Australian Vegetation

Third Edition

Australian Vegetation has been an essential reference for students and researchers in botany, ecology and natural resource management for over 35 years. Now fully updated and with a new team of authors, the third edition presents the latest insights on the patterns and processes that shaped the vegetation of Australia. The first part of the book provides a synthesis of ecological processes that influence vegetation traits throughout the continent, using a new classification of vegetation. New chapters examine the influences of climate, soils, fire regimes, herbivores and aboriginal people on vegetation, in addition to completely revised chapters on evolutionary biogeography, quaternary vegetation history and alien plants. The book's second half presents detailed ecological portraits for each major vegetation type and offers data-rich perspectives and comparative analysis presented in tables, graphs, maps and colour illustrations. This authoritative book will inspire readers to learn and explore first-hand the vegetation of Australia.

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Australian Vegetation

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To Roger Carolin, Peter Myerscough
and Doug Benson,
who inspired appreciation and learning in botany,
ecology and conservation.

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FOREWORD TO THE THIRD EDITION

Richard H. Groves

Attempts to classify and name the various major types of Australian vegetation have a long history. The Aboriginal peoples who first settled the continent recognised some different plant assemblages and assigned them descriptive words in their own languages, such as brigalow, kwongan, mallee, mulga and wallum, all of which remain in general use by Australians today. On 6 August 1699, William Dampier wrote of the vegetation at Shark's Bay in Western Australia:

> The Grass grows in great Tufts, as big as a Bushel, here and there a Tuft: Being intermix'd with much Heath. [. . .] Of Trees or Shrubs here are divers Sorts; but none above 10 Foot high: There Bodies about 3 Foot about, and 5 or 6 Foot high. [. . .] There were also beside some Plants, Herbs, and tall Flowers, some very small Flowers, growing on the Ground, that were sweet and beautiful, and for the most part unlike any I had seen elsewhere.

Spencer (1981, p. 108)

This is most likely the first description of an Australian vegetation type. Subsequent early European collectors, such as Robert Brown, or visitors such as Charles Darwin, were also intrigued by the different types of Australian vegetation they encountered, and especially by the eucalypt forests. The predominant emphasis over this early period was, however, on collecting, naming and describing the indigenous flora. It was really only in the late nineteenth century with the development of the new discipline of oecology in the northern hemisphere that European botanists and plant geographers began to describe vegetation types and attempt to classify them systematically (see e.g. Schimper 1903; Diels 1906; Warming 1909). Resident Australian botanists soon followed this development (Osborn 1914; Andrews 1916; Adamson and Osborn 1924) and some notable regional accounts of natural and modified vegetation were published subsequently (Wood 1937; Beadle 1948; Moore 1953a, b; Costin 1954).

To map the vegetation at a national scale, however, a consensual and rigorous classification of vegetation types was necessary; a terminological need met initially by Wood (1939), Beadle and Costin (1952) and Wood and Williams (1960), and subsequently by Specht (1970, 1981). Specht's classification used a matrix of two structural aspects – namely, life-form and foliage projective cover of the tallest stratum – to characterise 28 major vegetation types of Australia (Table F.1). It was this 1970 classification that Carnahan (1976) used to map the natural vegetation of Australia and subsequently to map the present vegetation types (Carnahan 1990). Specht's 1970 classification also largely formed the basis of accounts of the major vegetation types in the two earlier editions of this book (Groves 1981, 1994), although less so in other accounts, either national (Beadle 1981) or regional (Beard 1976; Kirkpatrick and Dickinson 1984; Keith 2004).

Table F.1 **Structural formations of Australian vegetation omitting the littoral and alpine complexes, and salt lakes (abridged from Specht 1970).**

	Foliage projective cover of tallest stratum			
Life form and height of tallest stratum	100–70%	70–30%	30–10%	<10%
Trees[a] > 30 m	Tall closed-forest	Tall open-forest	(Tall woodland)	(Tall open-woodland)
Trees 10–30 m	Closed-forest	Open forest	Woodland	Open-woodland
Trees < 10 m	Low closed-forest	Low open forest	Low woodland	Low open-woodland
Shrubs[a] > 2 m	Closed-scrub	Open-scrub	Tall shrubland	Tall open-shrubland
Shrubs 0.25–2 m[b]	Closed-heath	Open-heath	Low shrubland	Low open-shrubland
Shrubs < 0.25 m[b]	–	–	Fellfield	Open-fellfield
Hummock grasses < 2 m	–	–	Hummock grassland	Open-hummock grassland
Graminoids, herbs, ferns, etc.	Closed-grassland	Grassland	Open-grassland	Ephemeral herbland

[a] A *tree* is defined as a woody plant usually with a single stem; a *shrub* is a woody plant with many stems arising at or near the base.
[b] These categories may be subdivided into (1) sclerophyllous and (2) semi-succulent/succulent.

Current descriptions of major Australian vegetation types reflect this century-long history of attempts to classify vegetation types and usually comprise a mixture of structural and floristic nomenclature, as implicit in terms such as chenopod shrublands (Chapter 24). In this current edition, some environmental descriptors are added, e.g. 'dry' sclerophyll forest, even when this assemblage of sclerophyllous trees and shrubs may grow in moderately moist conditions, though without the prominence of ferns which seems to characterise so-called 'wet' sclerophyll forest (see Chapters 12 and 13). Both 'dry' and 'wet' sclerophyll forests are open forests in Specht's 1970 terminology (Table F.1). So-called 'desert' vegetation is common over extensive areas of central Australia, but is really a mixture of hummock grassland (Chapter 26), *Acacia* open-woodland and shrubland (Chapter 25), and low eucalypt open-woodland (Chapter 23) in varying proportions and is not an ecologically valid term for this admixture of several vegetation types that characterise Australian arid environments. At the other extreme from Specht's structural classification, Bridgewater (1994) presented a system for classifying Australian vegetation on a solely floristic basis. Each of his 26 divisions was defined by a suite of 'character genera' (see Groves (1999) for a further discussion of this floristic classification). Whatever the nomenclatural usages and bases for classification by individual botanists, Australian vegetation has increasingly captured the attention of plant ecologists over the last century or more, especially since the first edition of this book was published in 1981.

Despite the contemporary strength of Australian vegetation studies (as evidenced in the chapters that follow), I wish to introduce a few advances in vegetation science over the 35-year period since the earlier editions of this book were published. I shall also point to some deficiencies in coverage of earlier strengths as I perceive them.

The first advance seems to me to be the linking of vegetation type and functionality, as implicit in the title to Part I of this book and Chapter 1. An initially descriptive science of studying vegetation patterns at a continental scale now includes a consideration of functional aspects, such as seasonal water usage and nutrient cycling, as drivers of the dynamics of a vegetation type and, ultimately, its distribution nationally.

A second and allied advance is the enhanced study of fire effects on the distribution of a range of vegetation types. Gill (1975) introduced the concept of a 'fire regime' to begin to refine studies of fire ecology in Australia and elsewhere, but especially in relation to adaptive traits shown by plant species and, indeed, by sclerophyll vegetation generally, in responding to fires in Mediterranean-climate ecosystems (Gill 1977). The concept of the fire regime (a function of the frequency, intensity and season of fire) unified understanding of previous local descriptions of wild fires and enabled a recent attempt to predict the effects of changing fire regimes on the responses of woody plants at a continental scale (Clarke *et al.* 2015; Chapter 5).

Mapping and classification of Australian vegetation types has advanced greatly with the development of computers and geographic information systems (GIS). The initial intuitive classification of Australian rainforests of Webb (1959) was developed further only 10 or more years later into a computerised numerical analysis of field data (Webb *et al.* 1970, 1976) that enabled classification of a range of structural subtypes of rainforest and their different environmental relationships. So too the use of GIS methods to generate computer-enabled maps of Australian vegetation, such as that of the National Vegetation Information System (NVIS) of the Department of the Environment and Energy (2007), the products of which now replace the earlier hard-copy maps of Carnahan (1976, 1990). The latest NVIS version (4.2) maps 79 subgroups of native vegetation types in terms of both structure and floristics, e.g. *Banksia* woodlands, *Callitris* open woodlands, and 6 subgroups of non-native vegetation.

Some earlier strengths of Australian vegetation science have not advanced commensurately as the three topics I have pointed to above, however. In the first edition of this book, I noted that pollination biology was an aspect 'greatly in need of more research' and this need continues 35 years later. A further deficiency is the apparent lack of newly initiated long-term field studies of vegetation change of the type initiated by the Botany Department of the University of Adelaide at Koonamore (Hall *et al.* 1964; Sinclair 2005) in 1926 or on the Bogong High Plains initiated by the Botany Department of the University of Melbourne in 1947 (Carr and Turner 1959; Wahren *et al.* 1994). Although these are ongoing (Foulkes *et al.* 2014; Williams *et al.* 2014), some important long-term studies have fallen dormant, such as vegetation monitoring over 20 years the since cessation of grazing of alpine and sub-alpine plots in Kosciusko National Park (Wimbush and Costin 1979a, b). A notable exception to this apparent decline in the effects of time on grazed vegetation is the recent account of floristic changes over a 46-year period in mulga (*Acacia aneura*) vegetation in arid Western Australia by Davies *et al.* (2015).

Each edition of *Australian Vegetation* contains a chapter on the vegetation history of Australia (see Chapters 2 and 3). And yet it seems to me that currently there is a decline in studies of the important and longer-term effects of time on the dynamics of Australian vegetation types. The current absence of studies of long-term changes in vegetation type of the sort evidenced by the earlier studies of Singh at Lake George, New South Wales, and Kershaw on the Atherton Tableland, Queensland is especially significant (Singh *et al.* 1981). The results of both studies show an alternation between sclerophyll and rainforest vegetation with changing climates and the incidences of fires over a period as long as the last 100 000 years. Such studies offer valuable perspectives on recent vegetation history over much of eastern Australia and the effects of changing climates on vegetation distribution; they also provide clues to the resilience of such vegetation to human-induced climate change in future time.

I conclude that Australian studies in vegetation science have advanced considerably, both in number and in quality, since 1980. There have been some obvious strengths and weaknesses in research coverage and I have pointed to a few examples in each category. Previous editions of this book provide markers of where the science was at in both 1981 and in 1994, as seen through the eyes of the many contributors to both editions and this former editor. So too will the chapters in this third edition and the personal predilections of the present editor and the authors of the 27 chapters that follow this Foreword. I trust this third edition will continue to provide stimulus to graduate students in botany and visitors to this country who wish to learn more of the structural, floristic and functional aspects of Australian vegetation. I can attest personally to a continuing fascination with the diversity and beauty of the vegetation of Australia, especially as evoked by its eucalypt forests, its sclerophyll shrublands (heaths) and its natural grasslands.

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