

This impressive work is the first comprehensive account of the vegetation of southern Africa. The region contains a remarkable juxtaposition of different ecosystems, yet it forms a cohesive ecological unit with exceptionally high endemism.

The book is divided into three major parts: Part 1 provides the physiographic, climatic, biogeographic and historical background essential for understanding contemporary vegetation patterns and processes. Part 2 includes systematic descriptions of the characteristics and determinants of major vegetation units (the major terrestrial biomes, coastal vegetation, freshwater wetlands and marine vegetation). Part 3 elaborates on selected ecological themes of particular importance, including grazing, fire, alien plant invasions, conservation and human use of plants. These are discussed in the context of prevailing paradigms in the international literature.

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Edited by **R M Cowling, D M Richardson & S M Pierce**

Institute for Plant Conservation, University of Cape Town, South Africa



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This volume is dedicated to the memory of
J.P.H. Acocks (1911–1979) whose seminal work, *Veld Types of South Africa*,
inspired two generations of southern African plant ecologists.

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Contributors [chapter numbers in brackets]

Allsopp, N. Range and Forage Institute, Botany Department, University of the Western Cape, Bellville 7535, South Africa. [16]

Anderson, H.M. National Botanical Institute, Private Bag X101, Pretoria, 0001, South Africa. [4]

Anderson, J.M. National Botanical Institute, Private Bag X101, Pretoria, 0001, South Africa. [4]

Anderson, R.J. Seaweed Unit, Sea Fisheries Research Institute, Private Bag X2, Rogge Bay 8012, South Africa. [15]

Avis, A.M. Department of Botany, Rhodes University, P.O. Box 94, Grahamstown 6140, South Africa. [13]

Bolton, J.J. Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [15]

Bond, W.J. Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [18]

Boucher, C. Department of Botany, University of Stellenbosch, Stellenbosch 7600, South Africa. [13]

Bredenkamp, G.J. Department of Botany, University of Pretoria, Pretoria 0002, South Africa. [10]

Burke, A. Botany Department, University of Namibia, Private Bag 13301, Windhoek, Namibia. [9]

Cowling, R.M. Institute for Plant Conservation, Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [Editor, 3,6,12,19]

Cunningham, A.B. WWF/UNESCO/Kew People and Plants Initiative, P.O. Box 42, Betty's Bay, 7141, South Africa. [20]

Danckwerts, J.E. Roodeplaat Grassland Institute, P.O. Box 94, Adelaide 5760, South Africa. [17]

Davis, G.W. National Botanical Institute, Private Bag X7, Claremont 7735, South Africa. [20]

Dean, W.R.J. FitzPatrick Institute, University of Cape Town, Rondebosch 7700, South Africa. [7]

Henderson, L. National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa. [22]

Hilton-Taylor, C. Conservation Biology Research Unit, National Botanical Institute, Private Bag X7, Claremont 7735, South Africa. [3,19]

Hoffmann, J.H. Zoology Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [22]

Hoffman, M.T. National Botanical Institute, Private Bag X7, Claremont 7735, South Africa. [8,19,21]

Huntley, B.J. National Botanical Institute, Private Bag X7, Claremont 7735, South Africa. [Foreword]

Jacobson, K.M. Desert Ecological Research Unit of Namibia, P.O. Box 1592, Swakopmund, Namibia. [9]

Jürgens, N. Botanical Institute, Albertus Magnus University of Cologne, D-50923 Köln, Germany. [9]

Lubke, R.A. Department of Botany, Rhodes University, P.O. Box 94, Grahamstown 6140, South Africa. [13]

Macdonald, I.A.W. WWF South Africa, P.O. Box 456, Stellenbosch 7599, South Africa. [22]

Midgley, J.J. Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [12,19]

Milton, S.J. FitzPatrick Institute, University of Cape Town, Rondebosch 7700, South Africa. [7]

Mustart, P.J. Institute for Plant Conservation, Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [6]

O'Connor, T.G. Döhne Agricultural Development Institute, Private Bag X15, Stutterheim 4930, South Africa. [10]

Current address: Department of Grassland Science, University of Natal, P. Bag X01, Scottsville 3209, South Africa.

Owen-Smith, N. Department of Zoology, University of the Witwatersrand, P.O. Wits 2050, South Africa. [17]

Palmer, A.R. Agricultural Research Council - Range and Forage Institute, P.O. Box 101, Grahamstown, 6140, South Africa. [8]

Partridge, T.C. Climatology Research Group, University of the Witwatersrand, 12 Cluny Road, Forest Town 2193, South Africa. [1]

Pierce, S.M. Institute for Plant Conservation, Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [Editor]

Rebelo, A.G. National Botanical Institute, Private Bag X7, Claremont 7735, South Africa. [23]

Richardson, D.M. Institute for Plant Conservation, Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [Editor, 6,19,22]

Rogers, K.H. Centre for Water in the Environment, Department of Botany, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa. [14]

Rutherford, M.C. National Botanical Institute, Private Bag X7, Claremont 7735, South Africa. [5]

Scholes, R.J. Division of Water, Environment and Forestry Technology, CSIR, P.O. Box 395, Pretoria 0001, South Africa. [11]

Schulze, R.E. Department of Agricultural Engineering, Faculty of Engineering, University of Natal, P.O. Box 375, Pietermaritzburg, South Africa. [2,19]

Scott, L. Department of Botany and Genetics, University of the Orange Free State, P.O. Box 339, Bloemfontein 9300, South Africa. [4]

Seely, M.K. Desert Ecological Research Unit of Namibia, P.O. Box 1592, Swakopmund, Namibia. [9]

Seydack, A.H.W. Department of Water Affairs and Forestry, Private Bag X7, Knysna 6570, South Africa. [12]

Steinke, T.D. Estuarine and Marine Group, Department of Botany, University of Durban-Westville, Private Bag X 54001, Durban 4000, South Africa. [13]

Stock, W.D. Botany Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. [16]

van der Heyden, F. Range and Forage Institute, Botany Department, University of the Western Cape, Bellville 7535, South Africa. [16]

Current address: Division of Water, Environment and Forestry, CSIR, P.O. Box 320, Stellenbosch 7599, South Africa.

van Wyk, G.F. Division of Forest Science and Technology, CSIR, Futululu Research Centre, Private Bag, Mtubatuba 3935, South Africa. [12]

Vlok, J.H.J. Cape Nature Conservation, P.O. Box 123, De Rust 6650, South Africa. [7]

Witkowski, E.T.F. Department of Botany, University of the Witwatersrand, P.O. Wits 2050, South Africa. [16]

Yeaton, R.I. Botany Department, University of Natal, P.O. Box 375, Pietermaritzburg 3200, South Africa. [7]

Foreword

Southern Africa is endowed with an unusually rich flora with high levels of endemism, assembled within vegetation types ranging from desert to rainforest. Not only is the flora exceptionally rich, with over 22 000 species of indigenous ferns, gymnosperms and angiosperms, but the plants themselves are of great beauty, having attracted the attention of botanists since the seventeenth century. This interest resulted in a long history of botanical exploration, collection and description, and in the commercial exploitation of numerous southern African species, some of which today form the basis of a multi-billion dollar horticultural industry in Europe.

The study of southern Africa's flora and vegetation has been built on a strong tradition of fieldwork. The explorations in the late eighteenth century of C.P. Thunberg, A. Sparrman, F. Masson, C.F. Ecklon, C.L.P. Zeyher, etc. led to the publication of the *Flora Capensis* and many regional floras. The type specimens of much of this flora are housed in Kew, Paris, Berlin and other European institutions, but from the mid-nineteenth century, herbaria were established in Cape Town, Durban, Grahamstown, Pretoria, Windhoek and many other centres. These collections served the taxonomists of the late nineteenth and early twentieth century – J. Medley Wood, H. Bolus, J. Burtt-Davy, E.P. Phillips, R.A. Dyer – prolific workers who generated a momentum which continues to this day. In turn, these herbaria and taxonomists provided the essential foundation for the first wave of plant ecologists who described and mapped our vegetation – H.W.R. Marloth, R.S. Adamson, J.F.V. Phillips, J.W. Bews, I.B. Pole Evans, J.A. Pentz, M.R.B. Levyns, C.L. Wicht – the pioneers of southern African vegetation science.

The broad sweep of subject matter, and of geographic cover, addressed by these early workers is both inspiring

and intimidating to the student of the 1990s. The era of such ambitious, single-authored treatises ended in southern Africa with J.P.H. Acocks' classic *Veld Types of South Africa*, published in 1953. Acocks' map and descriptive memoir were prepared under duress – as a perfectionist he regarded his work as being both rushed and preliminary. Yet to this day, the work is the most valuable reference on the composition and distribution of South Africa's vegetation types. His interpretation of vegetation relationships and long-term dynamics has provided the platform for many subsequent studies and for continuing debate. His exhaustive and meticulously recorded field data, still unpublished, offer exciting prospects for the extension of his work through computerized analysis and modelling. Throughout his professional career, he challenged dogma and presented new insights into the workings of southern African vegetation. It is therefore appropriate that this volume be dedicated to his memory.

Acocks' *Veld Types* stands as a benchmark in southern African vegetation studies. It was followed in the 1960s and 1970s by many excellent regional and local vegetation surveys, some purely descriptive, some following the Braun-Blanquet phytosociological tradition, others testing the then new computer-based classification and ordination techniques. These works added depth and breadth to our knowledge of the distribution and composition of our vegetation. But they tell little of the evolution and functioning of the dynamic mix of landscapes, floras, ecosystems and human impacts that characterize southern Africa.

This volume provides a new synthesis of the wealth of information, understanding and opinion on the sub-continent's vegetation. Most particularly it builds on the

results of the renaissance of South African plant ecology which occurred from the mid 1970s to the end of the 1980s.

The new wave of ecosystem research was a direct result of the global upsurge of environmental awareness, which reached its scientific expression in the International Biological Programme, 1967–1972. South Africa played a minor role in the IBP, but the approach and philosophy of large, interdisciplinary and multi-organizational research programmes captured the imagination of South African ecologists and science administrators. A consequence was the initiation of a series of cooperative scientific programmes, focusing on biome-level studies on the structure and functioning of South African ecosystems: these comprised the Savanna Ecosystem Project (initiated in 1973), Fynbos Biome Project (1977), Grassland Biome Project (1982), Forest Biome Project (1985) and Karoo Biome Project (1986). The impetus that developed through these studies extended into the marine environment with the establishment of the Kelp Bed Project, followed by the massive research programme on the Benguela upwelling system, while research at the Desert Ecological Research Unit at Gobaab in the Namib Desert, and at the Okavango Swamps in Botswana, was stimulated and supported through South Africa's Council for Scientific and Industrial Research and various national and international non-governmental organizations.

The majority of the authors of this volume are products of these programmes. For the first time in southern Africa's history, 'soft money' was available in the 1970s and 1980s for young researchers to commence exciting, if risky, careers in ecology. This new generation of researchers succeeded in breaking out of the existing academic and institutional hierarchies, creating a vibrant and exciting invisible college of environmental scientists. Never before on the subcontinent had such a mix of disciplines and philosophies meshed together in a network of common interest. As a consequence, new dimensions emerged. Palaeoscientists gave a time perspective which, with geomorphologists, pedologists and systematists, presented new opportunities to unravel the biogeography and evolution of both flora and vegetation. The rapidly moving debate on the nature of communities, equilibrium theory and conservation biology provided intellectual challenges to be tested in the field. Significant contributions to the international literature in the form of original papers and synthesis volumes were made. These were heady days in southern African ecology, where a genuine spirit of sharing and testing ideas, field data and infrastructural resources reigned supreme. Sadly, this era emerged at a time of unpre-

cedented political oppression, violence and open warfare in South Africa and Namibia.

Today, largely as a result of changing science policy, the culture of cooperative multi-organizational research is a thing of the past. However, the new political dispensation throughout the subcontinent offers unprecedented opportunities for a new wave of ecological endeavour. Never before have the conditions for a regional programme of ecological research and application been better. The solid intellectual foundation, reflected in this volume, provides a springboard for collaboration between vegetation scientists from throughout the region. The social need for the development of environmental restoration and upliftment programmes to heal the land is critically urgent. The political will to support such programmes has been demonstrated repeatedly by leaders of all the countries in the region. Financial mechanisms to provide support for capacity building, infrastructural development and implementation projects have never been more substantial or more accessible to southern Africa.

The editors and authors have provided this volume as the first step towards launching a new era of vegetation science and its application towards achieving social benefits throughout southern Africa. May their lead inspire others to join together and motivate a new network of southern African ecologists in service of society.

B. J. Huntley

Chief Director, National Botanical Institute
Kirstenbosch, June 1995

Preface

Why a book on the vegetation of southern Africa? We can think of at least three answers to this question. The short and simple answer is that the publishers approached us and, perhaps against our better judgement, we could not resist the temptation. More seriously, the extremely varied vegetation of the subcontinent provides an opportunity for a regional synthesis that includes representative examples of many of the world's major ecosystems. The popular tourist slogan for South Africa, 'a world in one country', is no hyperbole. It is possible, over relatively short distances, to move from hyper-arid desert to mesic savanna, or from tropical rainforest to alpine heathland. Not only is there a remarkable juxtaposition of different ecosystems, but there is also great variation in the forces that determine their structure and functioning: the large herds of ungulates that tracked the pulses of productivity on the vast karoo plains grazed only a short distance beneath the apparently lifeless and fire-driven fynbos on the sterile Cape mountains. It seemed to us that there were fascinating stories in all of this and that an ideal medium for telling them would be an account of the vegetation of the region.

But have these stories not been told before? This brings us to the third reason for producing this book: that a comprehensive volume on the vegetation of southern Africa is overdue. Pole Evans (1936) produced the first map and accompanying memoir of the vegetation of the subcontinent (south of latitude 22°), at a time when ecologists were bold and broad enough to tackle syntheses of this scope. This was followed by Adamson's (1938) pioneering book, *The Vegetation of South Africa*, published under the auspices of the British Empire Vegetation Committee. Although invaluable in their time, these early studies have become dated, in

terms of both their conceptual framework and their information content. They are seldom referred to today.

In contrast, Acocks' (1953) *Veld Types of South Africa*, comprising a richly worded memoir and detailed vegetation map (Fig. x.1a), remains a standard text to this day. John Acocks, born and bred in South Africa, was a maverick botanist who pursued his remarkable career on a remote research station amidst the sweeping plains and ancient koppies of the eastern karoo veld that he so dearly loved. Although firmly rooted in the Clementsian paradigm of the time, Acocks provided a uniquely South African perspective of vegetation patterns and dynamics, stressing in particular the role of fire and grazing in shaping the plant cover and composition of the country. His knowledge of the flora, one of the richest in the world, was extraordinary and will probably never again reside in any one individual. It is true, and remarkably so, that with the exception of some remote mountain fynbos areas, Acocks was able, towards the end of his career, to identify perhaps 90% of the plant species observed during a ramble through any of South Africa's 70 Veld Types.

The publication in 1978 of *Biogeography and Ecology of Southern Africa*, edited by Marinus Werger (a plant ecologist 'on loan' from the Netherlands), which included contributions from local and international scholars, was a major landmark in that it internationalized southern African vegetation science. This volume was also significant in that it included material from countries in south-central Africa that, for obvious political reasons, were rapidly distancing themselves from South Africa. Fortunately, Frank White's (1983) *Vegetation of Africa*, comprising a map (Fig. x.1b) and descriptive memoir of the vegetation of the entire continent, provided an opportunity for the younger generation of South African plant ecol-

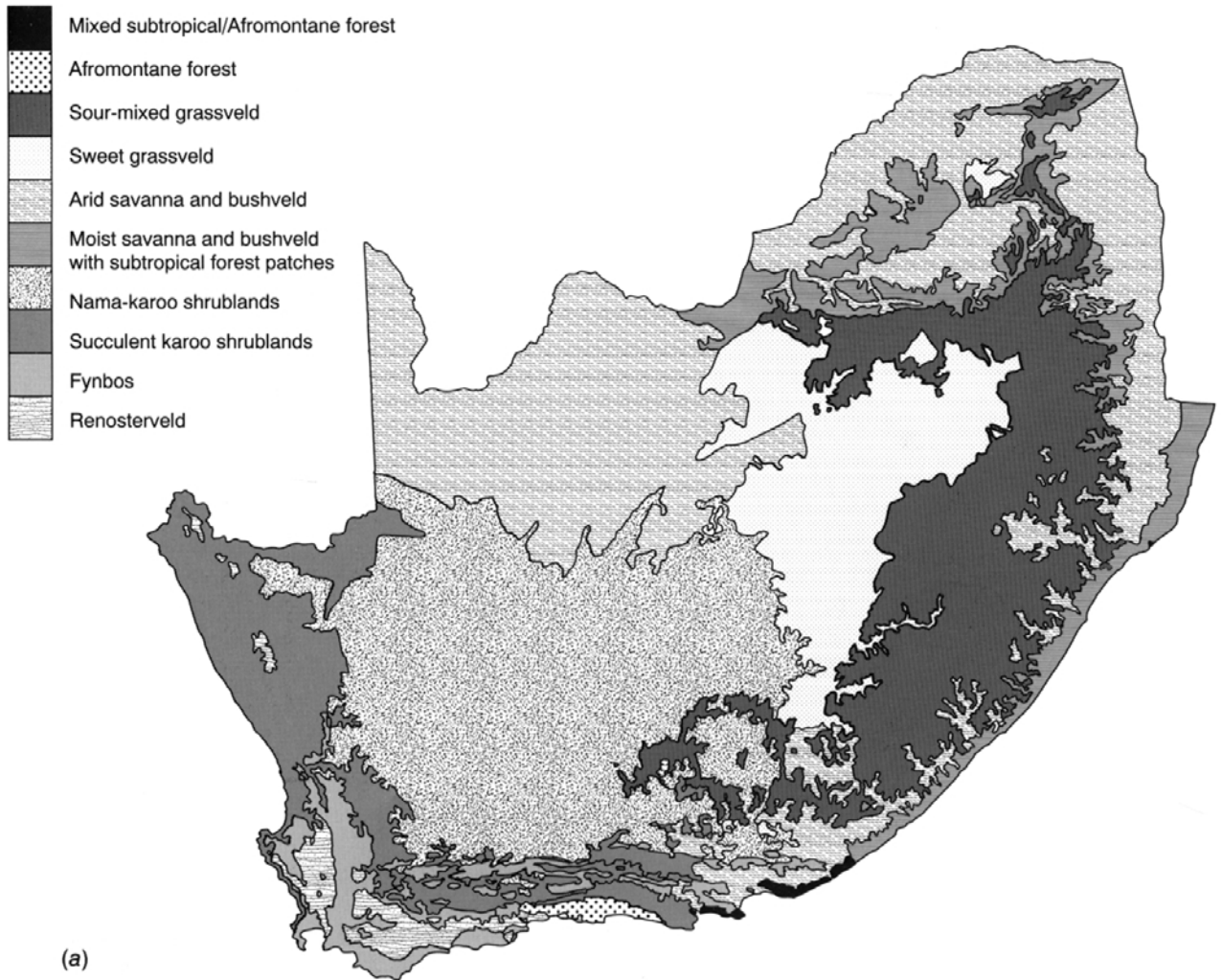


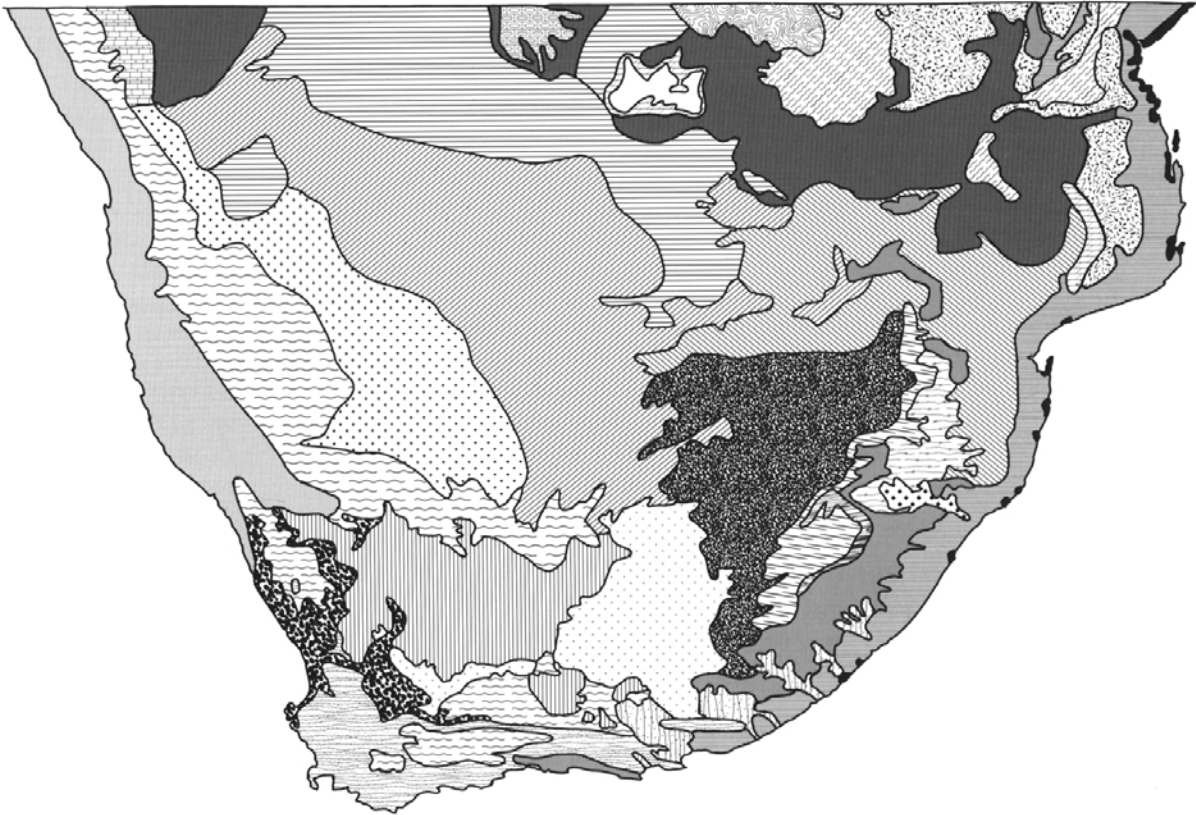
Figure x.1 Examples of vegetation maps for southern Africa: (a) Simplified version of Acocks' (1953) map of *Veld Types of South Africa* (R.J. Scholes, unpubl. data). (b) White's (1983) vegetation map based on phytochoria (see Chap. 3, this volume).

ogists, who had little field experience outside the subcontinent, to view their ecosystems in an African-wide context.

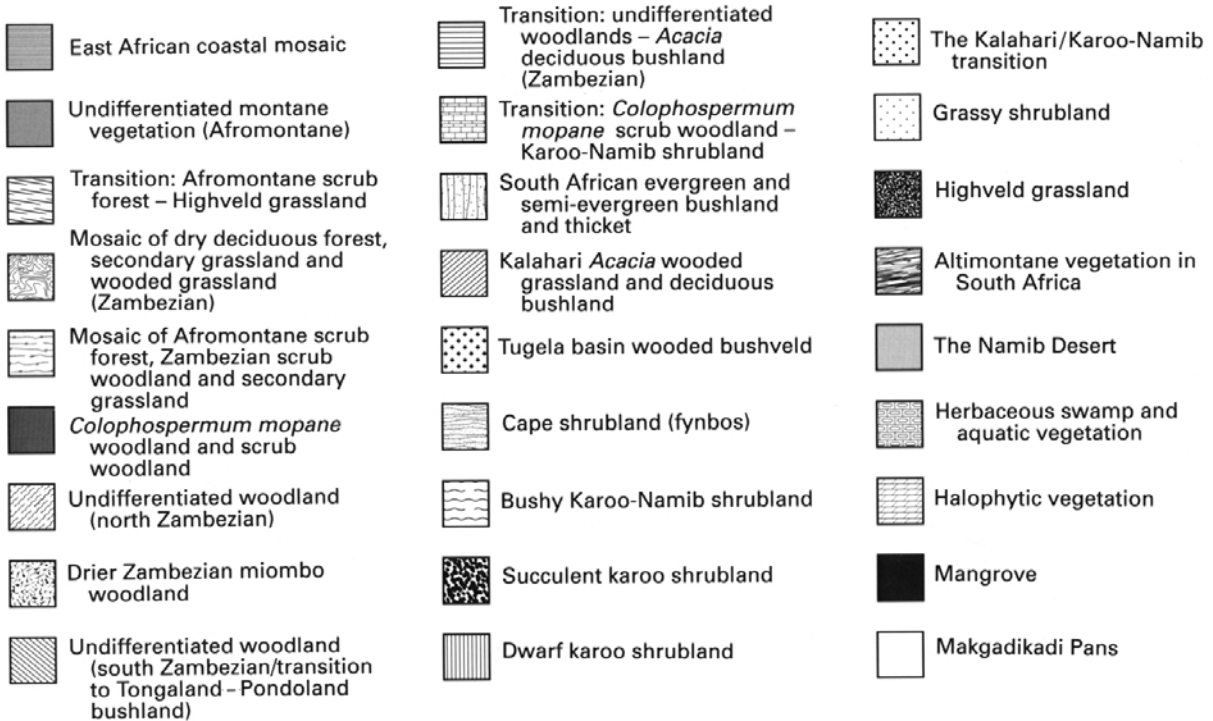
Southern African vegetation science has made great strides since the mid 1970s, largely as a result of the positive impact of National Programmes for Ecosystem Research initiated by the Council for Scientific and Industrial Research. These interdisciplinary and collaborative research programmes, organized as a series of biome-level projects, fostered a productive and imaginative corps of researchers who greatly advanced our understanding of southern African terrestrial ecosystems (Huntley 1987, 1992). Although there have been two biome-level syntheses of research carried out during this

era (Cowling 1992; Scholes & Walker 1993), with another on the arid biomes in preparation, there was a definite need for an updated subcontinent-wide synthesis of vegetation research.

We decided that the geographic scope of the book should be limited to southern Africa, defined so as to include Botswana, Lesotho, Namibia, South Africa and Swaziland, an area of 2 675 425 km² (Fig. x.2). This region forms a cohesive ecological and phytogeographical unit with exceptionally high endemism at the taxic, vegetation type and phytochorion levels (Goldblatt 1978; Gibbs Russell 1985; Rutherford & Westfall 1986; Cowling & Hilton-Taylor 1994; Chaps 3 and 5, this volume). However, the shortcomings of this delimitation became



(b)



evident in contributions that dealt with savanna vegetation, which extends from its centre in south-central Africa, as a series of somewhat depauperate and marginal communities into the northern reaches of our region. It made sense, therefore, to encourage discussion in these chapters (Chaps 11, 17 and 20) of the literature dealing with the more typical savannas of neighbouring countries such as Zimbabwe and Mozambique.

A potentially frustrating problem for the reader is posed by the numerous changes of place names that have accompanied the political reforms in the Republic of South Africa. While this volume was being prepared, the 'homelands' (e.g. Transkei) were abolished and the country, which formerly comprised four provinces, was divided into nine new provinces incorporating the 'homelands' and subdividing the old Cape and Transvaal provinces. We present for the reader's convenience two maps, one showing the old provincial boundaries (Fig. x.2a) and the other showing the new ones (Fig. x.2b). Province names from both schemes are used throughout the volume. Other than Transkei (location shown in Fig. x.2a), no reference is made to any of the 'homelands'. Where possible, we have tried to use the names of the new provinces. In the case of the old Natal and Orange Free State provinces, the boundaries have remained unchanged and the editors' task was simple. It was more complicated for the other provinces, because, for example, it was not always clear how closely 'western Cape' or 'northern Transvaal' in older publications conformed with the boundaries of the new Western Cape or Northern Province. Where ambiguity could arise, our approach has been to use the old province names, in which case the geographical modifier always appears in lower case (e.g. eastern Cape, eastern Transvaal).

The organization of this book provided us with a few major problems. The first of these was the definition of vegetation science (cf. Wilson 1991). The definition of vegetation as a discreet unit for analysis is fraught with the same conceptual problems associated with the delineation of communities. We adopted a pragmatic and holistic approach (Keddy 1993), defining vegetation science as the study of the patterns and processes that determine the plant cover and composition of a given area. Thus, rather than focus exclusively on the description of various units of vegetation, we have encouraged analysis of the historical and contemporary factors that govern the distribution, structure and functioning not only of vegetation units (or communities) but also of lower order (organisms, populations) and emergent entities (ecosystems).

Since there were no volunteers willing or foolish enough to take on the task of writing the entire volume, we opted for a multi-authored book and recruited

authors from across the subcontinent. It is important, in a book comprising contributions on related topics, to avoid repetition. We invited the principal authors of all chapters to attend a workshop during November 1993 on the shores of Langebaan lagoon near Cape Town. This exercise proved very useful in deciding on chapter content and minimizing overlap. We take the blame for any repetition that persists.

The book is divided into three major parts, each prefaced by an introductory text to provide context and integration for the individual chapters. Part 1, comprising four chapters, provides the physiographic, climatic, biogeographic and historical background essential for understanding contemporary vegetation patterns and processes. Part 2, the core of the book and comprising 10 chapters, is the encyclopaedic and systematic description of the characteristics and determinants of the major vegetation units. We chose biomes as the units of organization, for reasons outlined in the introduction to Part 2. Included in this part are three chapters that deal with the vegetation of non-biome-scale units, namely the coastal zone, freshwater bodies and the marine intertidal and subtidal environments. The final section of the book, Part 3, comprises eight chapters, each of which covers a topic that has been well researched and is uniquely interesting. We believe that these cross-biome reviews will provide material of interest to vegetation scientists throughout the world.

Nomenclature for plants listed in the text is according to Arnold & De Wet (1993) except for algae where nomenclature follows Seagrif (1984); occasional exceptions are qualified by author citation. Nomenclature for birds and mammals follows Maclean (1993) and Skinner & Smithers (1990), respectively.

It is a sad reflection of the history of the region that of all contributors to this volume none is black and only eight are women. There are several reasons for this. Foremost among these is the long history of oppression and official denial of access to quality education and employment prospects suffered by black Namibians and South Africans. Furthermore, the contributors are overwhelmingly South African: this country supports by far the strongest research personnel and infrastructure in the subcontinent. We hope that the next volume on the vegetation of southern Africa, which will probably be needed in about 20 years' time, will have a list of contributors more representative of southern Africa.

Finally, we would like to acknowledge the skills of Leslie Shackleton of Research Facilitation Services, Cape Town, for facilitating at the Langebaan workshop; the Foundation for Research Development, Pretoria, and the Institute for Plant Conservation, University of Cape Town, for financial support; Colin Paterson-Jones, the

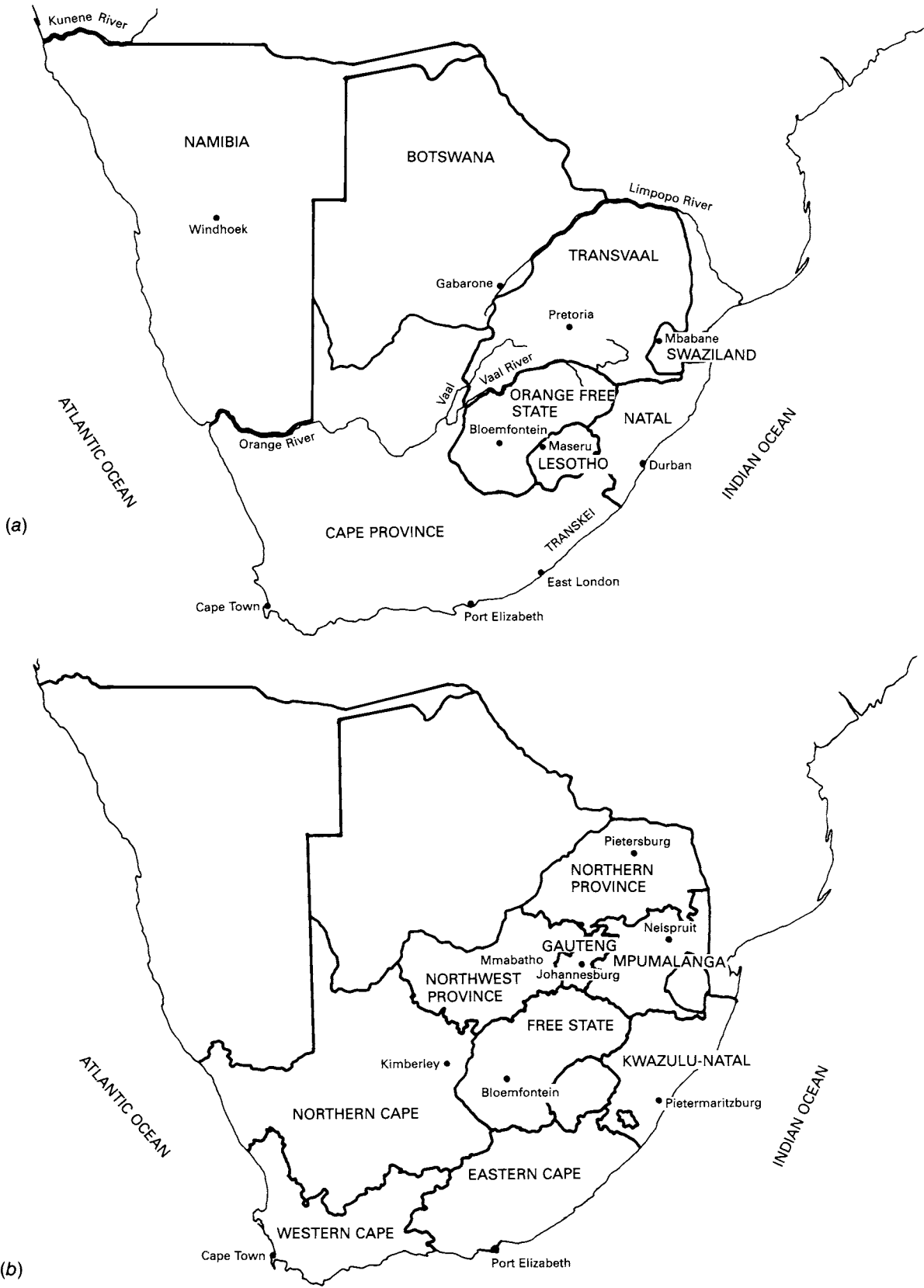


Figure x.2 Southern Africa, as defined in this volume. (a) shows the old provincial boundaries in the Republic of South Africa (pre-1992); (b) shows the boundaries of the nine new provinces in the Republic of South Africa.

National Botanical Institute at Kirstenbosch, and Fred Ellery for access to their photographic collections; Corlia Richardson for invaluable help with final editing, proof-reading, miscellaneous services and emotional support; Wendy Paisley, at the Institute for Plant Conservation, for her cheerful forbearance; Janet Barker, Ann Green and Wendy Hitchcock for producing some of the figures; Emile Boonzaaier and Royden Yates (Departments of Social Anthropology and Archeology, University of Cape Town) for helpful insights; and Alan Crowden and his

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Richard Cowling, Dave Richardson and Shirley Pierce
Cape Town, 31 July 1995

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