

PREFACE

Many books have been written about conifers during the 19th and 20th centuries, the majority of these with emphasis on horticulture in Europe. Those that are mostly compilations of species and their cultivars found to be grown in gardens and parks, with descriptions, illustrations and information about their cultivation, are known as handbooks or manuals. A conifer handbook as traditionally compiled is therefore a comprehensive guide to the conifers that are grown or could be grown in cultivation in a certain part of the world and includes, besides species and botanical varieties, cultivated varieties or forms (since 1953 universally known as cultivars). All such works, even the most comprehensive, emphasise conifers adapted to a cool temperate climate as experienced in Europe. Several have made this explicit in the title of the book, but even those that have not done this invariably treat 'hardy' conifers more fully than other species, which are at best only mentioned briefly. The scope, content and presentation are aimed at the horti- or silvicultural users. Some of the better-known conifer handbooks were reviewed in Chapter 1 of my Monograph of *Cupressaceae* and *Sciadopitys* (Farjon, 2005a). Most conifer handbooks are now out-of-print, but some new books have recently been added to the bibliography of conifers, while others are being compiled. The emphasis on the temperate conifers in cultivation has remained strong in these works, as far as I know.

The present Handbook is very different from these predecessors. There is no particular emphasis on conifers that can be grown in Europe. Of the 614 species known in the world at present, about 200 occur in the tropics. They receive here equal cover with the species that grow in temperate climates. In this respect, the present book more closely resembles a taxonomic monograph, as it includes all the currently known and accepted taxa, from the ranks of family down to variety and forma. However, it is not a monograph purely for taxonomists. Its content aims at a much wider audience. To achieve this, strictly taxonomic information has been limited to what is more or less essential, while other information has been included that may not even have been considered for a taxonomic monograph. There

are paragraphs on ecology, uses and conservation with all species accounts. This handbook does not describe or illustrate conifers that are only known in cultivation. With some 15,000 conifer cultivars known, no comprehensive coverage could have been achieved. Instead, a separate volume now covers these, authored by Aris Auders in Latvia and Derek Spicer in England, entitled *Conifers – A Comprehensive Guide to the Conifer World*, published under the auspices of the Royal Horticultural Society. It follows the taxonomy in this Handbook of the World's Conifers for families, genera and species and these two handbooks are therefore complementary and can (and should) be used side-by-side.

The need for a comprehensive and modern handbook concentrating on the species of conifers is clear. Awareness of the obligation to manage and protect the biological resources of this planet and use these resources sustainably has created a demand for accurate, up-to-date information. Conifers occur worldwide and are major or minor components of nearly all major forest and woodland types, as well as many timber plantations and numerous gardens and parks. They are of high economic value, but also play major roles in the ecology of many natural and semi-natural ecosystems. They are an integral part of many landscaped estates and parks from the subtropics of Australia and New Zealand to the temperate regions of Europe and North America. This handbook of conifers has been compiled to address this need for relevant information and should therefore be useful to botanists, conservationists, dendrologists, ecologists, foresters, horticulturists, land resource managers and, I should add, all those with an interest in the trees and forests of the world. Knowledge is not only useful, it is a pleasure that enhances the quality of life.

The introductory chapters have deliberately been kept brief, often merely touching on interesting aspects of conifer biology, evolution and taxonomy, as well as ecology, economics and conservation. For a recently published full introduction I refer to my book *A Natural History of Conifers* (Farjon, 2008), where all these issues are treated in much more detail. After these short chapters, the book moves to

the families, genera and species and becomes the handbook referred to above. For the general user it may be useful to outline and explain the conventions and format followed throughout for all genera and species. To identify a completely unknown conifer, one should start with the key to families on p. xxx; then the key to genera under the family determined, and the key to species under the genus arrived at. Genera with numbers of species greater than 15–20 have been divided, formally or informally, and keys to these groups are first to be consulted. Under species may follow subspecies and/or varieties; these are usually not included in keys. Not more than six infraspecific taxa are accepted under any one species in this book, and their descriptions are brief and diagnostic. These descriptions should primarily be compared with the relevant species description and the character states mentioned therein, and less with each other. No attempt has been made to create varieties within subspecies and, unless such ranking has been established by other authors and is followed here, the two ranks are treated as equal. In the taxonomic literature, the use of either subspecies or variety appears to derive more often from tradition than from explicit taxonomic concepts. I believe that botany would be well advised to follow zoological practice and use only a single infraspecific rank in future. After using the keys, reading the description of a species is recommended as a check to find out if the determination is correct. Also, as it is almost impossible to construct keys that use any and every feature of a specimen in hand, the reading of the description helps with the identification. An extensive glossary is provided to help explain much of the terminology used in this handbook.

Botanical names are given in full as in a taxonomic monograph, i.e. with (abbreviated) author name(s), abbreviated reference to the place of first publication, synonymy and type citation. The accepted names are followed by synonyms if these apply. Among synonyms, basionyms are always cited as types refer to these; other synonyms are cited selectively. In most cases, synonyms no longer in use as accepted names have been omitted. Most recently published names have been included, but not all, for instance new names resulting from a mere change of rank, such as variety to subspecies. When several synonyms are cited, homotypic synonyms are grouped together in one continuous line; heterotypic synonyms are separated by a blank line from the accepted name (and

its homotypic synonyms) or begin on a new line. Where relevant, the (aberrant) status of synonyms under the Botanical Code (ICBN) is given after the citation of the place of publication. Types (i.e. herbarium specimens designated to fix the application of a botanical name) are only given here for accepted names, including their synonyms if based on the same type. Types of genera are cited as names of species. The opportunity to designate types where it was appropriate and possible has been taken; but in several cases typification is complicated and then it has been left to future research. This is what is meant with the phrase "type not designated" under several species. Type specimens are deposited in institutional herbaria, abbreviated by an acronym and these can be found at www.sciweb.nybg.org/science2/IndexHerbariorum.asp.

Under species, subspecies, varieties and forms may be recognized. While these ranks are hierarchical in that order and species have been subdivided in that way, I am no advocate of this. A single rank under species would suffice in botany as well as it does in zoology. Leaving the rare use of forms aside as a special case, I am agnostic as to whether this should be the rank of subspecies or variety. In botanical taxonomy, we have an unavoidable historical legacy: both ranks have been used in the literature, often for the same taxon. In some countries one rank was preferred over the other. In this Handbook, therefore, I have used what ranks were available in validly published names under species where infraspecific taxa merited recognition; under a few species I have accepted two ranks if these appear to be widely used. Unfortunately, the same notion of one rank under species has induced the publication of numerous new combinations, some have changed subspecies to variety and others *vice-versa* depending on preferences. I have not seen fit to increase the number of pages by including all of these mostly superfluous name changes, nor by adding new combinations if none existed in the desired rank. If infraspecific taxa are recognized, the species name in the inclusive sense is given first (with authority and place of publication) and the description is similarly inclusive, i.e. it encompasses all subspecies and/or varieties. Synonyms and types are given with the latter and the short descriptions given there are exclusive. Botanical descriptions immediately follow the names of taxa and are not headed, but all other information is given under its

specific head (in bold type face) for clarity and ease of reference. The descriptions of species follow the conventional sequence for descriptions of trees; i.e. from size and habit to trunk, bark, branches, foliage, leaf details, male and female reproductive structures and ending with seeds. Despite the relative detail in some descriptions, it should therefore not be difficult to find particular parts and I have therefore not marked these with a different font or type. The botanical names of species are followed by the *etymology* of the accepted name and by *vernacular names*. Etymology is also explained for genus names but not for subspecies and varieties and only occasionally vernacular names are mentioned with the latter two. The vernacular names do not provide a comprehensive listing, especially not for species with a very large natural distribution, covering an area in which many languages may be spoken. Vernacular names may not be specific; if referring to the genus rather than the species and if more than one species occur in the area, such names are not listed. Some published vernacular names seem contrived; if these are not actually in use locally or regionally, they are not cited here. *Taxonomic notes* may follow the descriptions; they are usually comments on different taxonomic treatments or notes on typification of the species or mention similarities of taxa. In the concise format necessary in this Handbook, comments and discussions are limited to the essential and are kept brief. Not every name placed in synonymy can be discussed here; the reader can rest assured that due scientific consideration has been given, some of which has been published elsewhere. *Distribution* of taxa is given in two formats and these are often complementary. The first is descriptive, mentioning regions as well as countries, provinces, areas and localities, as appropriate. The second format uses the TDWG codes (Brummitt, 2001). These codes provide geographical information at three levels defined by geographically and politically delimited areas, e.g. 42 = Malesia (a geographical region) BOR = Borneo (an island) and SB = Sabah (a politically delimited area): 42 BOR-SB means therefore that the species occurs (also) in Sabah. The meaning of these codes can be found at www.catalogueoflife.org/search.php. For species with large ranges the TDWG codes provide more detailed information than the descriptive statement, but for species with very limited distribution the latter is often more precise because TDWG codes often do not go down to such detail. When

entered in a database, the TDWG codes linked to names can provide easy and quick listings of species per country, state or province. This information is available for conifers at www.catalogueoflife.org/search.php.

Ecology describes the habitat of a species and its altitudinal range (in meters above sea level: m a.s.l.) is given here. For many species, especially in the tropics, their habitat remains poorly documented, while much has been written on many species in the temperate northern hemisphere. Some information could be assembled from notes on herbarium specimen labels and has been recorded in the conifer specimen database available at dps.plants.ox.ac.uk/bol/home/default.aspx under "Online Groups". As indicated above, a balanced approach has meant that not all that is known can be mentioned here and for such species the information on ecology (and other subjects) is indicative rather than comprehensive. *Conservation* is usually concerned with species survival issues as defined by the World Conservation Union's (IUCN) Species Survival Commission (SSC). Information was gathered and the conservation status of taxa (species to varieties) has been assessed by members of a Specialist Group (SG) resorting under the SSC. In the case of conifers this is the Conifer Specialist Group (CSG) which is currently chaired by this author. Almost all conifers have been assessed under IUCN Red List criteria, the resulting categories of threat are given under the heading IUCN. For the abbreviated categories of threat see the introductory chapter Conservation; for definitions and decoding of the criteria used visit www.iucnredlist.org/static/categories_criteria. The listings given here are as in the 2008 IUCN Red List of Threatened Species" [www.iucnredlist.org] including the criteria of either version 2.3 (1994) or 3.1 (2001) as applied. *Uses* mentions commercial as well as other human uses of species. The two main categories are wood (timber) and its applications and horticulture, but other uses, including 'traditional', have been mentioned when known. As with ecology, much more is known about uses of species in the temperate zones than in the tropics. Often, timber is traded under a 'generic' name which may even include different genera, as in the family *Podocarpaceae*, which makes distinctions of use among species extremely difficult. Horticultural use is also unevenly distributed along similar lines of geographical demarcation, but uses in the subtropics

and tropics are picking up and therefore mentioned when known. This book does not include cultivars but if such exist under a species, that information is given. Plantation in a forestry context is usually mentioned with the uses of timber; for several species plantations have become the main source of that commodity.

The glossary in this Handbook is the most inclusive I have yet compiled. I have made use of several published in my earlier works, but added numerous entries specifically for this book. In particular, I have attempted to explain terms used by plant taxonomists, because this book is meant to be used and consulted by many others, amateur as well as professional. I hope it will be found useful, but I am aware of the difficulty of finding a balance between explaining commonly understood terms and thereby underestimating my readers and using unexplained terms for which one might need to consult a large dictionary. Finally, I have only included botanical names of conifers in the index. Numerous other species names occur in the texts on the ecology of conifer species, but giving information about these other species is obviously beyond the scope of this Handbook. Vernacular names, while cited under many species, are incomplete (especially in the tropics), use several languages besides or in lieu of English, and are often ambiguous. The reader is therefore encouraged to use (and learn) the botanical names of species. Both in the library and on the Internet, nearly all information is available under these identifiers. Because the information in this book is arranged by species, finding the species (they are arranged in alphabetical order as well as indexed) is all that is needed to obtain all the information about them given in this Handbook.

The compilation and writing of the Handbook of the World's Conifers has been a task which started some time after my official retirement from the Royal Botanic Gardens, Kew in 2006. Certain conditions had to be met before I could seriously embark on this project, because it required access to resources, to enable me to devote full working time to it. I was very fortunate that the Royal Botanic Gardens appointed me an Honorary Research Associate after my retirement, to be based in the Herbarium where I had worked before (now the Herbarium, Library, Arts & Archives Department). It was there that much of the work on this book was done and I am grateful to RBG Kew for this invaluable support. Funds

had to be raised for this project, and when money was being pledged, I had to find a registered charity to administer these funds. This was generously undertaken by the Linnean Society of London and I am grateful for the trust the Society has placed in one of their Fellows to fulfil the commitments thereby generated. The Treasurer of the Society, Prof. Grenville Lucas, guided me through this whole process in his capable and incomparable manner and I am most indebted to him for this generous support. Most importantly, my gratitude goes to all the generous donors to this project, who together have made this book possible. I have permission to name them here and shall do so in alphabetical order. They are the Arboricultural Association (UK), Mr. Lawrence Banks (UK), The Dendrology Charitable Company and the International Dendrology Society, Dr. Barry Denyer-Green (UK), the Lord Devonport Charitable Trust (UK), Mrs. Francine von Finck (Germany), Mrs. Arabella Killander (UK), the Samuel Storey Family Charitable Trust (UK) and the Stanley Smith Horticultural Trust (UK). This Handbook is the synthetic product of 25 years of research into conifers by its author. To give detailed acknowledgement to all persons and organisations who have assisted me in that research would be next to impossible. Research is often a collaborative effort, even if the resulting published output appears to have a single author. My thanks are therefore here expressed to all I have been in touch with on conifers from time to time, on field trips around the world as well as at my and their various home institutes during those years. Dr. Christopher N. Page reviewed the texts on *Podocarpaceae* and the smaller families and his supportive comments were much appreciated. Michael Frankis commented on common names and corrected errors therein. The entire text was copy-edited by Dr. Hans Kruijer, whose helpful corrections much improved consistency and clarity of presentation. Prof. Pieter Baas wrote a thoughtful foreword, for which I am most grateful. Finally, coming closer to the end product now before you, I wish to thank the publisher, Brill and their helpful staff (especially Michiel Thijssen, Sabine Steenbeek and Frits Fritschy) for their professional work and helpful patience with the author. They have turned a huge and complicated manuscript into a beautiful book.

Aljos Farjon, FLS
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PREFACE TO THE SECOND EDITION

Since the publication of this Handbook in 2010 rapid and substantial developments in conifer research and publication have occurred. Those that have caused many necessary corrections and amendments to the first edition are connected with two projects led by the author; the compilation of *An Atlas of the World's Conifers* published by Brill in 2013 and the reassessment for the IUCN Red List of all conifers in 2010–2013. As a consequence, new and often more detailed information

on distribution and conservation status of species became available and had to be incorporated in the new edition. Proposed taxonomic changes have been treated cautiously but those considered 'unavoidable' have been presented in an Appendix so as not to disrupt the alphabetical sequence adopted in the Handbook.

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[Kew, 30 November 2016]