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Fire regimes and impacts in transitional woodlands and shrublands

Ecosystem Science

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Context

The Great Western Woodlands (GWW) is an internationally significant area with great biological and cultural richness. This 16 million hectare region of south-western Australia arguably contains the world's largest and most intact area of contiguous temperate woodland. The GWW Conservation Strategy and a review conducted by a wide range of scientists with expertise in the region each identified inappropriate fire regimes as a threat to the woodlands and emphasised the need for a science-based fire management regime for the area. Critical gaps in the knowledge of fire ecology for GWW ecosystems are a major hindrance for ecological fire management in the region. The GWW supports eucalypt woodlands at very low mean annual rainfall (250-350 mm). Woodland eucalypt recruitment is stimulated by fire but individuals are very slow growing. In recent decades a large part of the GWW has been burnt and concern has been expressed over the ecological impacts of this. Fire ecology research already undertaken in eastern wheatbelt nature reserves will help resolve ecological fire management issues for mallee and mallee-heath communities in the GWW, but similar information for the dominant eucalypt woodlands is needed.

Aims

- Develop a method to robustly estimate stand time since fire in gimlet (*Eucalyptus salubris*) woodlands that have not been burnt during the period covered by remotely-sensed imagery, allowing the scale of recent extensive wildfires to be placed in a historical context.
- Investigate the effects of time since fire on the assembly and recovery of gimlet woodlands, including on plant and animal community composition and development of ecosystem structure.
- Measure fuel and carbon dynamics with time since fire in gimlet woodland.
- Investigate pathways to weed invasion in the GWW.

Progress

- A multi-century time since fire chronosequence of 76 plots has been established in gimlet woodlands, sampling plant composition, vegetation structure, visual fuel assessment, ants, birds and carbon pools.
- Data from the chronosequence have been used to: (i) develop a conceptual model of vegetation dynamics for the unique stand-replacement temperate eucalypt woodlands of southwestern Australia (manuscript in preparation); (ii) review the composition, biogeography, environmental correlates and ecology of Australia's temperate eucalypt woodlands (chapter in press for the book *Australian Vegetation*); and (iii) locate a second population of the critically endangered arid bronze azure butterfly, by using ant records.
- A revised model for estimating the time since fire of long-unburnt gimlet woodlands has been developed and presented at the 2016 Ecological Society of Australia conference.
- Tree and shrub, woody debris, litter, and soil carbon pools were measured at a subset of the gimlet chronosequence sites.
- Three Science and Conservation Information Sheets outlining the management implications of the research were published: (i) visual fuel assessments in gimlet woodlands; (ii) changes in ant communities across the gimlet chronosequence; and (iii) predictors of weed occurrence and delineation of priority weed species in the GWW.

Management implications

- National-scale syntheses of temperate eucalypt woodland fire ecology revealed that many Western Australian woodlands are uniquely dominated by taxa that are obligate seeding, and have vegetation dynamics driven by rare, stand-replacing disturbances. These characteristics illustrative a putative vulnerability to decreases in intervals between fires.

- Post-fire succession in plant composition and structure, which in turn determines successional patterns in animals, occurs over multi-century timescales, demonstrating the value of avoiding fire in mature woodlands to maximise future fire management options.
- Changes in vegetation structure and cover, and fire probability based on historical fire records, indicate maximum gimlet woodland flammability at intermediate times since fire, supporting the revision of fire behaviour ratings.
- Contemporary invasive plant spread in the GWW could be reduced via: (i) targeting abandoned and current settlements for removal of disjunct weed populations; (ii) minimising new settlement creation in locations currently remote from towns; and (iii) closing water points on conservation estate to reduce disturbance-induced weed recruitment. Considering future climate tolerance in weed species prioritisation results in a feasibly small selection of taxa for pre-emptive regional-scale eradication or containment.
- GWW woodlands have little grass in comparison to other temperate woodlands. If perennial grass weeds (such as buffel grass) become widely established, potentially facilitated by climate change, substantial fire regime shifts and subsequent extensive loss of mature woodlands are plausible.
- Knowledge generated through this project has been incorporated into eucalypt woodland fire ecology training being delivered to Department of Parks and Wildlife staff.

Future directions

- Finalise journal publications concerning vegetation dynamics model for stand-replacement temperate eucalypt woodlands and the refined model for estimating time since fire of long-unburnt gimlet woodlands.
- Analyse measurements of carbon pools across the gimlet chronosequence to determine the role of fire management in carbon sequestration.
- In collaboration with Birdlife Australia, complete analyses and publications on changes in bird communities with time since fire across the gimlet chronosequence