy of South African grasslands (e.g. Bezuidenhout *et al.*

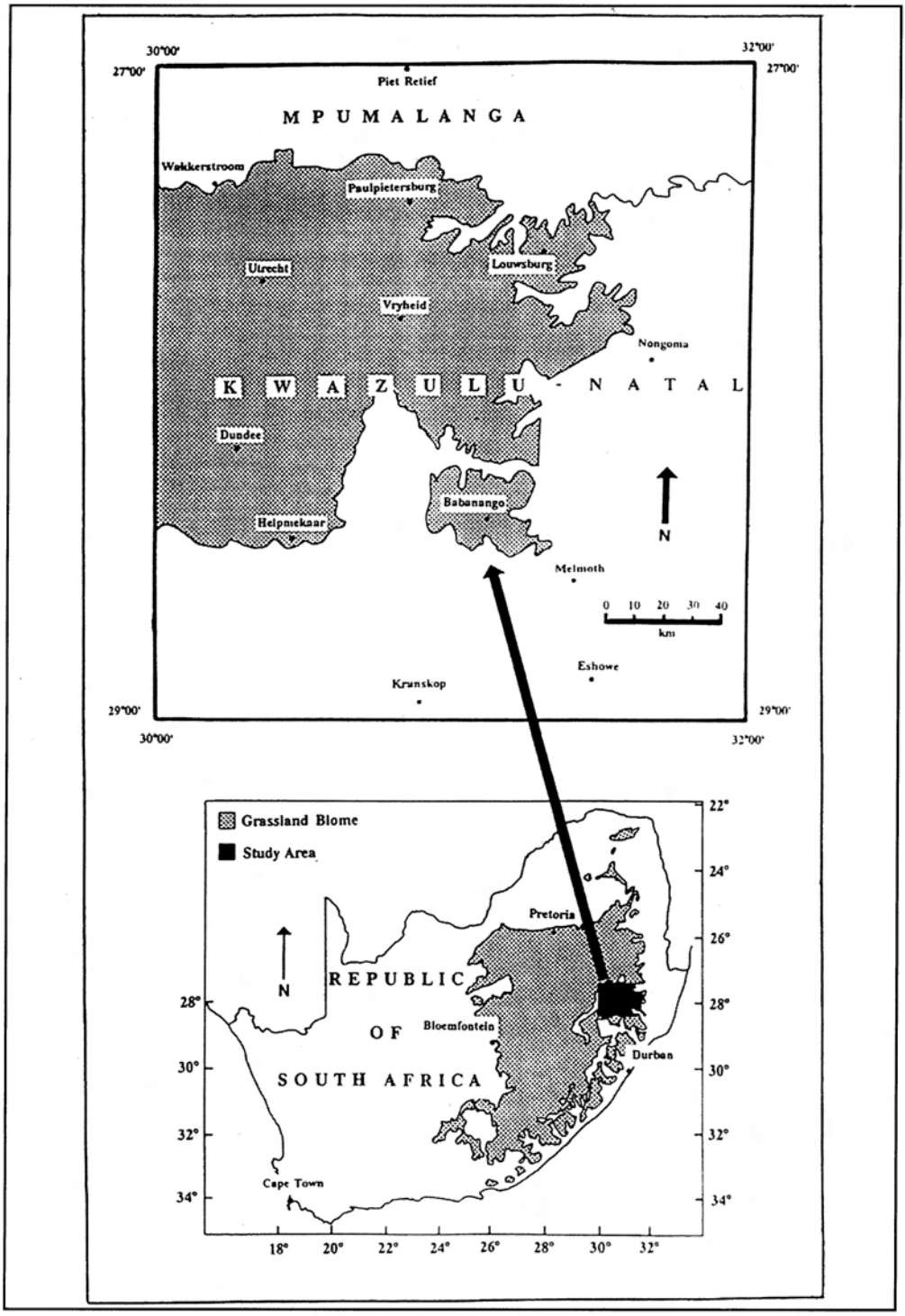


Fig. 1. Map indicating the location of the study area within the Grassland Biome.

1994), but little is known of the syntaxonomy of KwaZulu-Natal grasslands. The floristic data and phytosociological analysis from this region allows the compilation of a syntaxonomy, which is a major contribution to the phytosociological knowledge of South African grasslands.

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 approximately 14 366 km² and lies at an altitude of between 750 m and 2 290 m above sea-level. Mean annual rainfall is 850 mm, although it may vary markedly within the area due to physiographic heterogeneity (Schulze 1982). The area consists of irregular undulating lowlands in the central and south-western parts, undulating mountains and lowlands in the north-western and eastern parts, and low mountains in the south-eastern part (Kruger 1983). Parts of the vegetation are equivalent to the *Themeda-Tristachya-Digitaria* Northern Highlands Grassland described by Edwards (1967) which are predominantly fire-maintained grasslands with islands of woody vegetation scattered through-out the area (see also Eckhardt *et al.* 1996). The specific area covered by the *Alepidea longifolia-Monocymbium ceresiiforme* Grassland encompasses the high-lying central-northern parts of the study area.

Methods

Relevés were compiled in 156 sample plots, which were randomly distributed throughout the study area on the basis of terrain units and aspect. Care was taken as to cover all variations within the vegetation. All plots were circular and fixed at 100 m² (Scheepers 1975). All plant species occurring in the plots were recorded and given a value according to the Braun-Blanquet cover-abundance scale (Mueller-Dombois & Ellenberg 1974). Taxon names conform to those of Arnold & De Wet (1993). The structural classification system of Edwards (1983) was used to classify the different grassland types according to their structural properties. Environmental data recorded for each relevé included: terrain unit, aspect, slope, geology, soil type and depth, soil texture, rockiness of soil surface and degree of erosion.

Two-Way Indicator Species Analysis (TWINSPAN) (Hill 1979b) was performed on the floristic data set of 156 relevés. This classification was further refined by Braun-Blanquet procedures (Westhoff & Van der Maarel 1978; Kooij 1990; Bredenkamp & Bezuidenhout 1995; Fuls 1993). The results are presented in a phytosociological table (Table 1).

The ordination algorithm DECORANA (Hill 1979a) (Fig. 4) was also applied to the floristic data set to illustrate relationships between the vegetation units and the environmental factors recorded. For practical reasons the large data set has been transformed into a synoptic table to simplify the interpretation of possible gradients. If each relevé had to be indicated on the scatter diagram, the numbers representing the relevés would often overlap each other, thereby making them illegible.

The floristic data within each identified plant community were analysed further to determine species richness (see Eckhardt *et al.* 1996 for a more detailed discussion and definition).

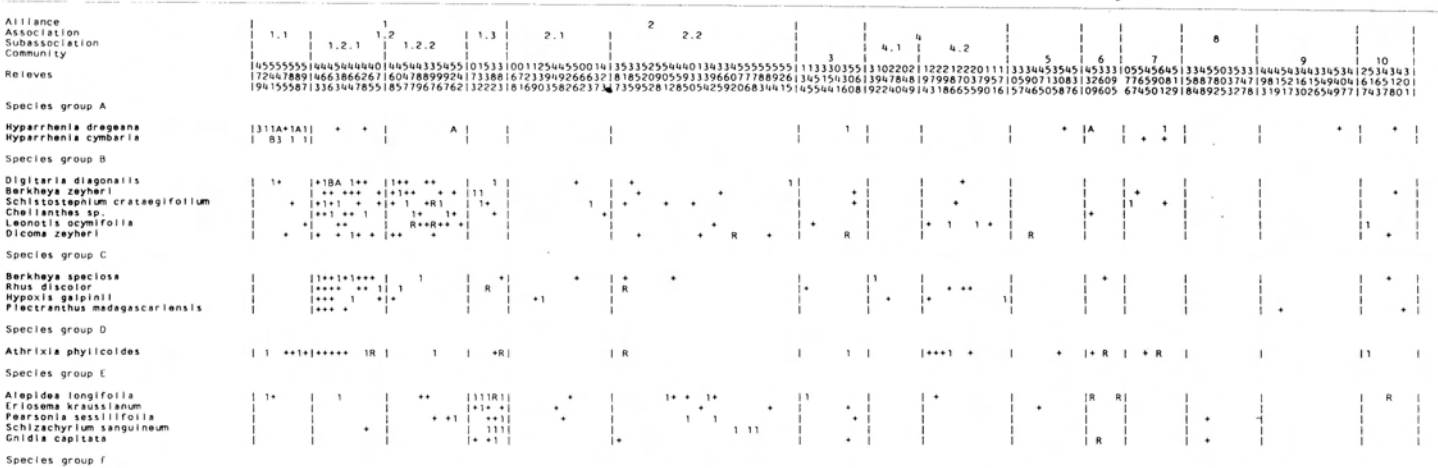
Results and discussion

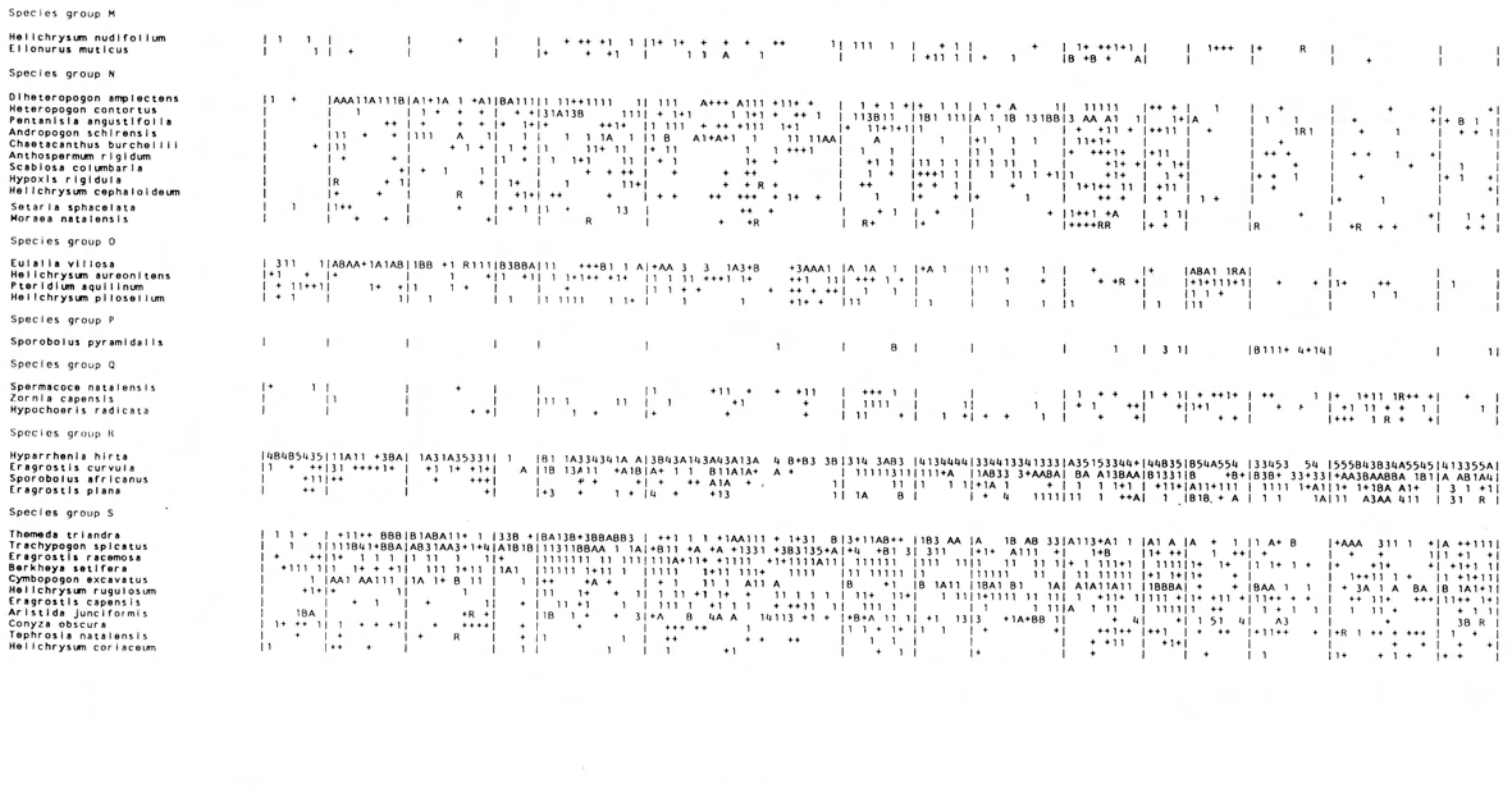
The different vegetation units which constitute Table 1 are generally classified together as moist, high-lying grasslands. These grasslands occur mainly on plateaux and midslopes, but are also often found on scarps. Tall (1-2 m) to high (>2 m) grassland (Edwards 1983) usually covers the steeper slopes and scarps with rocky conditions prevalent and woody vegetation being absent. Gradual slopes and undulating plains of the higher altitudes are covered by short (0.5-1 m) to tall grassland on deeper soils.

The most common and often physiognomically dominant species include *Hyparrhenia hirta*, *Eragrostis curvula*, *E. plana* and *Sporobolus africanus*, represented by species group R, as well as *Themeda triandra*, *Trachypogon spicatus* and *Cymbopogon excavatus* (species group S, Table 1). The species which comprise group R are the most widely

Table 1

Phytosociological table of the Alepidea longifolia - Monocymbium ceresiiforme *High-altitude Grassland of northern KwaZulu-Natal*





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distributed and often most prominent species encountered in this and other plant communities throughout the study area and are therefore included in one separate species group.

A diagrammatic presentation of the hierarchical classification and associated environmental interpretation of the different vegetation units is presented in Fig. 2.

The average species richness of the communities is 27.9 species per 100 m² and the average total number is 117.9 (Fig. 3). In contrast to these values the species richness for the two orders *Leucosideetalia sericeae* and *Acacietalia karroo*, described by Eckhardt *et al.* (1996), are 29.1 and 30.7 respectively, and the total number of species 59 and 79.1.

Classification

The analysis resulted in the following hierarchical classification:

1. *Cymbopogono validi-Eulalion villosae*
   - 1.1 *Hyparrhenio dregeanae-Hyparrhenietum hirtae* (vegetation unit 1)
   - 1.2 *Digitario diagonalis-Trachypogonetum spicati*
     - 1.2.1 *Digitario diagonalis-Trachypogonetum spicati athrixietosum phylicoidis* (vegetation unit 2)
     - 1.2.2 *Digitario diagonalis-Trachypogonetum spicati loudetietosum simplicis* (vegetation unit 3)
   - 1.3 *Alepideo longifoliae-Eulalietum villosae* (vegetation unit 4)

2. *Monocymbio ceresiiformis-Trachypogonion spicati*
   - 2.1 *Helichryso oreophilum-Themedetum triandrae* (vegetation unit 5)
   - 2.2 *Monocymbio ceresiiformis-Aristidetum junciformis* (vegetation unit 6)

3. *Hyparrhenia hirta - Aristida junciformis* Grassland (vegetation unit 7)

4. *Berkheyo onopordifoliae-Diospyretum lycioidis*
   - 4.1 *Berkheyo onopordifoliae-Diospyretum lycioidis hyparrhenietosum hirtae* (vegetation unit 8)
   - 4.2 *Berkheyo onopordifoliae-Diospyretum lycioidis acalyphetosum caperonioidis* (vegetation unit 9)

5. *Helichrysum nudifolium - Hyparrhenia hirta* Grassland (vegetation unit 10)

6. *Cymbopogon excavatus - Hyparrhenia hirta* Grassland (vegetation unit 11)

7. *Helichrysum aureonitens-Eulalia villosa* Grassland (vegetation unit 12)

8. *Sporobolo pyramidalis-Hyparrhenietum hirtae* (vegetation unit 13)

9. *Spermacoce natalensis-Eragrostis plana* Grassland (vegetation unit 14)

10. *Helichrysum rugulosum-Hyparrhenia hirta* Grassland (vegetation unit 15)

Description of the plant communities

1. *Cymbopogono validi-Eulalion villosae* all. nov.

Nomenclatural type: *Digitario diagonalis-Trachypogonetum spicati* (holotypus)

This alliance occurs on flat to steeply undulating topography at an altitude of more than 1 200 m, with slopes often being as steep as 25°- 35°, facing mainly north (Fig. 2). Soils are generally of the Glenrosa-Mispah complex, depth being less than 200 mm and clay percentages varying from 15-20%. Percentage surface rock cover usually exceeds 20%.

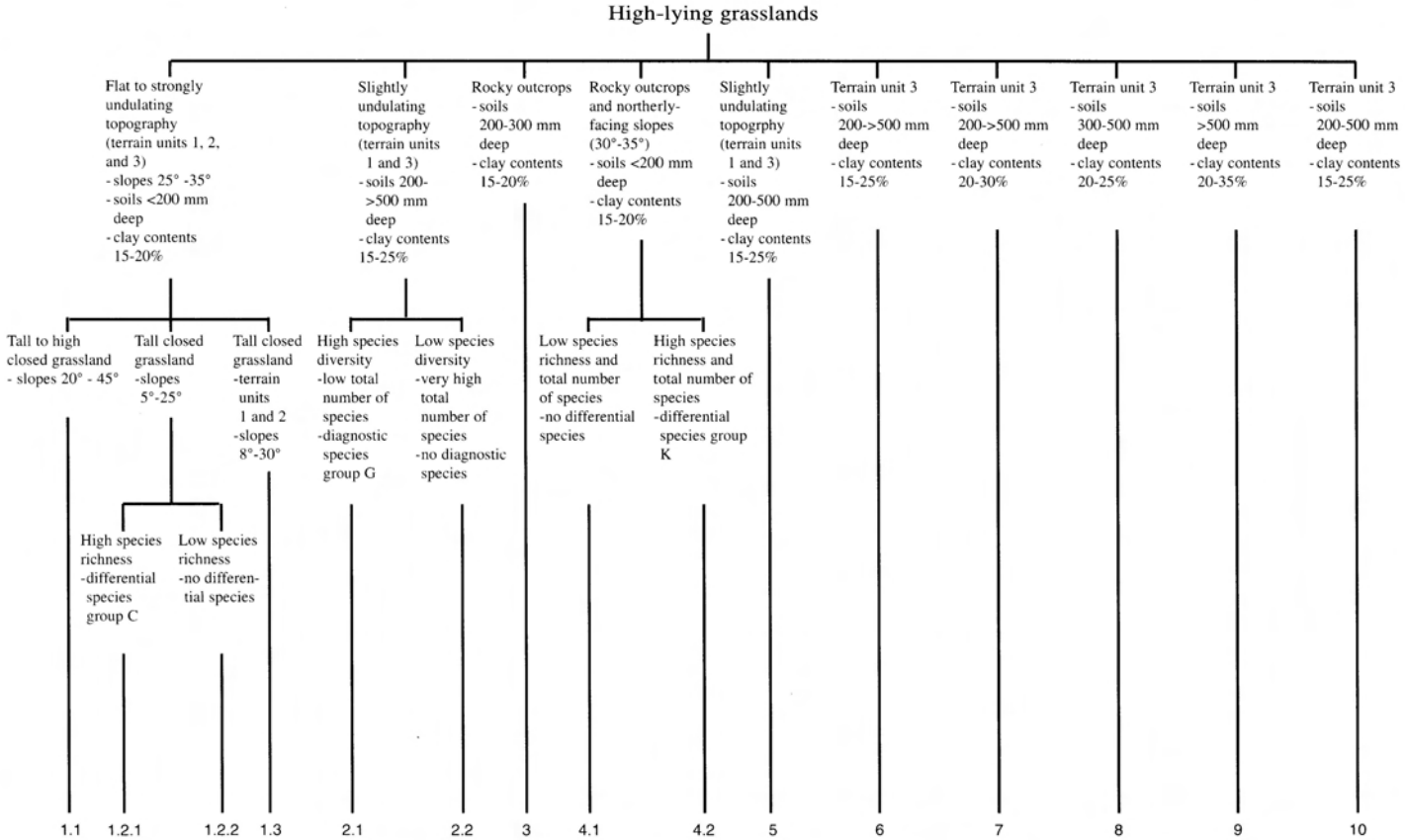
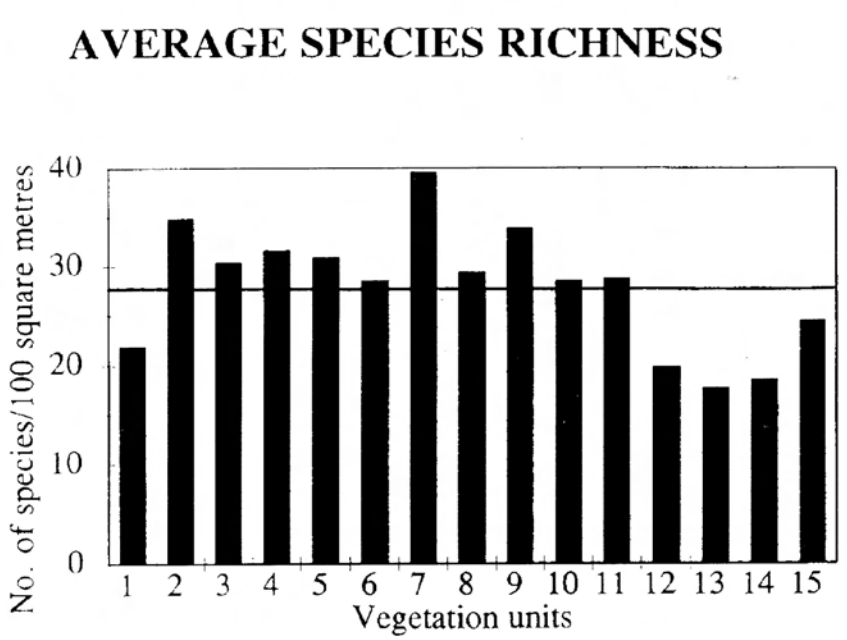


Fig. 2. The hierarchical classification and associated environmental characteristics of the 15 vegetation units.



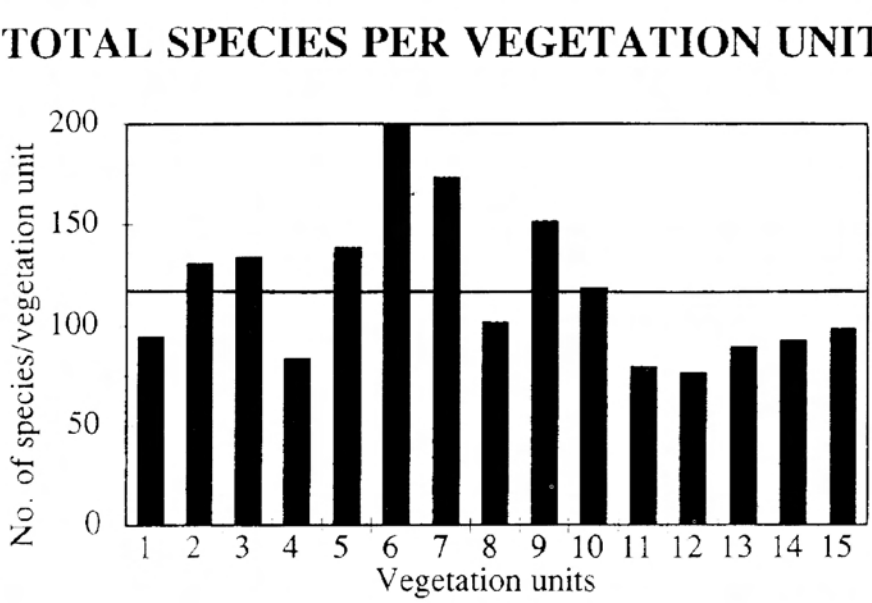


Fig. 3. Average species richness and total number of species calculated for each vegetation unit. Horizontal lines represent the respective averages for the *Alepidea longifolia-Monocymbium ceresiiforme* major vegetation type.

The only diagnostic species is the tall grass *Cymbopogon validus* (species group F, Table 1). Other prominent and often dominant species include *Eulalia villosa*, *Hyparrhenia hirta*, *Themeda triandra*, *Trachypogon spicatus* and *Cymbopogon excavatus*.

1.1 *Hyparrhenio dregeanae-Hyparrhenietum hirtae* ass. nov.

Nomenclatural type: relevé 545 (holotypus)

This tall to high closed grassland (Edwards 1983) association occurs on steep (20°- 45°), north-facing slopes (Fig. 2). Soils of the Glenrosa-Mispah complex predominate, the depth being less than 200 mm while clay percentages vary from 15-20%. Surface rocks cover more than 20% of the area, while the size of the rocks generally exceeds 500 mm.

Diagnostic species characteristic of this association are listed under species group A (Table 1). Other physiognomically conspicuous and dominant species are *Cymbopogon validus* and *Hyparrhenia hirta*.

The average number of species per sample plot (species richness) is 21.9 and the total number of species recorded is 95, both values being well below the respective averages (Fig. 3).

1.2 *Digitario diagonalis-Trachypogonetum spicati* ass. nov.

Nomenclatural type: relevé 466 (holotypus)

In comparison to the previous community this tall closed grassland (Edwards 1983) association occurs on less steeper (5°- 25°) slopes and more gently undulating terrain and is often associated with rocky outcrops (Fig. 2). The Glenrosa-Mispah complex soils are principally associated with this terrain type, soil depth being <200 mm. Clay percentages (15-20%) are very low. Surface rocks generally exceed 500 mm in diameter and cover more than 20% of the area.

Character species are listed under species group B (Table 1). Other prominent and often dominant species include *Cymbopogon validus, Loudetia simplex, Diheteropogon amplectens, Eulalia villosa*, *Hyparrhenia hirta*, *Themeda triandra*, *Trachypogon spicatus* and *Cymbopogon excavatus*. Although present in low numbers, the shrubs *Diospyros lycioides* and *Rhus dentata* are very conspicuous and associated mostly with rocky outcrops.

This association is the type for the *Cymbopogono validi-Eulalion villosae*. Two sub-associations are recognised within this association:

1.2.1 *Digitario diagonalis-Trachypogonetum spicati athrixietosum phylicoidis* subass. nov.

Nomenclatural type: relevé 466 (holotypus)

This grassland is characterised by the diagnostic species listed under species group C (Table 1). This sub-association is related to the *Hyparrhenio dregeanae-Hyparrhenietum hirtae* by the presence of the shrub *Athrixia phylicoides* (species group D, Table 1).

Both species richness (34.9) and the total number of species (131) are well above the respective averages (Fig. 3). In fact, the species richness is the second highest encountered within the vegetation units reported on in this paper.

1.2.2 *Digitario diagonalis-Trachypogonetum spicati loudetietosum simplicis* subass. nov.

Nomenclatural type: relevé 386 (holotypus)

This sub-association is found mainly on rocky outcrops (Fig. 2).

There are no diagnostic species which characterise this vegetation unit, but the latter is nevertheless distinguished from the *Digitario diagonalis-Trachypogonetum spicati athrixi-*

etosum phylicoidis by the absence of species groups C and D (Table 1).

The average number of species recorded per sample plot is 30.4, with the total number of species being 134 (Fig. 3).

1.3 *Alepideo longifoliae-Eulalietum villosae* ass. nov.

Nomenclatural type: relevé 73 (holotypus)

This tall closed grassland (Edwards 1983) association is found on strongly to moderately undulating terrain (Fig. 2). Soils of the Glenrosa-Mispah complex predominate, being between 200-300 mm in depth. Clay content varies between 15-20%. Surface rocks cover more than 20% of the area and are up to 500 mm in diameter. Among the character species, which are listed under species group E (Table 1), is the physiognomically conspicuous forb *Alepidea longifolia.* Other prominent species are *Cymbopogon validus*, *Eulalia villosa*, *Themeda triandra* and *Trachypogon spicatus*. The absence of *Hyparrhenia hirta* is noticeable and appears to be linked to the relatively undisturbed condition of the grassland. It seems that grassland becomes invaded by *Hyparrhenia hirta* if it is overutilised. This substantiates Edwards's (1967) finding that *Hyparrhenia hirta* was prominent in *Themeda-Trachypogon* Highlands Grassland where the primary grass cover had been disturbed by persistant overgrazing. This association is related to the *Hyparrhenio dregeanae-Hyparrhenietum hirtae* and the *Digitario diagonalis-Trachypogonetum spicati* by the presence of *Cymbopogon validus* (species goup F, Table 1).

The species richness is 31.6 and the total number of species recorded is only 84 which is well below the average (Fig. 3). The relative naturalness and high species richness lend this community conservation value.

2. *Monocymbio ceresiiforme-Trachypogonion spicati* all. nov.

Nomenclatural type: *Helichryso oreophilum-Themedetum triandrae* (holotypus)

This alliance occurs on slightly undulating topography, i.e. on plateaux and midslopes, at altitudes >1 200 m (Fig. 2). Major soil types encountered are the Glenrosa, Mispah and Clovelly Form. Soil depths vary from 200-500 mm and clay percentages from 15-25%. The percentage surface rock cover is mostly less than 5% but sometimes exceeds 20%.

This short to tall closed grassland (Edwards 1983) is clearly distinguished from the *Cymbopogono validi-Eulalion villosae* by the absence of the tall grass *Cymbopogon validus* (species group F, Table 1) and the presence of *Monocymbium ceresiiforme* (species group H, Table 1), which is also the only character species. Other physiognomically prominent species are *Hyparrhenia hirta*, *Themeda triandra* and *Trachypogon spicatus*. This vegetation unit resembles the *Themeda-Trachypogon* Highlands Grassland described by Edwards (1967).

Two associations are distinguished within this alliance:

2.1 *Helichryso oreophilum-Themedetum triandrae* ass. nov.

Nomenclatural type: relevé 230 (holotypus)

This association is the type of the *Monocymbio ceresiiformis-Trachypogonion spicati*. It occurs often on small rocky outcrops which are usually underutilised as a result of their inaccessibility for livestock caused by the high percentage (>20%) of large surface rocks (Fig. 2).

The character species are the forb *Helichrysum oreophilum* and the grass *Alloteropsis semialata* (species group G, Table 1). Other physiognomically prominent

species which largely constitute this community are the grasses *Monocymbium ceresiiforme, Loudetia simplex, Heteropogon contortus, Hyparrhenia hirta, Eragrostis curvula, Themeda triandra* and *Trachypogon spicatus* (Table 1).

A species richness of 30.9 and a total of 139 species were recorded (Fig. 3). High degree of naturalness and relatively high species richness lend this community conservation importance.

2.2 *Monocymbio ceresiiformis-Aristidetum junciformis* ass. nov.

Nomenclatural type: relevé 359 (holotypus)

This grassland has no diagnostic species and is distinguished from the *Helichryso oreophilum-Themedetum triandrae* by the absence of species group G and the presence of species group Q (Table 1). Conspicuous and dominant species include *Monocymbium ceresiiforme, Loudetia simplex, Eulalia villosa, Hyparrhenia hirta, Eragrostis curvula, Trachypogon spicatus* and *Aristida junciformis* (Table 1). Noteworthy is the presence of the latter species which suggests degradation as a result of ill-managed burning practices and selective grazing (Edwards 1967; Moll 1968). The grass *Aristida junciformis* causes a problem in certain high rainfall mountainous areas, gradually replacing more palatable species and thereby reducing the grazing capacity of the veld.

Although an average number of only 28.5 species was recorded per sample plot, an exceptionally large total number of 199 species was found (Fig. 3). This is the largest number of species found in any vegetation unit described in this paper.

3. *Hyparrhenia hirta-Aristida junciformis* Grassland

This short to tall closed grassland (Edwards 1983) community is generally restricted to rocky outcrops with surface rocks covering more than 20% (Fig. 2). The predominant soil type is the Glenrosa-Mispah complex, with depths varying from 200-300 mm and clay contents of between 15 and 20%.

The syntaxonomic position of this grassland community is unclear since no diagnostic species are recognised. Prominent species are *Hyparrhenia hirta, Themeda triandra, Trachypogon spicatus* and the unpalatable *Aristida junciformis* (Table 1).

An exceptionally high average number of 39.7 species was recorded per sample plot, which is the highest number recorded for all vegetation units described (Fig. 3). The total number of species is also very high (174) (Fig. 3).

4. *Berkheyo onopordifoliae-Diospyretum lycioidis* ass. nov.

Nomenclatural type: relevé 176 (holotypus)

This tall sparse to open shrubland (Edwards 1983) occurs on steep (30°- 35°) north-facing slopes and rocky outcrops (Fig.2). Glenrosa Form is the predominant soil type, with depths being less than 200 mm and clay contents varying from 15-20%. Surface rocks cover more than 20% of the area and were usually more than 500 mm in diameter.

Diagnostic species are listed under species group J (Table 1). The most prominent species is the shrub *Diospyros lycioides* which is closely associated with this type of terrain. Other conspicuous and often dominant species include *Hyparrhenia hirta, Eragrostis curvula, Themeda triandra, Cymbopogon excavatus* and *Aristida junciformis* (Table 1). The presence of *Aristida junciformis* indicates some degree of disturbance caused by selective grazing and ecological unsound burning practices (Edwards 1967; Moll 1968).

Two sub-associations are recognised within this association:

4.1 *Berkheyo onopordifoliae-Diospyretum lycioidis hyparrhenietosum hirtae* subass. nov.

Nomenclatural type: relevé 42 (holotypus)

This sub-association has no diagnostic species, but contains prominent species such as *Diospyros lycioides*, *Hyparrhenia hirta*, *Themeda triandra* and *Cymbopogon excavatus* (Table 1).

The total number of species recorded is 102, whereas the average number recorded per sample plot is 29.4 (Fig. 3).

4.2 *Berkheyo onopordifoliae-Diospyretum lycioidis acalyphetosum caperonioidis* subass. nov.

Nomenclatural type: relevé 176 (holotypus)

This sub-association is the type of the association and is distinguished from the *Berkheyo onopordifoliae-Diospyretum lycioidis hyparrhenietosum hirtae* by the presence of the diagnostic species group K (Table 1). Other prominent and often dominant species are *Diospyros lycioides*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Eragrostis curvula*, *Themeda triandra*, *Cymbopogon excavatus* and *Aristida junciformis* (Table 1). The strong presence of the latter species confirms the extent to which this vegetation unit is degraded, which can mainly be ascribed to selective grazing by sheep.

A relatively high species richness of 33.9 and large total number of 152 species were recorded (Fig. 3).

5. *Helichrysum nudifolium-Hyparrhenia hirta* Grassland

This short to tall closed grassland (Edwards 1983) community occurs on slightly undulating topography, i.e. terrain unit 1 and 3 (Fig. 2). Although various soil types may be encountered, the Glenrosa, Mispah and Clovelly Forms are the most predominant. Soil depths vary from 200 to more than 500 mm, while percentage clay varies from 15-25%. Surface rocks are generally absent, but sometimes cover as much as 5% of the area.

The syntaxonomic position of this grassland community is unclear. It contains no diagnostic species but is distinguished by the absence of certain species groups. Physiognomically conspicuous and often dominant species include *Heteropogon contortus*, *Hyparrhenia hirta*, *Eragrostis curvula*, *Themeda triandra* and *Cymbopogon excavatus* (Table 1).

An average number of 28.5 species was recorded per sample plot, with the total number of species being 119 (Fig. 3).

6. *Cymbopogon excavatus-Hyparrhenia hirta* Grassland

This short to tall closed grassland (Edwards 1983) community occurs predominantly on midslopes (Fig. 2), and soils of the Glenrosa and Mispah Form are most frequently encountered. Soil depths vary from 200 to more than 500 mm and clay content from 15-25%. Surface rocks usually cover less than 5% of the area.

The syntaxonomic position of this community is unclear since no diagnostic species are recognised. Prominent and often dominant species include *Hyparrhenia hirta*, *Eragrostis curvula*, *Themeda triandra* and *Cymbopogon excavatus* (Table 1).

The community as a whole is relatively species poor, consisting of only 80 species, although the species richness of 28.8 is slightly above average (Fig. 3).

7. *Helichrysum aureonitens-Eulalia villosa* Grassland

This short to tall closed grassland (Edwards 1983) occurs on flat to undulating midslopes (Fig. 2). The predominant soil types are

Glenrosa, Mispah and Clovelly Forms, with depths varying from 200 to more than 500 mm and clay contents from 20-30%. Surface rock was sometimes present, covering between 5-20% of the area.

The syntaxonomic position of this grassland is unclear. Character species are absent, but the most prominent are *Eulalia villosa*, *Hyparrhenia hirta*, *Eragrostis plana* and *Aristida junciformis* (Table 1). The high cover-abundance values recorded for *Aristida junciformis* are ascribed to selective grazing (Tainton 1981) and a long history of regular autumn, or early winter, burning (Moll 1968).

The species richness (19.9) and the total number of species (77) recorded are very low (Fig. 3). Although certain parts of this community are disturbed, as manifested by the strong presence of *Aristida junciformis*, the low values reported may indeed be an indication of the actual number of species which the habitat can maintain.

8. *Sporobolo pyramidalis-Hyparrhenietum hirtae* ass. nov.

Nomenclatural type: relevé 358 (holotypus)

This short to tall closed grassland (Edwards 1983) occurs on relatively flat topography, i.e. mainly on terrain unit 3 (Fig. 2). Different soil types are encountered, the most common including Clovelly, Mispah and Griffin Forms. Soil depths vary from 300-500 mm but usually exceed 500 mm, with clay contents varying from 20-25%. Surface rocks are generally absent. This association is characterised by the diagnostic species *Sporobolus pyramidalis* (species group P, Table 1), which is a tough and unpalatable species and an indicator of overgrazed and trampled areas (Tainton 1981; Van Oudtshoorn 1991). This vegetation unit has a low grazing potential, consisting mainly of old field grassland species *Hyparrhenia hirta* and *Eragrostis curvula* (Table 1). From an ecological and agricultural point of view this vegetation unit is in a poor condition as can be inferred from the low presence of *Themeda triandra*. This grassland can be considered as Secondary Grassland, which arises from mismanagement, burning and from other forms of human activity (Edwards 1967). These grasslands are thus in a disturbed state.

An exceptionally low number of only 17.7 species per sample plot was recorded, with the total number of species (90) being also far below the average (Fig. 3).

9. *Spermacoce natalensis-Eragrostis plana* Grassland

This short to tall closed grassland (Edwards 1983) is found on terrain unit 3, which has a flat to undulating topography (Fig. 2). The predominant soils are the Glenrosa, Mispah, Clovelly and Hutton Forms. The soil depths usually exceed 500 mm, with clay percentages varying from 20-35%. Surface rocks are virtually absent throughout.

The syntaxonomic position of this grassland is unclear. Diagnostic species are absent, but physiognomically conspicuous and often dominant species are *Hyparrhenia hirta*, *Eragrostis curvula*, *E. plana* and *Cymbopogon excavatus* (Table 1). These species and the simultaneous low cover-abundance values or total absence of species of more advanced successional stages typically indicate the disturbed state of this community, caused by overgrazing and ecological unsound burning practices.

An average number of 18.5 species was recorded per sample plot, the total number of species being 93 (Fig. 3).

10. *Helichrysum rugulosum-Hyparrhenia hirta* Grassland

This short to tall closed grassland (Edwards 1983) occurs on flat to undulating midslopes (Fig. 2). Major soils encountered include Glenrosa, Mispah and Clovelly Forms.

Although soils may be deeper than 500 mm, the usual depth varies from 200-500 mm and the clay contents from 15-25%. Surface rocks are usually present, covering from 5 to more than 20% of the area.

The syntaxonomic position of this community is unclear due to the absence of diagnostic species. The most prominent species are limited in numbers, including only *Hyparrhenia hirta* and *Eragrostis curvula* (Table 1). This community is distinguished from other communities by the absence of all species groups with the exception of species groups R and S (Table 1). The predominance of a few species is again very apparent, causing especially the forb species to be present in low numbers. The disturbance factor, caused by overgrazing and ecological unsound burning practices, is clearly observable in the species composition.

The species richness of 24.4 and the total number of 99 species recorded, indicate the relative species poorness of this community (Fig. 3).

Ordination

The scatter diagram displays the distribution of the synrelevés, representing the different vegetation units, along the first and second axes (Fig. 4). The relationships among the communities, and not within each community, are expressed by this diagram. The different vegetation units show some degree of coherence but do not display a distinct discontinuity. The distribution of the synrelevés is related to particular environmental factors. A disturbance gradient is described by the first axis, with the undisturbed vegetation units occurring to the left of the diagram. The synrelevés to the right of the diagram represent informal communities with the primary grass cover disturbed and therefore dominated by *Hyparrhenia hirta*. The second axis represents a gradient displaying the change in percentage surface rock cover. Vegetation units occurring at the top of the diagram are associated with rocky conditions, whereas those at the bottom of the diagram are associated with a low percentage surface rock cover. A third and fourth gradient occur along the same diagonal line running from the bottom right corner of the diagram. Vegetation units at the bottom right of the diagram are associated with deep clayey soils, whereas those further to the top left are associated with shallow sandy soils.

Concluding remarks

The successful delineation of 15 communities was obtained from TWINSPAN classification and subsequent refinement there-of by Braun-Blanquet procedures. These communities are related to certain environmental gradients as indicated on the DECORANA scatter diagram.

High species richness, high total number of species and naturalness lend the *Helichryso oreophilum-Themedetum triandrae* conservational value. The high cover-abundances of *Themeda triandra*, *Trachypogon spicatus* and *Alloteropsis semialata*, which are indicators of relatively undisturbed veld, confirm the ecological well-preserved condition of this vegetation unit.

High species richness and naturalness also lend the *Alepideo longifoliae-Eulalietum villosae* conservational value. The *Hyparrhenia hirta-Aristida junciformis* Grassland appears to be a disturbed vegetation unit, with the optimal species composition assumed to be represented by relevé 314 which is situated on the farm Waterval on the northern slopes of the Ntabankulu mountain. The absence of *Hyparrhenia hirta* is evident and this species is suspected of invading this grassland type if managed incorrectly. The vegetation represented by relevé 314 is unfortunately endangered by everexpanding *Eucalyptus* plantations, thereby destroying important islands of high species diversity and species richness.

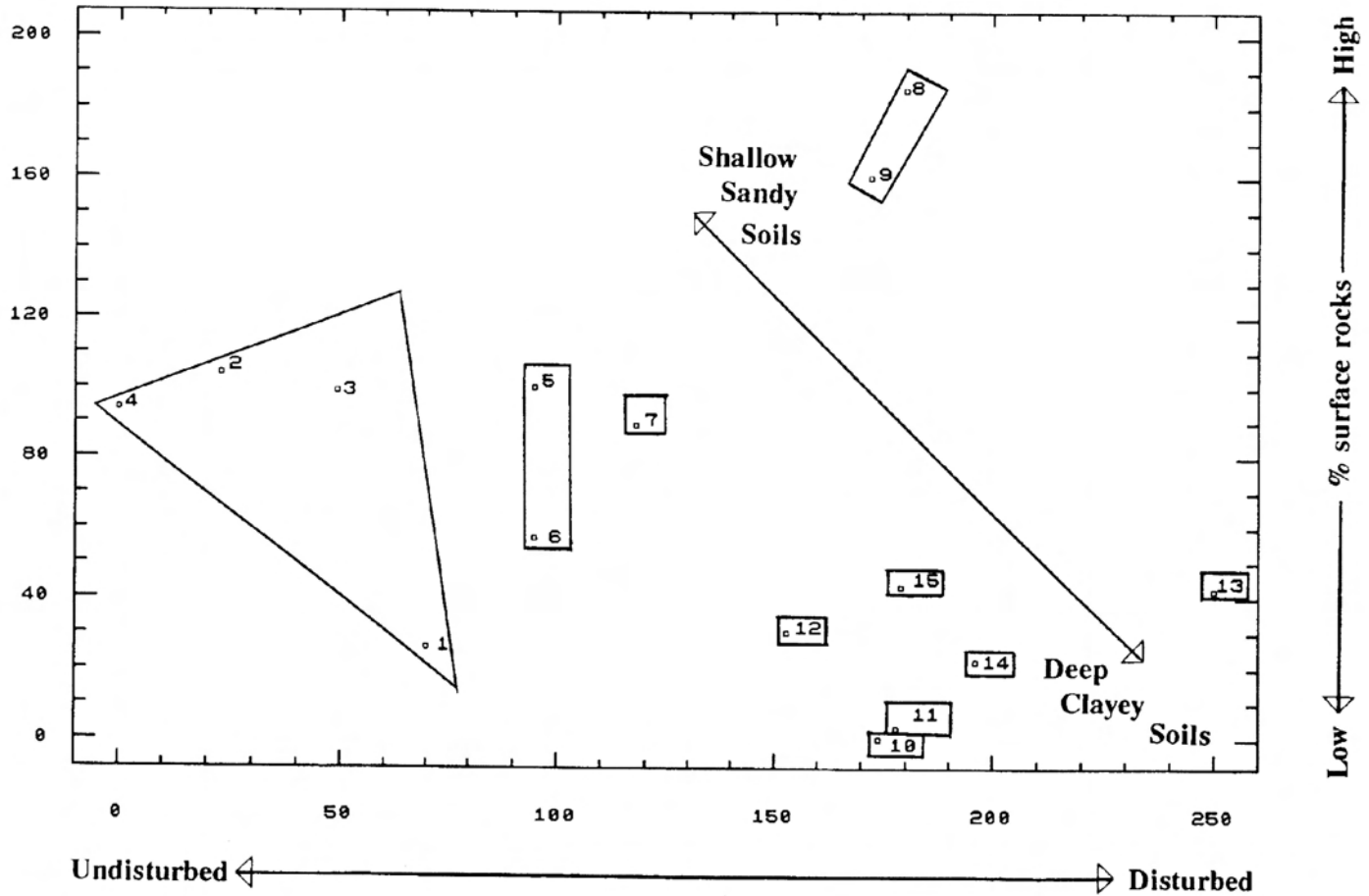


Fig. 4. DECORANA ordination to illustrate the distribution of the synrelevés along the first and second axes. The synrelevés represent the vegetation units.

In general, grasslands at altitudes of 1 500 m and higher are found suitable for afforestation purposes due to the high rainfall experienced in such regions. These mountainous regions are the origin and catchment of various rivers and smaller streams. Consequently, if these high-lying grasslands are converted into plantations, not only will areas with high species richnesses and diversity disappear, but water shortages caused by these plantations will adversely affect the environment and many people further downstream.

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