Structural characterization of vegetation in the Fynbos Biome

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in collaboration with
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PREFACE

The southern and south-western Cape is occupied by an exceptionally rich flora occurring as sclerophyllous shrublands and heathlands known locally as fynbos. The various fynbos ecosystems, their plants and animals, are of considerable scientific and aesthetic interest, while the mountain catchment areas of the region are of particular economic importance both as a water resource and as recreational areas.

Much research has been conducted in the biome in the past and in order to coordinate current activities, to stimulate new research and to synthesize available scientific information within the region, the Fynbos Biome Project was initiated in 1977.

The project is one of several cooperative scientific programmes within the National Programme for Environmental Sciences administered by the CSIR. The National Programme is a cooperative undertaking of scientists and scientific institutions in South Africa concerned with research related to environmental problems. It includes research designed to meet local needs as well as projects being undertaken in South Africa as contributions to the international programme of SCOPE (Scientific Committee on Problems of the Environment), the body set up in 1970 by ICSU (International Council of Scientific Unions) to act as a focus of non-governmental international scientific effort in the environmental field. The research of participating universities is financed from a central fund administered by the National Committee for Environmental Sciences and contributed largely by the Department of Water Affairs, Forestry and Environmental Conservation.

The first phase (1977 to 1980) of the Fynbos Biome Project has been centred on baseline studies, including the review and synthesis of current knowledge and on broad surveys of climate, soils, vegetation, fauna and land use patterns.

A number of individuals from a variety of disciplines have become involved in attempts to analyse, classify and describe fynbos plant communities on the basis of their structural, functional and physiognomic attributes, and to relate these characteristics to supposed evolutionary or adaptive responses.

The available systems of classification based on one or a combination of features of structure, function and physiognomy were either too broad or too specific for use in the Fynbos Biome. This document represents a system proposed by a group of individuals active in the field. The system is seen as providing standardized structural terms for describing extant vegetation stands or units, irrespective of the manner in which the units were initially delineated and disregarding successional considerations.

SAMEVATTING

'n Voorgestelde sisteem vir die standaardisasie van beskrywende vaktaal vir die strukturele uitbeelding van plantegroei in die Fynbosbioom word in tabelvorm geïllustreer. Spesifieke aanwendings van die sisteem word beskryf en illustrasies van sommige strukturele tipes wat in die Fynbosbioom voorkom, word ingesluit.

ABSTRACT

A proposed system for the standardization of descriptive terminology for structural characterization of vegetation in the Fynbos Biome is presented in tabular form. Specific applications of the system are described and illustrations of some structural types occurring in the Fynbos Biome are included.

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INTRODUCTION

In recent years a number of different systems for describing structural formations in the Fynbos Biome (sensu Kruger 1978) have been formulated (eg Taylor and van der Meulen in press; Kruger 1979; Department of Forestry). A great deal of plant community-oriented work is presently being undertaken by various workers as part of the Fynbos Biome Project (Kruger 1978) and this underlies the importance of having a standardized structural system applicable to the full range of vegetation within and adjacent to the Biome.

In this paper we propose a system and provide justification for its use. Two major considerations have been implicit in formulating this system: (1) it should be comparable with the system of Specht (1979) thus facilitating global comparisons of heathlands and (2) it should be capable of describing non-heathland vegetation (ie not only fynbos) within and adjacent to the Fynbos Biome.

We see the proposed system as providing standardized structural terms for describing vegetation stands or vegetation units, irrespective of the manner in which the units were initially delineated (eg floristic or structural methods, aerial photography). It is not envisaged that the system be used to name vegetation units; it is primarily for descriptive purposes. In assigning a descriptive term to a vegetation stand or unit, successional considerations are ignored; vegetation extant at the time of observation is described.

THE PROPOSED SYSTEM

The system is essentially that of Specht (1979), which was originally devised for Australian heathlands. Specht's system has major limitations when applied to vegetation types in and adjacent to the Fynbos Biome. It cannot, for example, accommodate certain non-heath shrublands such as Coastal Rhenosterbosveld, Karroid Broken Veld and Succulent Karoo (Acocks 1975). We have generalized this system so that it can incorporate non-heath shrublands while still retaining overall comparability with Specht's (1979) original system. In the case of forests and woodlands, which are limited in extent in the study area, we have followed the system of D Edwards which is being used by the syntaxonomists in the Botanical Research Institute (cf Boucher and Jarman 1977).

Our proposed system is given in Table 1 together with notes on its use.

In the scheme four basic formation classes are recognized: forest, woodland, shrubland, herbland. Unfortunately these terms have inherent problems since any single term can be used in a variety of senses. For example, in the broadest sense shrubland refers to all woody communities comprised of shrubs, including heathlands, for heaths are shrubs. In a narrower sense shrubland refers to all non-heath shrublands (Specht 1979). It is not easy to skirt this problem and we suggest that each user of the scheme is explicit about the way he uses the terms.

Table 1. Structural formations in the Fynbos Biome

PROJECTED CANOPY COVER OF THE DOMINANT STRATUM (%) (3)

GROWTH FORM OF THE DOMINANT STRATUM (3)	100-75 interlocking crown	75-50 crowns not interlocking	50-25	25-5	5-0,1
Tall Trees >10 m	Tall Forest	Closed Woodland		Open Woodland	Sparse Woodland
Low Trees <10 m	Low Forest				
Tall Shrubs >2 m	Tall Closed Shrubland (1)	Tall Mid-dense Shrubland	Tall Open Shrubland	Tall Sparse Shrubland	(4)
Mid-high Shrubs 1-2 m	Mid-high Closed Shrubland	Mid-high Mid-dense Shrubland	Mid-high Open Shrubland	Mid-high Sparse Shrubland	
Low Shrubs 25-100 cm	Low Closed Shrubland	Low Mid-dense Shrubland	Low Open Shrubland	Low Sparse Shrubland	
Dwarf Shrubs <25 cm	Dwarf Closed Shrubland	Dwarf Mid-dense Shrubland	Dwarf Open Shrubland	Dwarf Sparse Shrubland	
Shrubs and Graminoids codominant (5)	Closed Graminoid Shrubland (2)	Mid-dense Graminoid Shrubland	Open Graminoid Shrubland	Sparse Graminoid Shrubland	
Graminoids >1,0 m	Tall Closed Herbland (2)	Tall Mid-dense Herbland	Tall Open Herbland	Tall Sparse Herbland	
Graminoids <1,0 m	Closed Herbland	Mid-dense Herbland	Open Herbland	Sparse Herbland	

(1) When greater sophistication is required the terms Small-leaved, Large-leaved, Succulent, Proteoid and Ericoid can be appended to Shrubland (eg Low Open Small-leaved Shrubland).

(2) The term Graminoid can be replaced by Restioid, Grassy or Cyperoid, depending on the dominant graminoid. Similarly Herbland can be replaced by Restioland, Grassland or Sedgeland.

(3) When one wishes to refer to strata other than the dominant stratum, one can use the same terminology for canopy cover and height but the suffix 'land' will be dropped, and the terms Overstorey or Understorey can be used if necessary. Some examples are as follows: Closed Grassland with a Tall Sparse Shrub Overstorey (some Protea Pseudo-Savanna in the eastern mountains); Mid-high Mid-dense Shrubland with an Open Restioid Understorey; Tall Closed Proteoid Shrubland with a Low Mid-dense Shrub Understorey (many of the Protea communities).

(4) When one wishes to refer to low-cover shrubs or graminoids (less than five per cent) then one should use 'Very Sparse' or, if the components are emergents, then 'Emergent' should be used. For example, P. laurifolia fynbos is often Low Mid-dense Shrubland with Tall Emergent Proteoids.

(5) The Graminoid Shrubland formations should be given a height class description as for the Shrubland formations, eg Low Mid-dense Grassy Shrubland.

We suggest the use of capitalized terms when following the definitions implicit in Table 1. For example forest denotes all types of forest whereas Tall Forest denotes a vegetation where there are trees greater than 10 m tall with interlocking canopies.

In the shrubland concept as we use it in Table 1 we include heathlands and non-heath shrublands. As indicated in the glossary there are problems with the use of 'Heathland,' and in the structural system we do not recommend the use of this term for all fynbos communities.

Height and cover classes

When assigning a structural description to a vegetation type, it is unlikely that a single structural formation will suffice to describe the type if the height and cover classes are followed strictly. We feel that a deviation of 25% in height or cover is permissible. Thus, for example, a map unit designated as Low Closed Shrubland usually has a dominant stratum of shrubs 0,25 to 1,0 m high with a canopy cover greater than 75%. In some areas this unit could have shrubs as tall as 1,25 m and the shrubs could have cover as low as 60%.

The height classes are those of Specht (1979) but we have used projected canopy cover rather than Specht's projected foliage cover. No published work in the Fynbos Biome has used the latter variable. Our cover classes have been chosen to correspond with those of the Braun-Blanquet cover abundance scale.

Using the system

Each vegetation unit should be characterized by its dominant stratum and where greater sophistication is required, by its understorey and overstorey.

We use Waboomveld (Taylor 1978) to illustrate the varying degree of sophistication that is possible. A course characterization of much Waboomveld would be Sparse Woodland; at a more sophisticated level this same type could be termed a Sparse Woodland with a Low Mid-dense Grass and Shrub Understorey. We do not feel it necessary to provide strict rules for the recognition of the dominant strata (eg there is little difference between Tall Open Shrubland with a Closed Grassy Understorey and a closed Grassland with a Tall Shrub Overstorey). Where the upper stratum has low cover the understorey must be considered as the dominant stratum and the upper stratum as the overstorey. For example, Waboomveld is often Low Mid-dense Grassy Shrubland with a Sparse Low Tree Overstorey.

In certain instances mosaics of two formations may occur. An example is certain dune communities along the south coast where a Mid-high Mid-dense Large-leaved Shrubland (*Euclea*, *Rhus*) occurs in a mosaic with a Low Mid-dense Small-leaved Shrubland (*Passerina*, *Metalasia*). Since it is not possible to use the terms understorey and overstorey for these situations we suggest that the above type could be described as a Mid-high Mid-dense Large-leaved Shrubland/Low Mid-dense Small-leaved Shrubland where the oblique denotes a mosaic complex.

Where the dominant stratum consists equally of shrubs and graminoids which do not occur in a mosaic then 'Graminoid Shrubland' is used (see Table 1).

SOME APPLICATIONS OF THE PROPOSED SYSTEM

We demonstrate the application of the proposed system by providing structural characterizations of some communities described by Acocks (1975) and Kruger (1979). Descriptions of some structural types occurring in the Fynbos Biome are given in Figures 1 to 10.

Acocks's (1975) Veld Types are essentially agro-ecological units and are by no means structurally uniform. Coastal Rhenosterbosveld, for example, includes Low Forest, Tall Closed Large-leaved Shrubland, Mid-high Closed Large-leaved Shrubland, Low Open Small-leaved Shrubland, Low Mid-dense Grassy Small-leaved Shrubland, etc. Veld Types occurring within and adjacent to the Fynbos Biome include a great variety of structural types. For comparative purposes we have chosen only the dominant structural type within each Veld Type (see Table 2). Kruger (1979) on the other hand describes a range of true fynbos structural types which are compared more easily with suggested structural formations in Table 3.

Table 2. Comparison of some dominant structural types within Acocks's Veld Types occurring in and adjacent to the Fynbos Biome with suggested structural formations.

Veld Type (no.)	Structural Formation
Knysna Forest (4)	Forest
Eastern Province Thornveld (7b)	Closed Grassland and sometimes an Open Woodland (eg *Acacia karroo*)
Valley Bushveld (23)	Tall Closed Succulent and Large-leaved Shrubland
Spekboomveld (25)	Mid-high Mid-dense Succulent Shrubland
Karroid Broken Veld (26)	Low Open Succulent Shrubland (with Tall Emergent Shrubs or Low Trees eg *Euclea undulata*)
Strandveld (34a)	Mid-high Mid-dense Large-leaved Shrubland (sometimes with a Sparse Restioid Overstorey)
Coastal Rhenosterbosveld (46)	Low Mid-dense Small-leaved Shrubland

Table 3. Comparison of Kruger's (1979) fynbos structural types with suggested structural formations.

Kruger's (1979) Fynbos Types	Structural Formation
Broad sclerophyllous scrub or open scrub (*Protea* spp)	Tall Closed Proteoid Shrubland or Tall Mid-dense Proteoid Shrubland
Tall broad-sclerophyllous shrubland or open shrubland with heathland (Waboomveld)	Tall Sparse Proteoid Shrubland or Open Woodland with a Low Mid-dense Shrub Understorey
Low ericoid open heath or open graminoid heath (*Erica* and Restionaceae)	Low Mid-dense Small-leaved Shrubland or Low Mid-dense Restioid Small-leaved Shrubland
Broad-sclerophyllous closed shrubland (riparian scrub; *Meterosideros-Brachylaena* community)	Tall Closed Large-leaved Shrubland
Restioid herbland	Tall Closed Restioland; Closed Restioland, Mid-dense Restioland with a Low Sparse Small-leaved Shrub Overstorey
Low graminoid heathland (eastern mountains and hills)	Low Open Small-leaved Shrubland with a Closed Grass Understorey
Coastal Fynbos on limestone	Tall Mid-dense Proteoid Shrubland with a Low Sparse Shrub Understorey
Fynbos on coastal sands (*Euclea racemosa*, *Rhus lucida-Passerina vulgaris*, *Metalasia muricata*)	Mid-high Mid-dense Large-leaved Shrubland/Low Mid-dense Small-leaved Shrubland

Figure 1. Low Open Succulent Shrubland (with a Tall Sparse Shrub Overstorey). Karroid Broken Veld near Calitzdorp.

Figure 2. Mid-high Open Small-leaved Shrubland (with a Tall Sparse Shrub Overstorey and a Sparse Restioid Understorey). Arid Fynbos near Pakhuis.

Figure 3. Low Mid-dense Small-leaved Shrubland. Mountain Renosterbosveld near Calitzdorp.

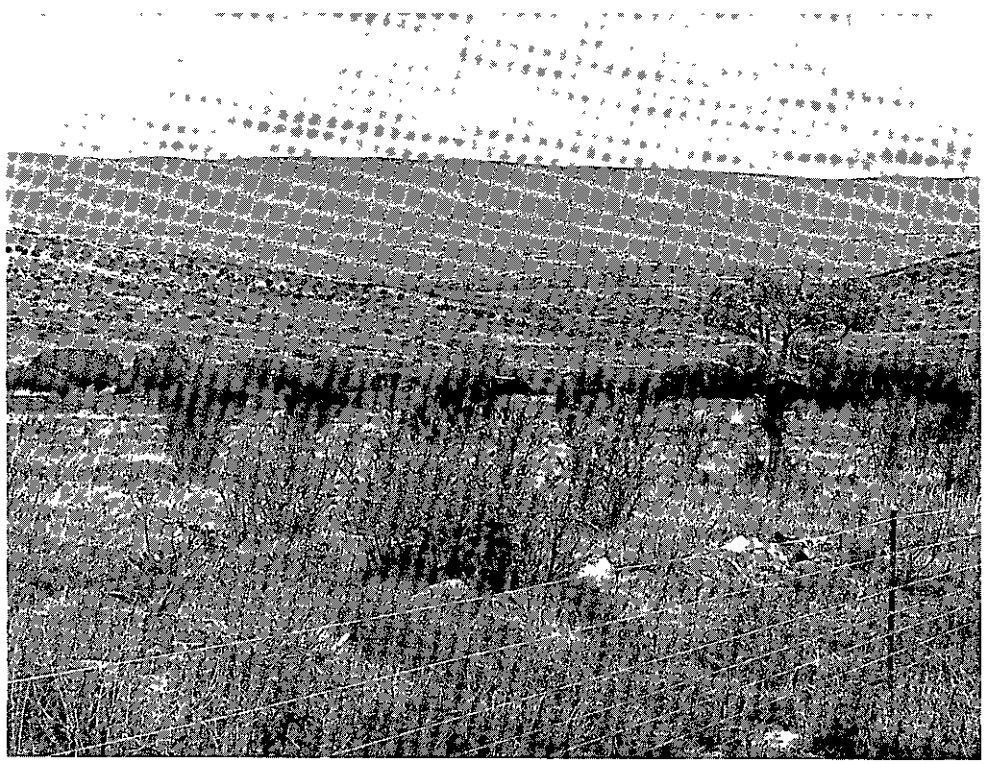

Figure 4. Low Closed Grassy Shrubland (with a Mid-high Sparse Shrub Overstorey). False Karroid Broken Veld near Ann's Villa, Zuurberg.

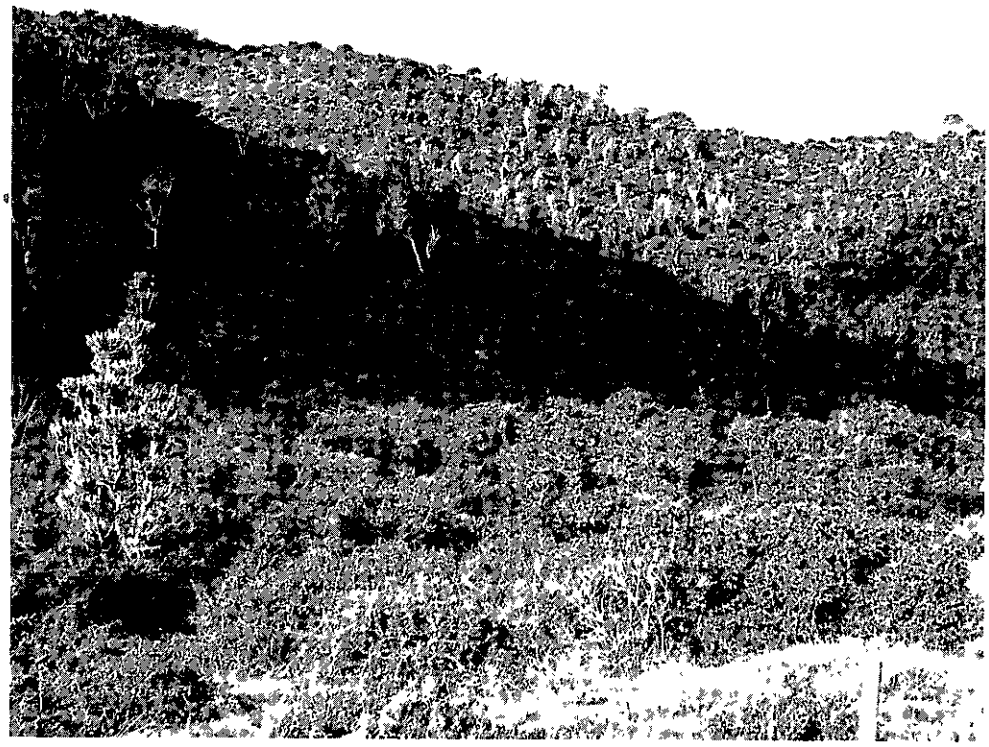

Figure 5. Tall Closed Large-leaved Shrubland (with an Open Succulent Low Tree Overstorey). Valley Bushveld near Addo.

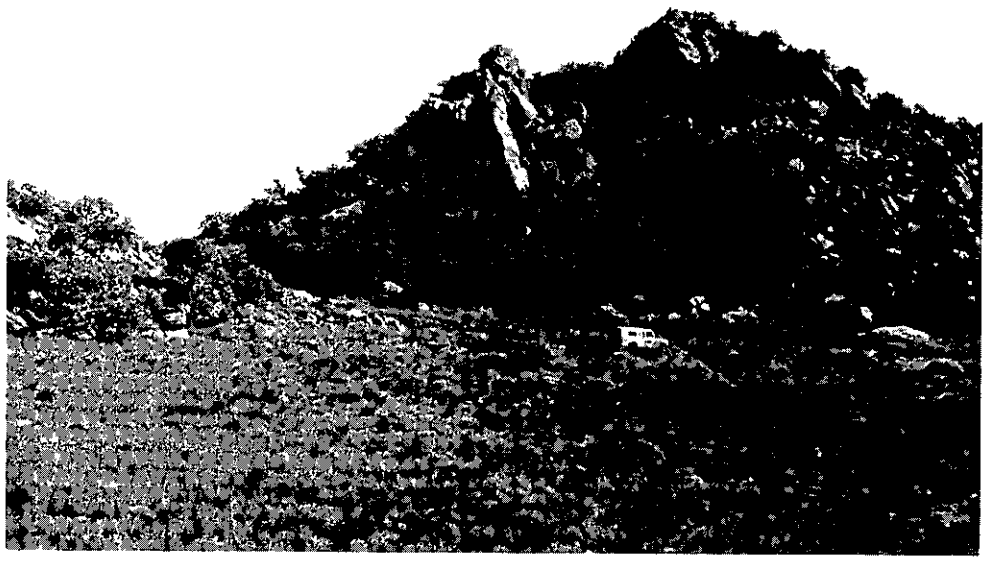

Figure 6. Background: Low Forest and Tall Closed Large-leaved Shrubland. Groot Winterhoek Mountains.

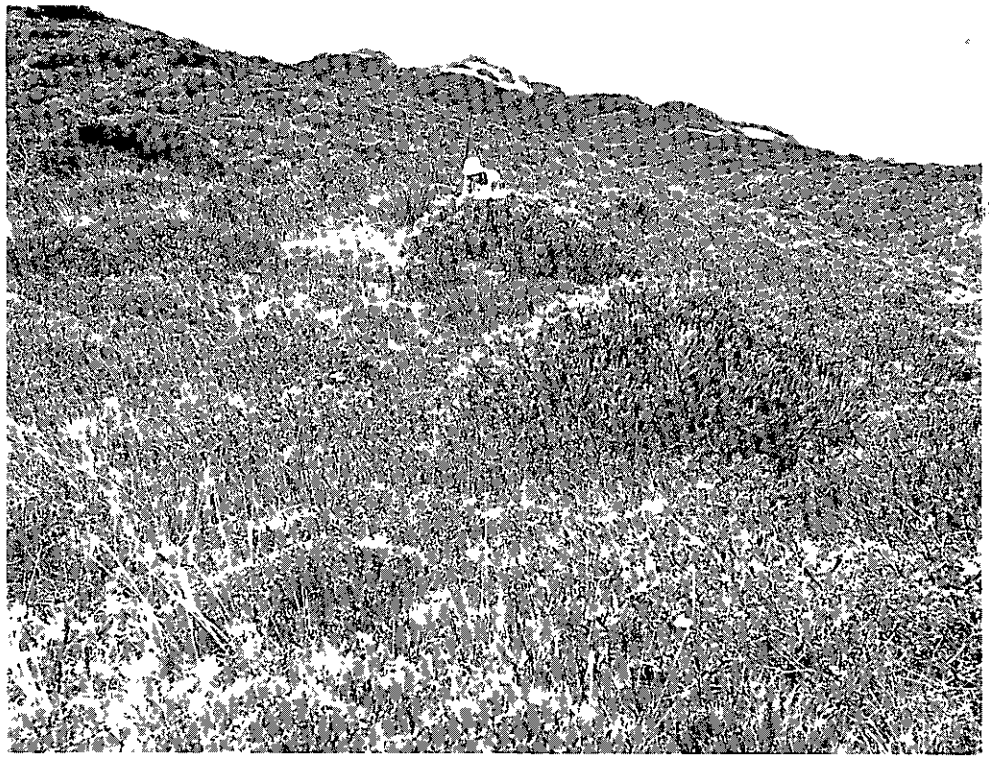

Figure 7. Low Closed Small-leaved Graminoid Shrubland/Mid-high Closed Large-leaved Shrubland. Dune Fynbos near Groenvlei.

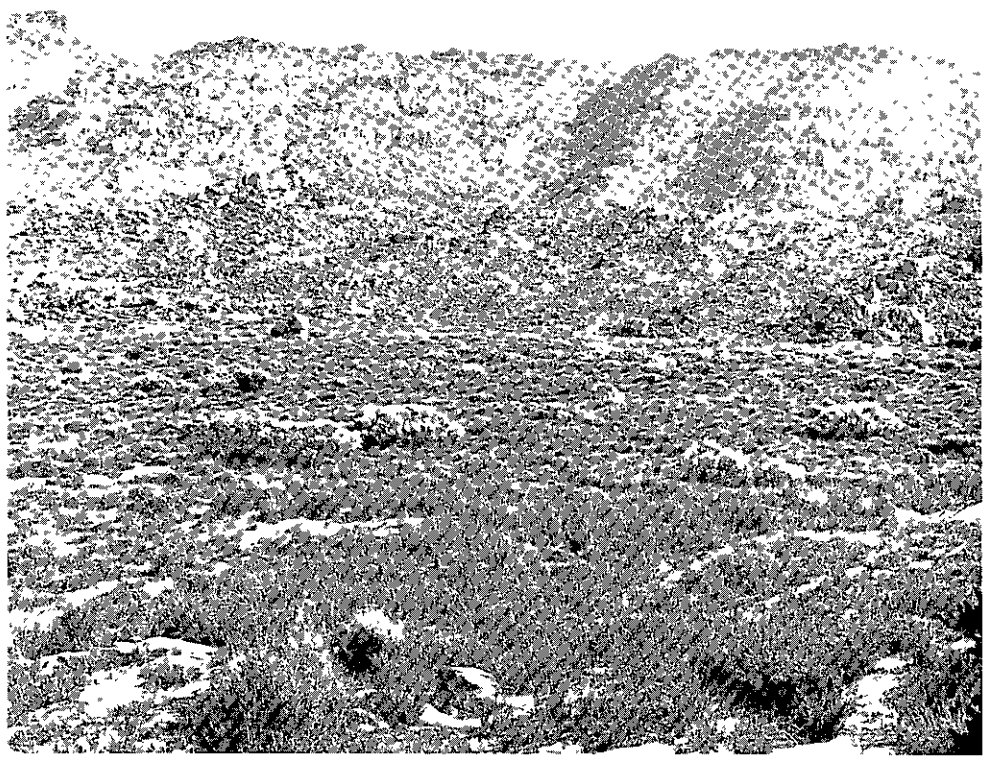

Figure 8. Mid-dense Restiolands (with a Mid-high Sparse Proteoid Shrub Overstorey). Mountain Fynbos, Cedarberg.

Figure 9. Mid-high Closed Proteoid and Ericoid Shrubland (with a Tall Open Proteoid Overstorey). Mountain Fynbos, Robinson's Pass.

Figure 10. Mid-high Closed Ericoid Shrubland (with an Open Restioid Understorey). Mountain Fynbos, Cedarberg.

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GLOSSARY

Cover

Our cover classes are expressed in percentage cover. Often easier to measure is the distance between plant crowns, measured in terms of crown diameters apart. A rough conversion of some of our class limits is as follows:

25% = 1 crown diameter apart

5% = 3 crown diameters apart

0,1% = 30 crown diameters apart

Cyperoid see Graminoid

Dominant growth form

As a rough rule, a growth form is dominant if it has three times more cover than another growth form. Thus a vegetation type is Restioland if restioids have three times more cover than shrubs in the same stratum. If shrubs have three times more cover than restioids then it is a Shrubland. In intermediate situations the formation name Restioid Shrubland is applied. Similarly restioids must have three times more cover than grasses or sedges for the name Restioid Shrubland to be applied in preference to Grassy Shrubland or Cyperoid Shrubland.

Ericoid

Narrow sclerophyllous leaves with lower surface deeply grooved (Specht 1979).

Graminoid

We recognize three floristic types: Grasses (Poaceae - as in Grassland, Grassy Shrubland, 'with a Grassy Understorey'); Restioids (Restionaceae: Restioland, Restioid Shrubland, 'with a Restioid Understorey') and Sedges (Cyperaceae: Sedgeland, Cyperoid Shrubland, 'with a Cyperoid Understorey').

Grasses see Graminoid

Heathland

Some users may wish to use the term heathland to distinguish fynbos shrublands from non-fynbos shrublands. This term, however, is not without problems. In many fynbos communities true heaths (Ericales) are lacking (eg much of the Arid Fynbos, grassy fynbos and Restioland). Some Cape workers would prefer to restrict the term heathland to those fynbos communities which have a high ericaceous component (W Bond personal observation; B M Campbell personal observation; R M Cowling personal observation). Furthermore the Australian usage of heathland does not include proteoid formations (Specht 1979). These are termed Proteoid Shrublands.

Height

The height of a vegetation is measured to the highest vegetative organ.

Leaf-size

We use 'small-leaved' for indicating leaves <25 mm^2 and 'large-leaved' for leaves >25 mm^2. We have no objection to the direct use of Raunkiaer's (1934) terminology:

Leptophyll	<25 mm^2
Nanophyll	25-225 mm^2
Microphyll	2-20 cm^2
Mesophyll	20-182 cm^2

Proteoid

We reserve this term to describe the isobilateral, broad, sclerophyllous leaves of most Proteaceae (cf Taylor 1978).

Restioid see Graminoid

Sedges see Graminoid

Shrub

Any woody plant under 2 m is a shrub. Woody plants between 2-5 m are shrubs if they are multi-stemmed (branch below 0,5 m) or if they have a diameter at breast height <10 cm, and are trees if they are single-stemmed and have a diameter at breast height >10 cm. Plants above 5 m are trees unless they have very small diameters at breast (<5 cm). Thus in fynbos there are very few trees. Occasionally the southern Cape proteoid communities are Closed Woodlands (eg Protea mundii, and sometimes P. aurea and Leucadendron eucalyptifolium). Waboomveld is often a Sparse Woodland. See Kruger's (1979) discussion of trees in fynbos.

Tree see Shrub.

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