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Science Division

Changes in plant diversity and vegetation structure with time-since-fire in mallee and mallee-heath

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Background

Fire is an important ecological process shaping vegetation patterns and community composition. Community assembly following fire is influenced by a number of factors, one of which is the time since the last fire. Several models have been proposed to explain time-since-fire changes.

According to the 'initial floristic composition' model, all plant species present during the post-fire succession re-establish shortly after fire and changes over time reflect differential growth rates and survivorship. Diversity is predicted to decline with increasing time since the last fire, but structural change may follow one of several scenarios: (i) there may be little change, as climate may limit vegetation structure; (ii) communities may continue to develop in stature beyond average fire-return intervals, being limited by climate but modified by fire; or (iii) components of fire-maintained communities may decline and senesce as species exceed their longevity or succumb to competition.

Alternatively, according to the classical 'relay floristic' model of succession, there are directional changes in vegetation over time as species colonise and outcompete existing vegetation. This would lead to highest diversity at intermediate periods since fire, when species with both high and low tolerances to disturbance can co-exist. A change in vegetation structure may also occur as the post-fire community is replaced by a structurally different community regulated by climate.

In the Western Australian wheatbelt, fragmentation of native vegetation has led to substantially altered fire regimes, with remnants experiencing less frequent and less extensive contemporary fires than uncleared portions of the landscape. Understanding vegetation changes related to time since fire is a crucial component in identifying appropriate fire return intervals for biodiversity conservation and to guide fire management interventions. We investigated changes in vegetation structure and diversity with time since fire in two widespread vegetation communities (mallee-heath and mallee) that occur in mosaic across this fire-prone landscape.

Findings

- Diversity (species density, Shannon diversit and evenness) declined with time since fire in mallee-heath, supportive of the initial floristic composition model of plant succession. Evidence for changes in diversity over time in mallee was weak (Fig. 1).
- Measures of standing dead vegetation and bare ground indicated an increase in senescent vegetation in long-unburnt (> 40 years) mallee-heath, but not in mallee (Fig. 1).
- The mallee community increased in stature as the vegetation aged post-fire, with increased size of *Eucalyptus* spp., increase vertical vegetation profile development and maximum leaf litter cover. In mallee-heath, these values peaked after 30-40 years, and then either stagnated or declined (Fig. 2).

A recently burnt (left; 6 years post-fire) and long unburnt (right; >40 years post-fire) example of the mallee (above) and mallee-heath (below) vegetation communities

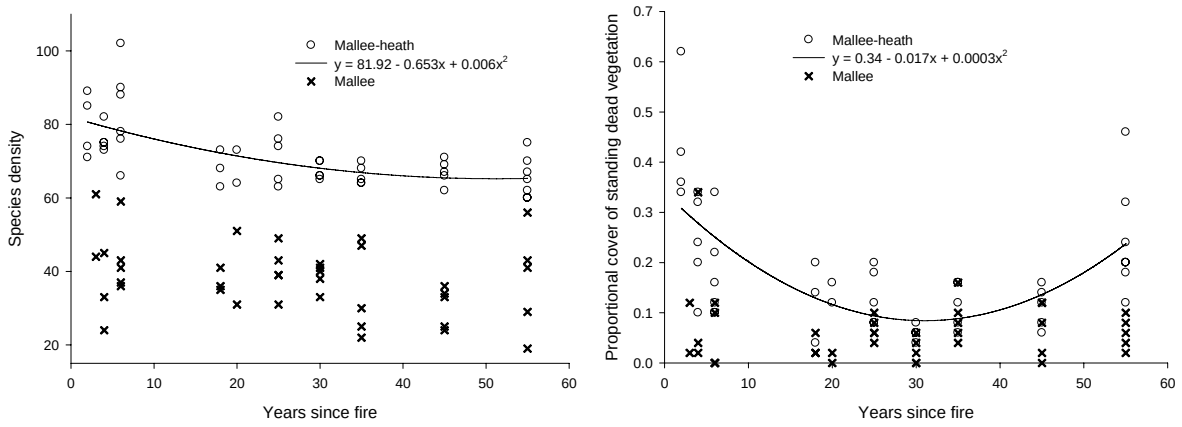

Fig. 1. Relationships in mallee and mallee-heath between the number of years since fire and (left) the number of species per 100m², and (right) the proportion of point intercepts with standing dead vegetation. Regression curves are shown, with no significant relationship in the mallee community in either case.

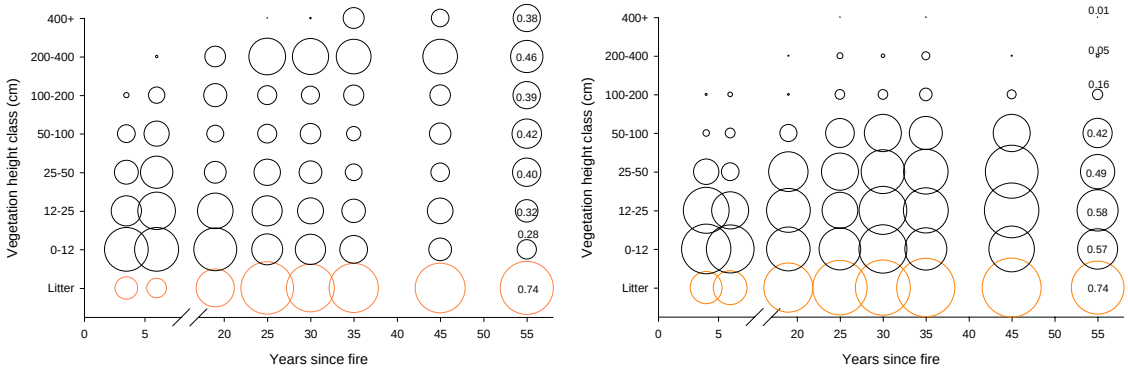

Fig. 2. Development of the vegetation profile and accumulation of leaf litter with increasing time since fire for mallee (left) and mallee-heath (right) communities. The proportional cover of point intercepts with standing vegetation in each height class and for leaf litter is shown in long-unburnt (i.e. 55+ years) vegetation for scale.

Management Implications

- **Plant diversity and vegetation structure in mallee-heath is fire-maintained**; hence mallee-heath has lower resilience to large deviations from modal fire intervals. While maximum intervals between fires in mallee-heath could be at least 50 years, active fire introduction may be appropriate in small wheatbelt remnants where current mean fire return intervals exceed 100 years.
- **Mallee communities** are modified by fire but are resilient to long intervals without fire. Short intervals between fires will limit structural development, which, if affecting large portions of the landscape, may have substantial consequences for fauna and carbon storage. As appropriate fire return interval ranges for mallee have a longer upper bound, active introduction of fire in mallee communities in remnants would be a much lower priority than for mallee-heath.
- **Any decision to introduce fire** into reserves in fragmented landscapes must be underpinned by a thorough analysis of the risks to all biodiversity values and especially potential interactions with invasive species.

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