



Changes in plant diversity and vegetation composition with time since fire in gimlet woodlands

by Carl Gosper^{1,2}, Colin Yates¹ and Suzanne Prober²

¹DEC Science Division, ²CSIRO Ecosystem Sciences, (08) 93336442

carl.gosper@dec.wa.gov.au; colin.yates@dec.wa.gov.au; suzanne.prober@csiro.au

Background

Recurrent fire is a dominant disturbance across Mediterranean-climate landscapes. Fire shapes vegetation patterns, community composition and community diversity. Understanding how communities change with aspects of the fire regime, such as time since fire, is crucial for the identification of appropriate fire return intervals for biodiversity conservation.

The Great Western Woodlands (GWW) form the world's largest extant Mediterranean-climate woodland, with *Eucalyptus* woodlands occurring in mosaic with mallee, shrublands and salt lakes over an area of 160 000 km². Eucalypt woodlands in the GWW are typically fire sensitive, with many of the dominant species like gimlet (*Eucalyptus salubris*) killed by complete canopy scorch and being very slow growing. Recent fire return intervals across the GWW appear to be shorter than the longer-term average, raising concerns over the persistence of mature woodland communities. The aim of this study is to better understand how the composition of plant species and functional types (PFTs) in eucalypt woodland develops after fire, and the time scales over which any changes occur. To do this, we used a space-for-time approach in *E. salubris* woodlands, using two models of times since fire of long-unburnt sites derived from growth ring-size relationships (see Information Sheet 65/2013).

Findings

- Plant species density and evenness (diversity) are lower in woodlands at an intermediate age post-fire (35-200/450 yrs; the two age ranges are from the two models for estimating stand age), higher in young (< 18 yrs post-fire) and highest in mature (> 200/450 yrs post-fire) vegetation (Fig. 1).
- This unusual 'U'-shaped relationship between diversity and time since fire is likely to be driven by dominant trees and shrubs having maximum cover (and maximum competitive influence in suppressing the understorey) at intermediate times since fire (Fig. 2).
- A few plant species were restricted to vegetation of one time since fire age class. *Glischrocaryon* spp. behaved as classic post-fire ephemerals, occurring only in recently-burnt woodlands. In contrast *Amyema* spp. (mistletoes), being fire-sensitive and lacking a persistent seed bank, were absent from recently-burnt areas. They recolonise from unburnt patches.
- Species were divided into PFTs based on plant life form and seed dispersal potential (short or long). The richness and abundance of many PFTs changed with time since fire.
- Community-dominant trees with short-distance dispersal potential (e.g. *E. salubris*) had peak cover at intermediate times since fire. Shrubs with short-distance dispersal potential (e.g. *Acacia hemiteles*) had lower cover in mature vegetation, while annuals (e.g. *Calotis hispidula*) and perennial herbs and grasses (e.g. *Austrostipa elegantissima*) with long-distance dispersal potential increased in cover in mature vegetation (Fig. 2).

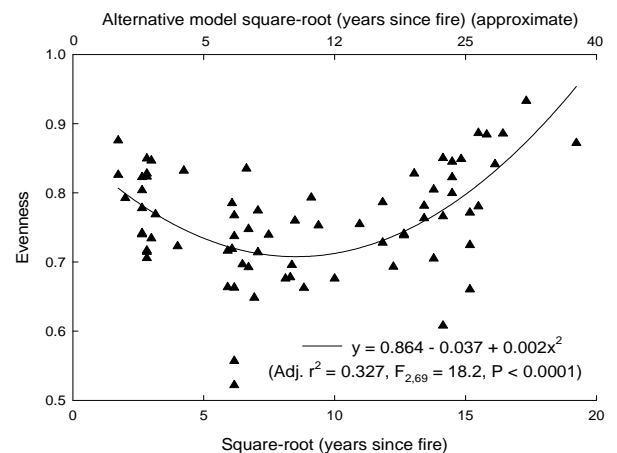


Figure. 1. The 'U'-shaped response in community evenness with time since fire in gimlet woodlands. Evenness is an index reflecting the equality of cover among species. The higher the evenness, the more equally cover is shared among species.



Left: A recently burnt (2 years post-fire) gimlet woodland, with regenerating *Eucalyptus salubris*, and the post-fire ephemeral *Glichrocaryon* spp. in the foreground. Centre: Gimlet woodland of an intermediate (~40 years) time since fire, showing high cover of 'pole' *E. salubris* and a dense shrub layer. Right: Mature gimlet woodland (> 200/450 years post-fire), showing lower tree and shrub cover, but more space at ground level for low shrubs, perennial herbs & grasses and annuals.

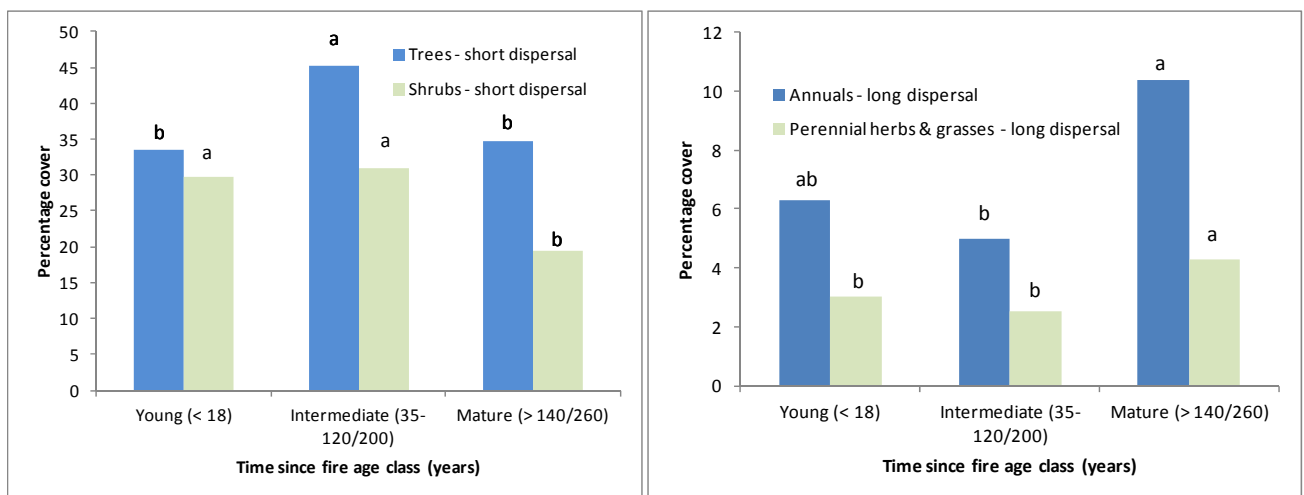


Figure 2. Change in vegetation cover in four PFTs between time since fire age classes in gimlet woodlands. Letters above bars refer to statistically significant differences in cover between times since fire age classes for that PFT. Bars with the same letter are not significantly different at $p < 0.05$.

Management Implications

- As diversity was highest in mature woodlands, there is no support from these community-level measures for *E. salubris* woodlands requiring recurrent fire to maintain plant diversity.
- Although there was evidence for turnover of species with time since fire in *E. salubris* woodlands, the overall community type showed no evidence of changing. A single fire appears unlikely to initiate change from woodlands to mallee or shrublands.
- Intense stand-replacing fires at intervals of < 200 yrs would have adverse implications for biodiversity conservation. Species diversity would not increase to the community maximum and the mature vegetation community that appears distinct in species and PFT composition would not develop.

Further information: Gosper CR, Yates CJ and Prober SM (in press) Floristic diversity in fire-sensitive eucalypt woodlands shows a 'U'-shaped relationship with time since fire. *Journal of Applied Ecology*.

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