

# Floristic and structural features of the coastal foreland vegetation south of the Berg River, western Cape Province, South Africa

C. BOUCHER\*

## ABSTRACT

Floristic and structural features of the three main vegetation types found in the coastal foreland of the western Cape Province, south of the Berg River, are outlined. Coastal Renosterveld, which occupies 6% of its former extent, is the most threatened type, followed by Coastal Fynbos (14%) and West Coast Strandveld (41%). Coastal Renosterveld is closely related to Mountain Fynbos vegetation found on clay-rich soils together with West Coast Strandveld inclusions in specific habitats. Coastal Renosterveld is the product of recent regular disturbance by a short interval burning regime and overgrazing.

## RÉSUMÉ

*TRAITS FLORISTIQUES ET STRUCTURAUX DE LA VÉGÉTATION DE L'AVANT-PAYS CÔTIER DE LA RIVIÈRE BERG, DANS LA PROVINCE OCCIDENTALE DU CAP EN AFRIQUE DU SUD*

*Les traits floristiques et structuraux de trois types de végétation trouvés dans l'avant-pays côtier de la Province occidentale du Cap, au sud de la rivière Berg, sont esquissés. Le Renosterveld Côtier, qui occupe 6% de son étendue antérieure, est le type le plus menacé, suivi par le Fynbos Côtier (14%) et le Strandveld de la Côte Occidentale (41%). Le Renosterveld Côtier est étroitement apparenté à la végétation du Fynbos de Montagne trouvée sur des sols riches en argile avec des enclaves de Strandveld de la Côte Occidentale dans des habitats spécifiques. Le Renosterveld Côtier résulte d'une perturbation régulière récente consistant en un régime de brûlage à courts intervalles et un surpâturage.*

## INTRODUCTION

The Cape Floral Kingdom (Good, 1974; Takhtajan, 1969) is concentrated in the region known as Capensis (Taylor, 1978; Walter, 1973). The western part has a distinctly mediterranean-type climate with dry summers and wet winters, but eastward the rainfall becomes increasingly non-seasonal (Taylor, 1980). The region is bounded to the north and east principally by the Karoo-Namib Region together with some outliers of the Sudano-Zambezian and Afromontane Regions (Taylor, 1980; Werger, 1978; Werger & Coetsee, 1978; White, 1978).

The Capensis vegetation has recently been subdivided into two main formations, namely, the heathlands on oligotrophic soils which are called fynbos (Kruger, 1979) and mediterranean-type shrublands, the scrub formations found on the more fertile soils, called renosterveld and strandveld (Boucher & Moll, 1981; Di Castri, 1981).

The indigenous vegetation of the coastal foreland of the western Cape Province, between the Berg River and False Bay is described in this paper. Structural and floristic features of the vegetation are related to variations in the habitat. Some tentative suggestions on the affinities between the local veld types (Acocks, 1975) and their derivation are presented. The main vegetation types shown in Fig. 1 are based on the interpretation of 1: 10 000 scale orthophoto maps, on data obtained from the intensive study of three east-west transects through the area, and on field experience. Island outliers of

Mountain Fynbos, which occur on upland sites, are not described in this article.

A variety of geological substrates of various ages is exposed in the western coastal foreland which contribute to the ecological diversity of the vegetation. The oldest substrates are the Late Precambrian Malmesbury Group shales which are intruded by Cape granites and are overlain by Klipheuwel and Table Mountain Group sandstones and shales with Mesozoic to Cainozoic limestones, calcretes and sands on top.

The western Cape has been inhabited by hunter-gatherers since the Late Pleistocene and by herders for at least the last 2000 years (Avery, 1975). Nomadic Khoisan or Hottentot tribes used fire to stimulate vegetation regrowth for grazing purposes, a habit adopted by European man subsequent to his arrival here in 1652. Fires caused by lightning and by rock falls are considered to be a natural phenomenon in the mountains of the south-western Cape (Taylor, 1978) and they would presumably have spread from there to the adjacent lowland areas.

European man has destroyed large areas of the coastal foreland vegetation through his unrelenting quest for grazing, for fuel and for arable land. This vegetation has been depleted to the extent that at most only 14.7% of the western coastal foreland vegetation remains in a reasonably natural state today. Table 1 outlines the degree to which the three veld types in this area, namely, West Coast Strandveld, Coastal Renosterveld and Coastal Fynbos, have been reduced through the activities of man. Coastal Renosterveld is by far the most threatened of these veld types.

\* Botanical Research Unit, Department of Agriculture, P.O. Box 471, Stellenbosch 7600, South Africa.

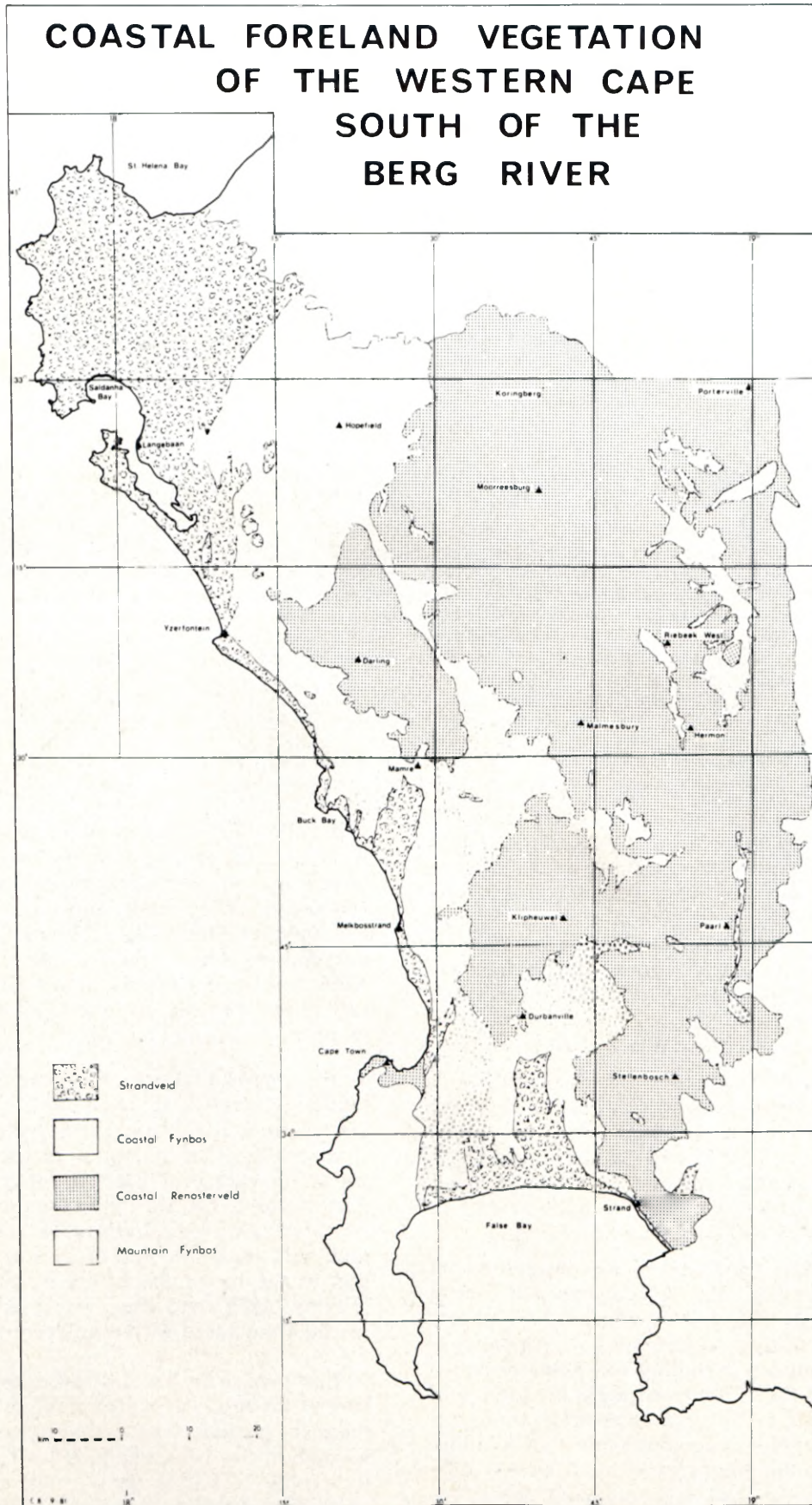


FIG. 1.—Coastal foreland vegetation of the western Cape south of the Berg River.

TABLE 1.—Remaining natural vegetation in the western Cape foreland south of the Berg River in 1972. Extracted from the 1972 series of 1:10 000 scale orthophoto maps

Veld Type	Original area (ha)	Remaining area (ha)	Percentage left
West Coast Strandveld	177 266	74 195	41%
Coastal Fynbos	295 860	41 239	14%
Coastal Renosterveld	512 266	29 502	6%

## WEST COAST STRANDVELD

Strandveld vegetation is found on calcareous dune sands, calcretes, limestones, weathered granites and shales.

Mature, West Coast Strandveld communities are dominated by a fairly continuous canopy of sclerophyllous, nanophyllous to microphyllous, divaricately branched, nanophanerophytes such as *Chrysanthemoides incana*, *Colpoon compressum*, *Euclea racemosa*, *Olea exasperata* and *Pterocelastrus tricuspidata* forming a 1.0–2.5 m tall scrub. The West Coast Strandveld is commonly referred to as a broad-leaved sclerophyllous scrub. Deciduous, succulent-leaved nanophanerophytes such as *Othonna floribunda* and *Zygophyllum morgsana* are usually present (Boucher & Jarman, 1977). Chamaephytes generally form a lower shrub layer with perennial grasses abundantly interspersed up to 1.0 m tall. Typical species of the lower shrub layer are *Ehrharta calycina*, *E. villosa*, *Limonium perigrinum*, *Ruschia caroli*, *Tetragonia fruticosa* and *T. spicata*. A high proportion of the West Coast Strandveld shrubs, dwarf shrubs and even annuals have succulent leaves or stems. Deciduous-leaved geophytes are regularly encountered and the annual flora often provides mass displays of colour in spring particularly in disturbed areas (Acocks, 1975; Boucher & Jarman, 1977; Boucher & Moll, 1981; Taylor, 1978).

Strandveld vegetation is very variable, for instance the sandy littoral generally supports prostrate, spreading succulent chamaephytes, while small patches of a tall broad-leaved sclerophyllous scrub, up to about 3.5 m high, with a closed canopy can develop in isolated sheltered positions between the dunes. The dominant species in these latter situations are *Euclea racemosa* and *Sideroxylon inerme*.

Scattered clumps of *Willdenowia striata* and emergent *Thamnochortus* spp. (Restionaceae), associated with a depauperate West Coast Strandveld vegetation, occur with increasing abundance as the distance from the sea increases, together with marginal fynbos species belonging to the Fabaceae (*Aspalathus*), Polygalaceae (*Muraltia* and *Nylandtia*), Rutaceae (*Agathosma* and *Diosma*) and Thymelaeaceae (*Passerina*). Ericaceae and Proteaceae are not found in West Coast Strandveld vegetation.

## COASTAL RENOSTERVELD

This veld type is found on shales and granites in a rainfall zone of 250–550 mm per annum. Typically,

Coastal Renosterveld consists of a matrix of cupressoid and leptophyllous, orthophyllous, divaricately branched shrubs, particularly Asteraceae such as *Athanasia trifurcata*, *Elytropappus rhinocerotis*, *Eriocephalus africanus*, *Felicia filifolia*, *Metalasia muricata* and *Stoebe spiralis* 1–2 m tall. *Anthospermum aethiopicum* (Rubiaceae) is generally abundant and geophytes belonging to the families Iridaceae, Liliaceae and Oxalidaceae are important components of the basic Coastal Renosterveld matrix. Perennial grasses such as *Cymbopogon marginatus*, *Pentaschistis* spp. and *Themeda triandra* become locally abundant with annual European grasses and herbs common in very disturbed situations. Restionaceae are seldom dominant, but can usually be found in this veld type. Randomly scattered bush clumps through the Coastal Renosterveld matrix are dominated by the sclerophyllous evergreen tree, *Olea europaea* subsp. *africana*. The margins and interior of these 2–4 m tall *Olea* patches are commonly dominated by deciduous, orthophyllous, microphyllous, nanophanerophytes, particularly a number of *Rhus* species. Hemicryptophytes and geophytes are usually abundant in the herbaceous stratum. These bush clumps are associated with *Microhodotermes viator* termitaria which have been present in the area for the last one million years (J. J. N. Lambrechts, pers. comm.). These bush clumps are also usually clustered around rock outcrops and drainage lines, probably because of more favourable, moist, local conditions.

For at least a decade or two these old lands retain an overwhelming dominance of the Asteraceae found in the general Coastal Renosterveld matrix. Single robust *Elytropappus rhinocerotis* individuals have been found to persist for at least 50 years.

Coastal Renosterveld is not generally considered to be a true Cape heathland vegetation because it lacks the constant presence of the ericoid component (Taylor, 1978), although Ericaceae are not entirely absent from this veld type.

## COASTAL FYNBOS

This heathland vegetation occurs on leached acid sands which accumulate from the *in situ* weathering of granites and sandstones, or as wind blown accumulations of sand from rivers or estuaries, or on leached maritime dunes. The sands vary in depth from less than a metre to more than 70 m.

The typical form of this veld type is dominated by ericoid, narrow leptophyllous, evergreen, divaricately branched shrubs and rhizomatous hemicryptophytes 0.75–1.50 m tall. Taller, up to 2.5 m high,

micro- to mesophyllous, sclerophyllous, shrubs increase towards the margins of the Coastal Fynbos where the sand is shallower. Annual herbs and geophytes occur throughout, but they do not assume the same proportions found in either the Coastal Renosterveld or the West Coast Strandveld. The low nutrient status of the substrate is probably responsible for the virtual absence of the invasive European annual flora. In contrast, this treeless vegetation (Campbell *et al.*, 1979; Kruger, 1979; Levyns, 1961) is very susceptible to invasion by trees and tall shrubs from the Australian heathlands, such as *Acacia* spp. and *Eucalyptus* spp. *Leptospermum* spp., and by *Pinus* spp. from the northern hemisphere heathlands.

The Coastal Fynbos is a complete fynbos vegetation dominated by typical Cape elements, namely, Proteaceae, Restionaceae and by ericoid-leaved shrubs, although not by Ericaceae. Three of the five endemic Cape families, Bruniaceae, Penaeaceae and Stilbaceae are found. It is characterized by the presence of *Erica mammosa*, *Phyllica cephalantha*, *P. stipularis*, *Thamnochortus obtusus* and *T. punctatus*. Acocks (1975) referred to 'an easy transition' between Coastal Fynbos and its adjacent Coastal Renosterveld and West Coast Strandveld vegetation in which large clumps of *Willdenowia striata* (Restionaceae) become particularly evident. These veld types are, however, quite distinct, although local patches of West Coast Strandveld, associated with calcrete outcrops, and of Coastal Renosterveld, associated with partially exposed termitaria or granite outcrops, occur within Coastal Fynbos.

#### DISCUSSION

The West Coast Strandveld in the arid winter rainfall area of Namaqualand has a more open canopy than in the western Cape and the vegetation is generally shorter. Succulents become more prominent and the vegetation assumes the appearance of Succulent Karoo after disturbance. Scrub forest patches are far more common in the strandveld east of False Bay, where the summer drought is less severe (Boucher & Moll, 1981; Taylor, 1961, 1978; Von Breitenbach, 1974). The West Coast Strandveld plants react to the dry summer and wet winter periods in an expected fashion, growing when it is wet and being generally dormant in the dry period. The dominant broad-leaved sclerophyllous scrub species all sprout after fires. The West Coast Strandveld is, therefore, a typical mediterranean-type climate shrubland vegetation of lime-rich sandy soils adapted to a fire regime.

Some component species of the western Coastal Fynbos are apparently out of phase with their environment in that they grow during the dry summer period. A high proportion of the Coastal Fynbos species have very small or reduced leaves, a low proportion of succulence and the perennial herbaceous flora is largely hard and stiff with reduced leaves and photosynthetic stems. These conditions are possibly an adaptation to the low

nutrient status of the substrate where it is advantageous to utilize the meagre nutrient resources efficiently, as soon as they become available, without wasting them in the production of unnecessary vegetative parts. They also have anatomical adaptations to use water economically (Cutler 1972; Low, 1980; Specht, 1979; Specht *et al.*, 1980).

The ability of western Coastal Fynbos to survive under low rainfall minima is indicated by its presence in the semidesert conditions of Namaqualand in a rainfall of around 100 mm *per annum*. This contrasts markedly to the Coastal Fynbos in the Knysna area of the southern Cape, which receives a mean annual rainfall of about 1 400 mm per annum and occurs alongside tall temperate forests. The low rainfall (100–700 mm *per annum*), the summer soil moisture deficits and the periodic fires have been suggested as reasons for the absence of indigenous trees in the western Coastal Fynbos (Campbell *et al.*, 1979).

Coastal Fynbos is far more uniform in composition than Mountain Fynbos, possibly because of the uniformity of the sandy plains in contrast to the great variety of niches present in the folded mountains of the Cape.

Coastal Renosterveld is akin to the Californian Coastal Sage (Rutherford, 1978; Taylor, 1978) in that it is the product of a disturbed environment. This condition is shown by the overwhelming dominance over large areas by a few species with pioneering abilities. It is tempting to postulate about the development of the Coastal Renosterveld to its present state. Species which can become dominant in pelitic upland fynbos, that is Mountain Fynbos on weathered granites or shales, are either dominant or are scattered through the Coastal Renosterveld. These species that are mainly confined to the shrubby matrix of the Coastal Renosterveld are largely unpalatable seed regenerating species with a short maturation period of maximally five years (e.g. the dominant Asteraceae), or sprouting species of Ericaceae (*Erica sparsa*), Proteaceae (*Leucadendron salignum*) and Restionaceae (*Restio cuspidata*), or geophytes (*Watsonia* spp.). Fifty-four percent of the species found in a recent survey to be restricted to the Coastal Renosterveld have also been recorded in the Mountain Fynbos vegetation of the Jonkershoek State Forest. The remaining bush clump species on termitaria and around granite rock outcrops in the Coastal Renosterveld are largely sprouting species, geophytes and annuals which are structurally and floristically allied to the West Coast Strandveld.

The overwhelming contribution of species which can withstand recurrent five yearly fires is indicated in Table 2 for the western coastal lowland.

The conclusion drawn is that the western coastal foreland vegetation is the product of disturbance that probably took the form of repeated short interval fires, overgrazing and the collection of firewood (Acocks, 1979; Killick, 1979; Kruger, 1979; Levyns, 1929, 1950, 1956; Story, 1952).

Present day longer intervals of more than ten years between fires and the almost complete

TABLE 2.—Mode of regeneration of perennial species restricted to each of the three veld types in the coastal foreland of the western Cape (data based on observation and the analysis of sample data)

Veld Type	Number of samples	Number of species	Geo-phytes	Hemicrypto-phytes	Sprout-ing shrubs	Succu-lents	Seeders maturing in < 5 yrs	Seeders maturing in > 5 yrs
West Coast Strand-veld	105	84	15%	10%	29%	25%	21%	—
Coastal Renoster-veld	133	181	22%	13%	27%	7%	30%	1%
Coastal Fynbos	54	66	5%	18%	45%	3%	26%	3%

destruction of the larger indigenous fauna, including both predators and grazers, has allowed a continuous shrub canopy to develop in undisturbed areas of Coastal Renosterveld. The herbaceous flora has consequently become depleted under these conditions through shading and through increased termite activity.

The extensive cultivation of annual wheat crops, together with the continued general destruction of the indigenous vegetation, particularly through overgrazing, has led to soil erosion and a generally drier soil climate in which the West Coast Strandveld flora, particularly the succulent component, is becoming more conspicuous in areas now supporting Coastal Renosterveld.

#### CONCLUSIONS

The West Coast Strandveld, Coastal Fynbos and Coastal Renosterveld all appear to be types that have been exposed to a relatively short interval fire regime and to heavy grazing. This is a relatively recent phenomenon, probably related to the appearance about 2 000 years ago of pastoral Khoisan (Hottentot) tribes, who used fire to improve the grazing for their flocks of sheep and cattle. Subsequent to their settlement here 300 years ago, European settlers adopted this practice in an uncontrolled fashion, despite repeated legislation and heavy fines designed to curb this habit (Botha, 1924). It might reasonably be postulated that the present composition and structure of the lowland vegetation, particularly of the treeless Coastal Fynbos, is due to the very recent introduction of a short interval fire regime under which a tree flora must still evolve. The success of the acacias, pines and eucalypts in the Coastal Fynbos suggests, however, that the evolution of an indigenous tree flora might never take place because this so-called 'vacant niche' will have been occupied.

Unvegetated expanses of sand accompany overgrazing in Coastal Fynbos and result in longer intervals between fires. The systematic burning of this veld type to obtain better grazing has been superseded recently, in parts by brush-cutting. This system benefits the sprouting plants, particularly the Restionaceae, which achieve an overwhelming dominance to the detriment of seed regenerating

species. This degradation is equivalent to that of Coastal Renosterveld and West Coast Strandveld, under a short interval burning regime coupled with overgrazing where the stages of degradation go from dominance by scrub, to shrubs, to low inedible dwarf shrubs, particularly succulents, to perennial herbs and finally to dominance by annuals. This degradation is considered to be related to a general drier soil climate.

#### ACKNOWLEDGEMENTS

The information presented in this paper is the result of research being undertaken for a Ph.D. degree at the University of Stellenbosch under Dr J. G. Smith and Prof. E. J. Moll (University of Cape Town) and is part of a research project being carried out for the Department of Agriculture and Fisheries.

#### REFERENCES

- ACOCKS, J. P. H., 1975. Veld types of South Africa. 2nd edn *Mem. bot. Surv. S. Afr.* No. 40.
- ACOCKS, J. P. H., 1979. The flora that matched the fauna. *Bothalia* 12: 673–709.
- AVERY, G., 1975. Discussion on the age and use of tidal fish-traps (viswywers). *S. Afr. archaeol. Bull.* 30: 105–113.
- BOUCHER, C. & JARMAN, M.L., 1977. The vegetation of the Langebaan area, South Africa. *Trans. R. Soc. S. Afr.* 42: 241–272.
- BOUCHER, C. & MOLL, E. J., 1981. South African Mediterranean shrublands. In F. di Castri, D. W. Goodall & R. L. Specht, *Mediterranean-type shrublands*. Amsterdam: Elsevier.
- BOTHA, C. C., 1924. Note on early veld burning in the Cape Colony. *S. Afr. J. Sci.* 21: 351–352.
- CAMPBELL, B. M., MCKENZIE, B. & MOLL, E. J., 1979. Should there be more tree vegetation in the Mediterranean climatic region of South Africa? *Jl S. Afr. Bot.* 45: 453–458.
- CUTLER, D. F., 1972. Vicarious species of Restionaceae in Africa, Australia and South America. In D. H. Valentine, *Taxonomy, phytogeography and evolution*. London: Academic Press.
- DI CASTRI, F., 1981. Mediterranean-type shrublands of the world. In F. di Castri, D. W. Goodall & R. L. Specht, *Mediterranean-type shrublands*. Amsterdam: Elsevier.
- GOOD, R., 1974. *The geography of the flowering plants*. 4th edn London: Longman.
- KILLICK, D. J. B., 1979. African mountain heathland. In R. L. Specht, *Heathlands and related shrublands of the world. A. Descriptive studies*. Amsterdam: Elsevier.
- KRUGER, F. J., 1979. South African heathlands. In R. L. Specht, *Heathlands and related shrublands of the world. A. Descriptive studies*. Amsterdam: Elsevier.
- LEVYNS, M. R., 1929. Veld-burning experiments at Idas Valley, Stellenbosch. *Trans. R. Soc. S. Afr.* 17: 61–92.

- LEVYNS. M. R., 1950. The relations of the Cape and the Karoo floras near Ladismith, Cape. *Trans. R. Soc. S. Afr.* 32: 235-246.
- LEVYNS. M. R., 1956. Notes on the biology and distribution of the rhenoster bush. *S. Afr. J. Sci.* 52: 141-143.
- LEVYNS. M. R., 1961. Some impressions of a South African botanist in temperate western Australia. *Jl S. Afr. Bot.* 27: 87-97.
- LOW. A. B., 1980. Preliminary observation on specialized root morphologies in plants of the western Cape Province. *S. Afr. J. Sci.* 76: 513-516.
- RUTHERFORD. M. C., 1978. Karoo-fynbos biomass along an elevational gradient in the western Cape. *Bothalia* 12: 555-650.
- SPECHT. R. L., 1979. Heathlands and related shrublands of the world. In R. L. Specht, *Heathlands and related shrublands. A. Descriptive studies*. Amsterdam: Elsevier.
- SPECHT. R. L., MOLL. E. J., PRESSINGER. F. & SOMMERVILLE. J., 1980. *Moisture regime and nutrient control of seasonal growth in mediterranean-type ecosystems*. Paper read at the 3rd International Conference on Mediterranean-type Ecosystems held in Stellenbosch, South Africa.
- STORY. R., 1952. A botanical survey of the Keiskammahoeck district. *Mem. bot. Surv. S. Afr.* No. 27.
- TAKHTAJAN. A., 1969. *Flowering plants: origin and dispersal*. Edinburgh: Oliver & Boyd.
- TAYLOR. H. C., 1961. Ecological account of a remnant coastal forest near Stanford. Cape Province. *Jl S. Afr. Bot.* 27: 153-165.
- TAYLOR. H. C., 1978. Capensis. In M. J. A. Werger, *The biogeography and ecology of southern Africa*. The Hague: Junk.
- TAYLOR. H. C., 1980. Phytogeography of fynbos. *Bothalia* 13: 231-235.
- VON BREITENBACH. F., 1974. *Southern Cape forests and trees*. Pretoria: Govt. Printer.
- WALTER. H., 1973. *Vegetation of the earth in relation to climate and ecophysiological conditions*. London: English Univ. Press.
- WERGER. M. J. A., 1978. The Karoo-Namib Region. In M. J. A. Werger, *Biogeography and ecology of southern Africa*. The Hague: Junk.
- WERGER. M. J. A. & COETZEE. B. J., 1978. The Sudano-Zambezian Region. In M. J. A. Werger, *Biogeography and ecology of southern Africa*. The Hague: Junk.
- WHITE. F., 1978. The Afromontane Region. In M. J. A. Werger, *Biogeography and ecology of southern Africa*. The Hague: Junk.