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VEGETATION RESEARCH IN AUSTRALIA

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In 1981, the year of the International Botanical Congress in Sydney, a remarkably large number of publications on the vegetation and flora of Australia appeared, including several major works. For many botanists this congress was a welcome occasion to visit Australia for the first time and for some of them it will have stimulated a lasting interest in this fascinating continent. In this context the following remarks on past and present vegetation research in Australia may be useful. A selective list of publications has been added.

The first major book to appear specifically on Australian vegetation was a work in the German-Swiss phytogeographical tradition (DIELS 1906). It was the result of a travel from 1900–1902. It focusses on the physiognomy of large vegetation units ("formations") which correspond with major climatic areas. It is well illustrated, well written, still worth reading, and easily available, since a reprint edition appeared in 1976.

In the 19th century taxonomy was already flowering, as is shown by G. BENTHAM's Flora Australiensis (also reprinted recently) which appeared in seven parts from 1863–1878. Later on taxonomy and phytogeography became old-fashioned, and only very recently modern works comparable in scope with the books mentioned above, are appearing. This relative neglect of descriptive research in botany (including palynology) was only a matter of quantity: work of excellent quality was never difficult to find (e.g. BURBIDGE 1960). Plant ecology in Australia was mainly autecology, with emphasis on physiological backgrounds and on species of economic importance, e.g. introduced pasture species and weeds. Synecological work was often detailed and analytical, according to the "A-A-A" (Anglo-American-Australian) tradition with a constant search for more objective, exact or predictive methods. Outstanding examples are to be found in the work of Australian or Australianised ecologists like D. W. Goodall, W. T. Williams and R. M. May. A combination of numerical classification with description of varied and complicated formations is to be found in the work of WEBB et al. (1967, 1976) on rainforests. However, Webb's work is rather exceptional. During the years the present author was working in Canberra (1963–1968), mainly on weeds ecology (DOING 1972), it was often a source of frustration for him that so much time and energy was spent on methods and techniques rather than on results of vegetation research. There was a quite general opinion that the "descriptive stage' in plant ecology was something of the past, while it was obvious that much of Australian vegetation had never been

properly described at all. Even now the importance of mapping vegetation or soils (NORTHCOTE 1960 seq., excellent but rarely quoted by ecologists) is underrated. Consequently it is difficult to place the results of experimental work within a wider context.

The main stimulus for descriptive work in vegetation science and landscape ecology has been its necessity for land use planning, rangeland and various other management problems, including soil erosion, irrigation, forestry, and conservation. Prominent in this respect were the surveys carried out by the Division of Land Research and Regional Survey (The Canberra branch is now called Division of Land Use Research) of the C.S.I.R.O. (Commonwealth Scientific and Industrial Research Organisation). Mainly during the 50's and 60's the "Land Research Series" (e.g. CHRISTIAN & STEWART 1953) appeared, with a few exceptions describing areas in tropical Australia and Papua-New Guinea. These are, in our terminology, "landscape mapping" plus "land evaluation" projects carried out by a team of experts: soil scientists, geologists, plant ecologists, climatologists, land reclamation experts etc., often three to six persons in total. Project areas are very large by European standards and maps are based on the interpretation of aerial photographs. The first study was carried out in 1946, thus nearly coinciding with the landscape based soil surveys in The Netherlands by Edelman and his coworkers. Thanks to the firm basis laid by C. S. Christian, G. A. Stewart, R. A. Perry and many others (among which also Dutch immigrants, e.g. H. A. Haantjens en P. C. Heyligers), Australia has been one of very few – in regard to modern agriculture – developing countries which has carried out its own research work in this field, comparable with e.g. the work of the I.T.C. (International institute for aerial survey and earth science in Enschede, The Netherlands) for various African countries. The basic mapping unit is called "land system", a well chosen term in which the holistic view of geological substrate, geomorphology, soil, vegetation, land use and atmosphere is included as well as the system's approach.

More specific vegetation studies, sometimes of more limited areas, have been carried out by various institutes of the C.S.I.R.O., the universities or conservation services. Without much discussion natural vegetation generally has been the basis of classifications. Admittedly, even in relatively densely settled areas, a reconstruction of the original vegetation is possible in most cases. On the other hand this has resulted in a neglect of man-made vegetation in this respect, partly due to the after-effects of Clementsian ecology. Outstanding examples of vegetation studies are COSTIN's (1954) description of the ecosystems of the Snowy Mountains and BEADLE's "Vegetation and pastures of Western N.S.W." (1948). One more "one-man" project to be mentioned in this context is the series of maps covering the whole state of Western Australia (2.5 million km^2), produced by J. S. Beard, also known for his work in South America and South Africa, and former director of "Kings Park" in Perth, one of the most beautiful botanical gardens of the world. These are vegetation maps on a scale 1: one million, based on aerial photographs and field reconnaissance. Since relatively little was

known about the very rich and unique vegetation and flora of this state these maps are a most valuable enrichment of the literature.

A synthesis of regional descriptions of Australian vegetation is now available (BEADLE 1981). This book is briefly reviewed in this issue of Acta Botanica Neerlandica on p. 127. Some remarks on the classification used in this book may be added here. The term "Association" is used for the basic unit of classification. However, for purposes of surveys, the "Alliance" is more useful. This is a rather large hierarchic unit, characterised by one to four species, dominant in the highest layer. Apart from being different from the Alliance (Dutch: verbond) and from the association of the Braun-Blanquet classification (based on fidelity), the way the units are used is not always easy to understand for non-Australian botanists. After reading a number of descriptions it becomes gradually clear that the units are not really plant communities, characterised by a certain structure, floristic composition, etc., but areas of land dominated by one or more prominent species of the original vegetation. The following quotations from Beadle's book may serve to illustrate this. Page 201: "The communities vary considerably in structure with no change in composition of the dominants; over most of the area they are open forest 12–25 m tall, but towards the drier limits of the suballiance the species constitute woodlands mostly 10–15 m tall." Page 271 under the heading "Eucalyptus niphophila suballiance": "Waterlogged soils within the suballiance support swamps, heath or grassland." Page 388–389: "E. dundasii is the dominant tree around salt lakes in the southern segment of the alliance and at its northern limit it occurs with E. lesouefii... At the bases of greenstone ridges it may mix with E. brockwayi, a species restricted to greenstone ridges within the limits of this suballiance." The system clearly breaks down where there are no dominant species, e.g. in the case of heaths. Page 418: 'Each of the "alliances" could possibly be divided into two or more and doubtless a few hundred associations could be identified if a detailed analysis of the assemblages were done.' A classification of savannas on the basis of trees instead of grasses is also unsatisfactory in many cases. Mosaics of plant communities caused by small-scale but wide variation in the abiotic environment, human influence, fires, or primary succession in dynamic landscapes cannot be properly classified in this way.

Although the distribution map of major alliances (scale c. 1:11.5 million) is rather primitive – CARNAHAN's (1976) map is much more adequate, but he uses a different classification – the text mostly reads like a description of mapping units which are often widely different in floristic and ecologic content. Some "alliances" can be reasonably characterised by mentioning a small number (down to 1–5) species (e.g. *Typha domingensis* alliance), others contain several hundreds (e.g. *Eucalyptus melliodora* and *E. blakelyi* alliances). Ecological and successional backgrounds and interconnections are mostly restricted to the general chapters.

More readable but less comprehensive and homogeneous is the book edited by R. H. GROVES (1981) and written by 22 authors. In fact both books complement each other quite nicely (LANGE 1982). Special attention may be drawn

to P. W. Michael's chapter on the immigrant flora and to R. L. Specht's review of the presence of vegetation types in nature reserves.

Another important appearance is the three volume work edited by KEAST (1981), a monumental work by 70 authors. This includes animal ecology and geography, climatic history, fossil floras and human ecology, including prehistory and anthropology of aboriginals. One of the most important discoveries in this context is that human influence on vegetation has been much longer and much more drastic than has been assumed until recently. A period of human presence of c. 60,000, perhaps even 100,000 years coinciding with a strong increase of fires is now thought to be closely connected with large scale changes in vegetation, notably the great extension of vegetation dominated by Myrtaceae (mainly *Eucalyptus*) at the cost of the rainforests.

One more landmark in the history of Australian botany is the appearance of Vol. I of the "Flora of Australia" (1981). There will be 50 volumes, to be issued within 20 years. The total flora (including naturalised aliens) is now estimated at c. 20,000 species of vascular plants. Apart from Bentham's flora only a number of regional and state floras (e.g. CURTIS 1956–1980) have appeared (far from complete) and state taxonomists have rarely been able to work on Australia-wide revisions of taxonomic groups. Also very useful for the vegetation scientist is the book by CHIPPENDALE & WOLF (1981) containing distribution maps of all 550 species of *Eucalyptus* in Australia. Added to this is a list of all species (varying from 0–97) recorded for each grid unit (= topographic map 1:250,000). It is based on all Australian herbarium sheets of *Eucalyptus* collected since 1770.

During the 1981 congress poster sessions, symposia and papers gave a wealth of information on recent research with subjects i.a. "Community ecology", "Applied botany", "Vegetation mapping", "Vegetation management" etc. In the scope of this paper it is impossible to discuss these. For papers on current research, now and in the future, I may refer to the "Australian Journal of Ecology" (e.g. WEBB, TRACEY & WILLIAMS 1976), now in its eighth year, and to the "Proceedings of the Ecological Society of Australia".

Finally the recent introduction into Australia of phytosociology according to the Braun-Blanquet or French-Swiss school must be mentioned. Interesting papers in this field, e.g. on salt marshes and mangroves, have been published, mainly by P. B. Bridgewater (see CLOUGH 1981), who was originally working with D. J. Bellamy in Durham (England).

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