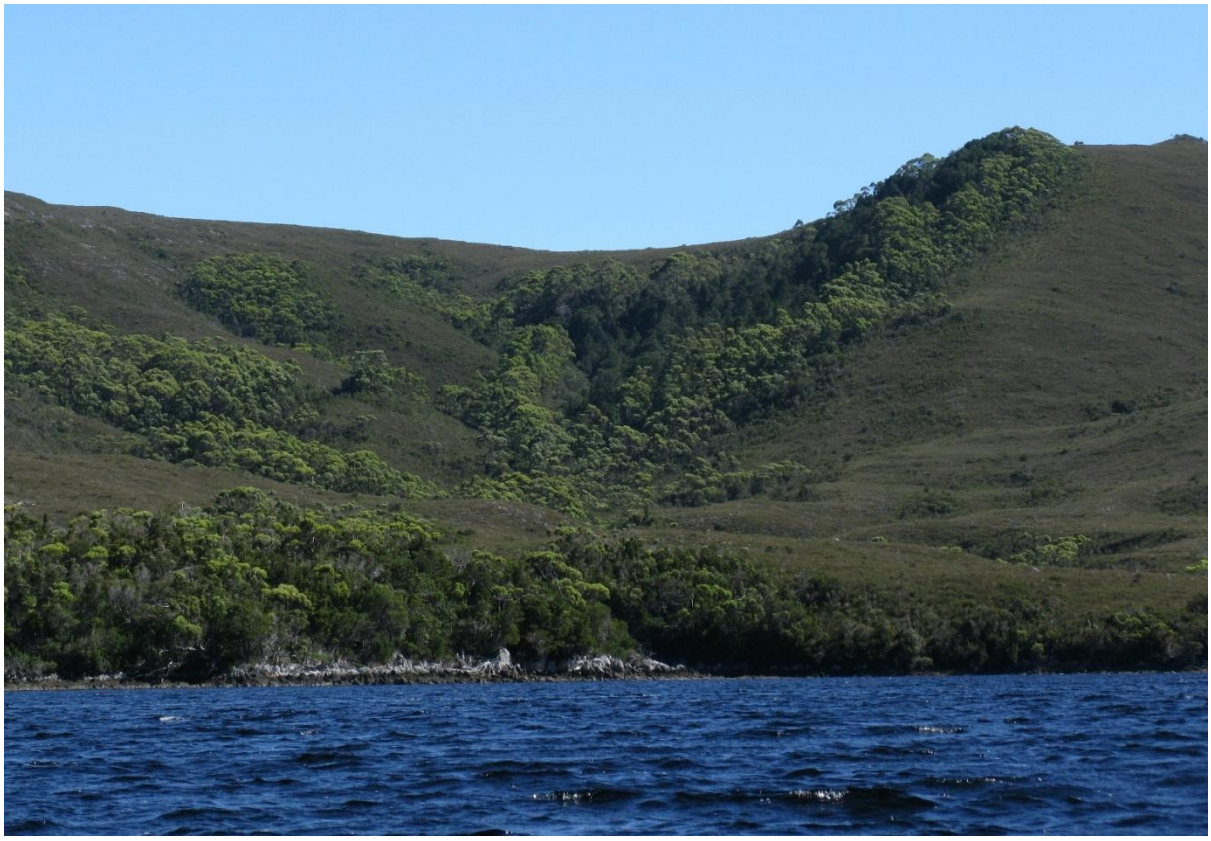
Fire-mediated alternative stable states in the vegetation communities of southwest Tasmania



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Statement of publication

Peer-reviewed publications produced as part of this thesis:

(1) Wood, S.W., Murphy, B.M., and Bowman, D.M.J.S. (2011) Firescape ecology: how topography determines the contrasting distribution of fire and rainforest in the southwest of the Tasmanian Wilderness World Heritage Area. *Journal of Biogeography*, **38**, 1807-1820.

(2) Wood, S.W. and Bowman, D.M.J.S. (In Press) Alternative stable states and the role of fire-vegetation-soil feedbacks in the temperate wilderness of southwest Tasmania. *Landscape Ecology*, (accepted for publication, October 17, 2011).

(3) Wood, S.W., Hua, Q. and Bowman, D.M.J.S. (2011) Fire-patterned vegetation and the development of organic soils in the lowland vegetation mosaics of southwest Tasmania, *Australian Journal of Botany*, **59**, 126-136.

(4) Wood, S.W., Hua, Q., Allen, K.J. and Bowman, D.M.J.S. (2010) Age and growth of a fire prone Tasmanian temperate old-growth forest stand dominated by *Eucalyptus regnans*, the world's tallest angiosperm. *Forest Ecology and Management*, **260**, 438-447.

(5) Bowman, D.M.J.S. and **Wood, S.W.** (2009) Fire driven land cover change in Australia and W.D. Jackson's theory of the fire ecology of southwest Tasmania. In: *Fire and Tropical Ecosystems* (ed. By M.A. Cochrane), pp. 87-106, Springer, New York.

Statement of co-authorship

In regards to the above list of peer reviewed publications:

SW was the lead author of all four papers and contributed to all aspects of each study including the development of the ideas, the collection and analysis of data, and the writing of the manuscript. BM provided statistical advice and assisted with refinement of the manuscript in (1). QH supervised SW for the laboratory analysis and contributed to the writing of the methodological sections of (3) and (4). KA supervised SW for the dendro-ecology study and assisted with refinement of the manuscript in (4). DB provided overall guidance and supervision for all four papers, including the development of ideas, the analysis of data and the writing of the manuscripts. SW and DB contributed equally to the research and writing of (5).

We the undersigned agree with the above stated "proportion of work undertaken" for each of the above published (or submitted) peer-reviewed manuscripts contributing to this thesis:

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Abstract

The World Heritage listed landscapes of southwest Tasmania are an ideal model system for investigating the role of fire in shaping the distribution of fire-sensitive and fire-adapted vegetation communities. Two models of vegetation dynamics have been put forward to explain the mosaic of rainforest, sclerophyll and treeless moorland vegetation in this region: the alternative stable states model of Jackson (1968) and the sharpening switch model of Mount (1979). Drawing on the concepts in these models, this aims of this thesis were to (a) contribute new evidence on the decadal, century and millennial scale dynamics of southwest Tasmanian vegetation communities and (b) investigate the role of interactions between fire, vegetation, soil and the physical environment in determining observed vegetation dynamics.

The application of geospatial statistics to mapped distributions of rainforest vegetation and the spatial pattern of four very large fires confirmed that the distribution of fire-sensitive rainforest is related to topographic fire refugia. Topography clearly plays an important role in mediating the feedbacks between fire and vegetation in southwest Tasmania. This study also provided the first integrated data on the relative flammability of the major vegetation communities at the landscape scale.

Repeat image analysis of aerial photographs (1948, 1988) and satellite imagery (2010) revealed that forest and non-forest vegetation communities have been largely stable over the last sixty-two years. Decadal scale fluctuations near forest boundaries were related to recovery from stand replacing fire and the very slow encroachment of trees into moorland. Analyses of soil samples collected across stable forest boundaries suggested that fire-vegetation-soil feedbacks may contribute to the maintenance of vegetation communities over time. Evidence from radiocarbon dating showed that interactions involving soils are also influenced by topography and its effect on drainage. This study also showed that stable

carbon isotopes in organic soil profiles cannot be used to examine millennial scale vegetation boundary shifts in southwest Tasmania.

Dendro-ecology studies revealed that an even-aged cohort of *Eucalyptus regnans* and *Phyllocladus aspleniifolius* established after a stand-replacing fire in 1490-1510AD. Therefore, overstorey *E. regnans* trees can live for well in excess of 500 years. Current models of forest dynamics for southwest Tasmania clearly underestimate the time frame required for century scale transitions from eucalypt forest to rainforest in productive systems.

Whilst there is some evidence to support the alternative stable states model for southwest Tasmanian vegetation communities, this support must remain equivocal. Vegetation patterns in southwest Tasmania appear to be predominantly stable at a range of temporal scales and interactions between fire, vegetation, soil fertility and topography are likely to contribute to the resilience of vegetation communities. Transitions between vegetation types can occur, although the time frames for transitions appear to be underestimated by current models. Further investigations into feedback mechanisms, the role of the physical environment and state-transition dynamics are required. The implementation of a well designed vegetation monitoring system is an important step toward our understanding and management of the relationships between fire and vegetation in southwest Tasmania under current and future climates.

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