



# Evolution of the Australian Flora in Response to Cenozoic Climate Change

A thesis submitted for the degree of  
Doctor of Science

Robert S. Hill

Volume 1

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Veblen, T.T., Hill, R.S. & Read, J. 1996. Introduction: Themes and concepts in the study of <i>Nothofagus</i> forests. In: The Ecology and Biogeography of <i>Nothofagus</i> Forests (Eds T.T. Veblen, R.S. Hill & J. Read) pp. 1-10. (Yale University Press, Yale). (20%) .....	1238
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- Hill, R.S. & Truswell, E.M. 1993. *Nothofagus* fossils in the Sirius Group, Transantarctic Mountains: Leaves and pollen and their climatic implications. In: J. Kennett & D. Warnke (eds) *The Antarctic Paleoenvironment: A Perspective on Global Change (Part 2)*. American Geophysical Union, Washington. pp. 67-73. (50%) ..... 1337
- \*Hill, R.S., Scriven, L.J. and Jordan, G.J. 1995. The fossil record of the Proteaceae. In: A.E. Orchard (ed.) *Flora of Australia. Proteaceae*. Australian Government Publishing Service, Canberra. pp. 21-30. (80%) ..... 1344  
 (This book chapter was published in 1995 but arrived during 1996 near the completion of this thesis, and thus it is out of order.)

## Abstract

The extant Australian flora is the result of a wide range of past factors, most notably climate change and soil nutrients. This thesis contains the results of almost 20 years of publications on the Cenozoic flora, mostly of southeastern Australia, documenting the effects of those factors. Two taxa have formed the focus of detailed research. The genus *Nothofagus* has long been recognised as a key taxon for understanding Southern Hemisphere biogeography. My research has clarified the infrageneric taxonomy of this genus, presented a detailed phylogenetic reconstruction of the extant species, vastly increased our understanding of the macrofossil record (including detailed reconstructions of evolution in response to climate change), and allowed more informed reconstruction of the origin and history of the genus. The southern conifers, and the family Podocarpaceae in particular, have also been an important research focus. I have greatly increased our understanding of the macrofossil record of this group and have reported evolutionary trends that are clearly climatically based. The Podocarpaceae offer great potential for future research into climate change, and that potential has only become clear as a result of my research. More generally, I have undertaken research that demonstrates the temporal fragmentation of complex Early Paleogene rainforests into the patterns exhibited today along the east coast of Australia, and shown that this is a climatically-based phenomenon. I have also undertaken research on the history of the scleromorphic heath flora, and shown that the morphological expression of the effect of low soil nutrients occurred before that of low water availability. In a more restricted way I have been able to show that the alpine flora of Australia was beginning to develop by at least 20 million years ago in Tasmania, and that the ancestors of many of the taxa in the modern alpine flora have a long history *in situ*. My conclusions are broad-based, but always hinge on the strict taxonomic treatment of the fossils concerned. This taxonomic research underpins all my research, and is the most critical part of it.