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Multi-century changes in vegetation structure and fuel availability in fire-sensitive eucalypt woodlands

by Carl Gosper[1,2], Colin Yates[1] and Suzanne Prober[2]
[1]Science and Conservation Division DPaW, [2]CSIRO Ecosystem Sciences, (08) 93336442
carl.gosper@dpaw.wa.gov.au; colin.yates@dpaw.wa.gov.au; suzanne.prober@csiro.au

Background

The Great Western Woodlands (GWW) are the world's largest extant Mediterranean climate woodland. Like most other Mediterranean climate regions, recurrent fire is a feature of the landscape. Mature woodlands, because of their open tree canopy structure and patchy distribution of shrubs and litter, have a lower probability of burning than most adjoining vegetation types. However, extensive fires can occur during hot, dry and windy weather.

As woodland ecosystems recover from fire, changes occur in the composition, structure and biomass of vegetation, affecting its properties as fuel and as fauna habitat. Little is known about the recovery of woodland vegetation structure and the time periods over which changes occur.

This study aimed to understand how vegetation structure and fuel availability change with time after fire in *Eucalyptus salubris* (Gimlet) woodlands to better inform fire management for biodiversity conservation and protection of human assets. This was accomplished by studying vegetation structures in woodlands of different but known times since the last fire, which was estimated by a combination of satellite imagery, tree stem growth ring counts and growth ring-plant size relationships. Using these techniques, fire history could be reconstructed for periods exceeding 300 years (see Science Division Information Sheet 65).

Findings

- All vegetation structural components showed significant differences between time-since-fire classes (characterised as 'young', 'intermediate' and 'mature').
- The vegetation structural components with the highest overall cover, and which contributed most to the fuel complex, were vegetation 4-10 m high and dead material on the soil surface, including leaf litter, logs etc. Both changed with time since fire and had peak cover at intermediate times since fire (Figs. 1, 2).

Eucalyptus salubris woodland representative of 'young' (left; <20 years since fire), 'intermediate' (35 to 120-200 years since fire) and 'mature' (>140-260 years since fire) age classes. The ranges in the bounds of age classes reflect differences between models used to estimate stand time since fire (see Information Sheet 65).

- Lateral gaps between foliage increased with time since fire (Fig. 2), indicating that in mature woodlands longer flame lengths would be required to bridge gaps between foliage fuel.

- There was little evidence of an increase in standing dead vegetation in mature woodlands such as would suggest significant senescence when long-unburnt. However, standing dead vegetation was significantly higher in a drier sample year, demonstrating how climatic factors can affect fuel availability.
- Total stand basal area increased rapidly after fire then appeared to stabilize beyond about 100 years. At this stage decreases in stand density due to natural thinning were offset by the increased growth of surviving trees.

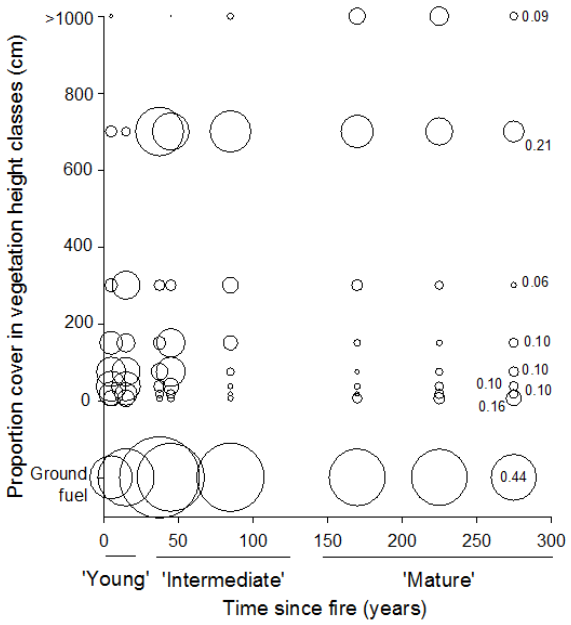

Fig. 1. Bubble plot showing the vertical distribution of flammable fuel in *E. salubris* woodlands. The fuel ladder is most continuous and has greatest cover in several individual layers at intermediate times since fire. The bubble scale is shown for the last column.

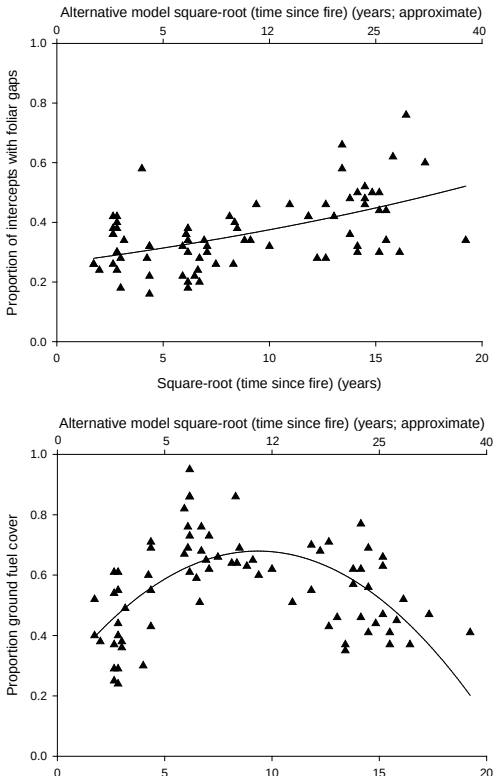

Fig. 2. Changes with time since fire in (top) gaps in foliage cover and (bottom) cover of ground fuel in *E. salubris* woodlands. Alternative time since scales (see Information Sheet 65) are shown on top and bottom x-axes, which have been square-root transformed.

Management Implications

- Cover and connectivity of key fuel layers in *E. salubris* woodlands peaked at intermediate times since fire. It would be desirable to conduct experimental fires to test whether fire behaviour reflects the changes in fuel availability we have inferred from measurements of cover.
- Replacement of mature woodlands with intermediate time-since-fire woodlands with greater cover and connectivity of key fuel layers potentially instigates a self-reinforcing fire regime shift favouring larger and/or more uniform fires. If such changes eventuate, substantial losses in conservation values of *E. salubris* woodlands are likely.
- Following a number of large wildfires over recent decades, large areas of regenerating woodlands will be passing into a stage of post-fire development with higher cover of key fuels over the period 2025-2150, creating significant and increasing challenges for fire management.
- Management interventions to reduce the likelihood of extensive wildfires in the GWW are being investigated. These include fuel reduced buffer strips and the application of patch burning during mild autumn conditions.

Further reading: Gosper CR, Prober SM and Yates CJ (2013) Multi-century changes in vegetation structure and fuel availability in fire-sensitive eucalypt woodlands. *Forest Ecology and Management* **310**, 102-109.

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