Department of Environment and Conservation

Information Sheet 65 / 2013
Science Division

Ageing long-unburnt Gimlet woodlands

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Background

Establishing the time since disturbance is a significant challenge in studies of temporal changes in ecosystem composition and function in infrequently-disturbed communities. Individual fire events, for example, can have effects lasting for centuries. Dating fires that occurred prior to those documented in contemporary sources (e.g. historical records or remote-sensed imagery) is not a trivial problem, as many ecological processes, such as hollow formation, operate over long time scales. Estimates of the actual time since fire of long-unburnt vegetation can be made through dendrochronology (measuring trunk growth rings), or establishing relationships between plant size and time since fire.

Eucalyptus salubris (gimlet) is a fire-killed tree widespread across the globally-significant Great Western Woodlands (GWW). We aimed to characterize the relationship between gimlet tree rings, plant age and plant size. The woodlands of the GWW are typically fire sensitive and are at risk from inappropriate fire regimes. Uncertainty concerning the time since fire of long-unburnt woodlands, and hence the scale over which temporal changes in woodland dynamics occur, currently constrains understanding as to whether the recent fire regime represents a significant long-term threat to mature woodland ecosystems.

Gimlets (*Eucalyptus salubris*) are killed when burnt and recruit en-mass post fire (left) from seed released from a canopy-stored seed bank. Satellite imagery can be used to determine the time since fire of woodlands regenerating post-fire for periods up to ~ 40 years ago (centre), but is unable to be used to determine the time since fire of the iconic woodlands characterised by large, widely-spaced trees that typify the Great Western Woodlands (right).

Findings

- Growth ring counts strongly reflected plant time since fire over the period for which fires could be dated with certainty (the last 40 years). Growth rings could be used to estimate the time since fire of plants up to approximately 100 years old, by which time most gimlets had developed hollow cores, truncating the growth ring record.
- A variety of models were tested to estimate the number of growth rings, incorporating a variety of combinations of predictors (tree diameter at the base, height and location) and transformations. Models based on both untransformed and square-root transformed growth rings predicted by tree diameter (± location) performed well over the range of trunk sizes that could be dated (Figure 1). These models could be used to estimate stand time since fire.
- For trunks >~20 cm diameter, there is greater uncertainty over their time since fire (Figure 1).

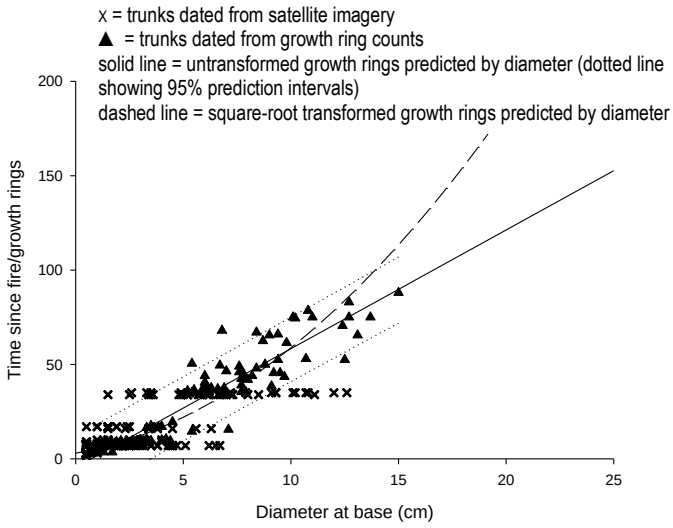

Figure 1. Relationship between time since fire and diameter at the base in gimlet.

Trunk section of gimlet, showing visible growth rings

- The estimated age-class distribution of woodlands has been calculated (Figure 2), under the assumption that the time since fire of the long-unburnt gimlet stands sampled in this study reflects the distribution of times since fire in woodlands across the GWW more broadly.
- Age-class distributions generated from size-age relationships show a considerably greater diversity of times since fire than those from analysis of satellite imagery, as satellite imagery substantially truncates maximum ages (Figure 2).

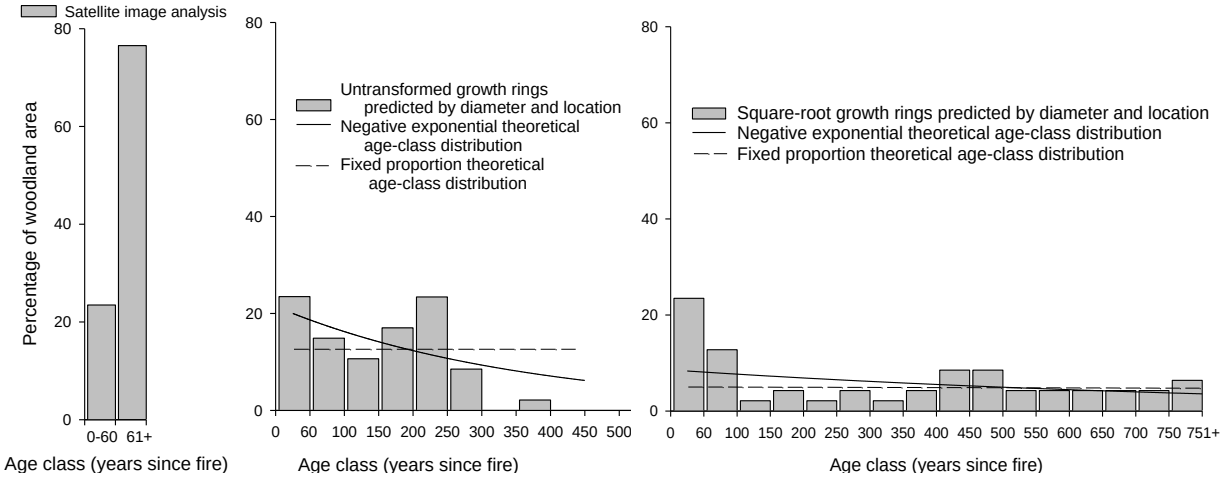

Figure 2. Comparison of gimlet woodland age-class distributions generated from: (left) analysis of satellite imagery (note that no resolution of age classes beyond 60 years post-fire is possible); (centre and right) estimates derived from two well-fitting growth ring-size relationships. Commonly-applied theoretical age-class distributions are shown based on: (i) a fixed proportion in each age class across all times since fire; and (ii) a negative exponential function showing a declining proportion in each age class with increasing time since fire.

Management Implications

- Satellite imagery is inadequate for describing fire history and guiding landscape fire management in *Eucalyptus* woodlands in the GWW.
- Actual age-class distributions can be compared with theoretical distributions to determine the type and scale of fire management interventions to facilitate improved conservation. Irrespective of the model used to estimate the age-class distribution, recently-burnt vegetation is over-represented on a fixed proportion basis but less so compared to a negative exponential function.

Further information: Gosper CR, Prober SM, Yates CJ and Wiehl G. (in press) Estimating the time since fire of long-unburnt *Eucalyptus salubris* stands in the Great Western Woodlands. *Australian Journal of Botany*

This research is jointly funded by DEC (GWW Conservation Strategy) and CSIRO.

Produced and published by the Science Division, Department of Environment and Conservation, Western Australia, Locked Bag 104, Bentley Delivery Centre, WA 6983

GREAT WESTERN WOODLANDS