Department of Environment and Conservation

Information Sheet 39 / 2010
Science Division

Using fruit crop and mortality to determine appropriate fire-return intervals

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

Background

Departures from historic fire regimes (e.g. in the length of inter-fire period) can have substantial consequences for ecosystem composition and function. One method through which appropriate bounds of inter-fire intervals can be estimated is through the measurement of plant vital attributes. Particular functional traits of plants confer inherent vulnerability to variation in fire interval, such as serotiny (canopy-stored seed) or the inability to sprout after fire. Serotinous seed banks typically persist only as long as adult plants survive, and thus in non-sprouters, these seed banks are unable to buffer populations from declines that result from fire during the juvenile period, or after adult plants die. Understanding how reproductive potential and mortality in serotinous non-sprouters changes with time since fire is useful for identifying appropriate fire return intervals for the vegetation communities of which they form a part, and to guide fire management interventions.

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. Whilst adverse conservation outcomes are a possible consequence of atypically long intervals between fires, uncertainty regarding appropriate fire-return intervals for specific vegetation communities constrains fire management.

We established replicate sites in vegetation between 4 and 55+ years post-fire in two widespread communities (mallee-heath and mallee) that occur in mosaic in the Lake Magenta area. We measured fruit crops (calculating mean fruit crop size per plant and the proportion of the population carrying closed fruit) and mortality (calculating the proportion of the population dead) for a range of serotinous non-sprouters (Table 1). In the examples below, we set thresholds for minimum fire interval (when plants reach reproductive maturity) at the age post-fire when mean fruit crop size reaches 25% of the maximum for that species, and when 50% of individuals carry closed fruit. The threshold for maximum fire interval (when populations senesce) was set at mortality reaching 25% of individuals. Other thresholds to define interval bounds could be applied, corresponding to different levels of risk of management actions.

Findings

- All serotinous non-sprouters had a significant relationship between fruit crop attributes and time since fire (Fig. 1). Fruit crops, starting at zero immediately post-fire, increased with greater time since fire, although for some species there was a slight decrease from a prior peak in the longest-unburnt (55+ years) vegetation.
- Whilst some serotinous non-sprouters had little mortality in vegetation of any age post-fire, in others mortality increased in the longest-unburnt vegetation, indicating senescence of populations (Fig. 1). Only in mallee-heath did mortality reach pre-defined threshold levels.

A recently burnt (above left; 6 years post-fire) and long unburnt (above right; >40 years post-fire) mallee-heath vegetation community. Important vital attributes to evaluate the potential for population replacement post-fire in serotinous non-sprouters are the size of the canopy-stored seed bank (below left; *Hakea pandanicarpa*) and levels of mortality in long-unburnt vegetation (below right; *Banksia blechnifolia*).

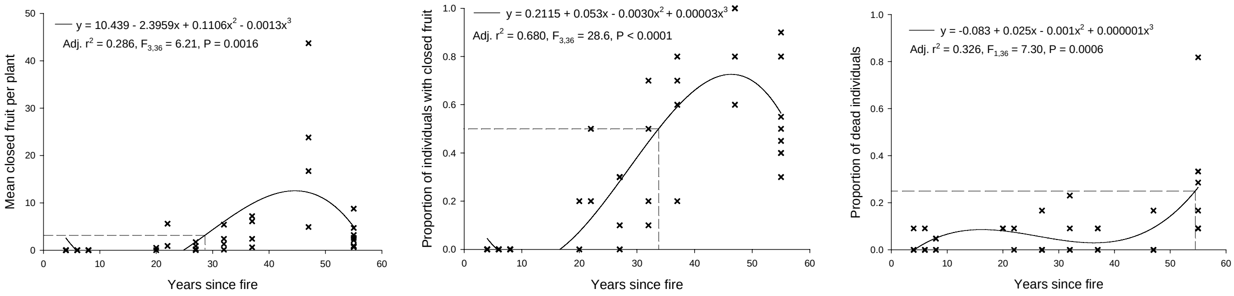
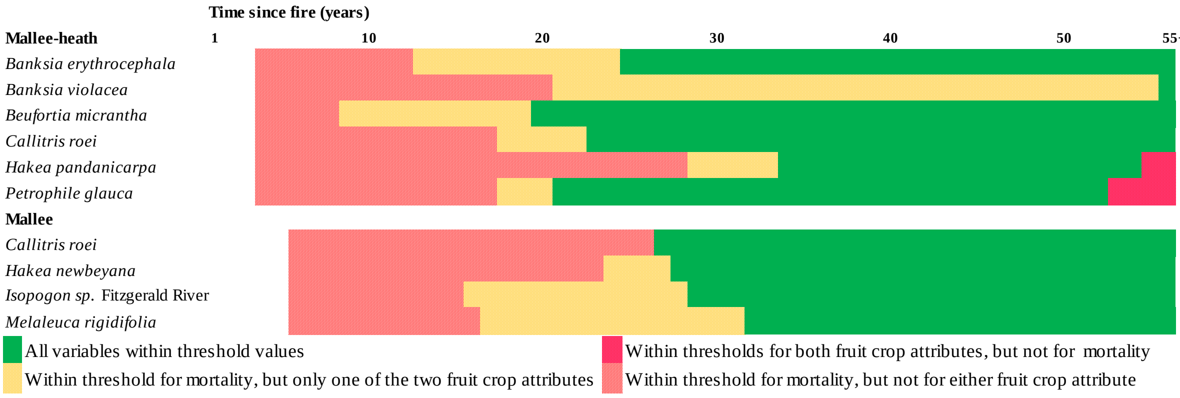


Fig. 1. The relationships in *Hakea pandanicarpa* ssp. *crassifolia* between time since fire and mean fruit crop per plant (left); the proportion of the population with closed fruit (centre), and the proportion of the population dead (right). Dashed lines indicate the intercept with the regression relationship between time since fire and the thresholds specified for deriving fire return intervals: (left) minimum fire-return interval when fruit crops reach 25% of the maximum (~29 years); (centre) minimum interval when 50% of the population carries closed fruit (~34 years) and (right) the maximum interval when the proportion of dead individuals exceeds 25% (~55 years).

- Individual species reached one or other of the fruit crop thresholds (juvenile period) between 9 and 29 years post-fire, and reached both thresholds between 18 and 55 years (Table 1).
- On the basis of the species sampled, an acceptable fire-return interval range in mallee-heath in the Lake Magenta area will be ~30-55 years (Table 1). In mallee, no species showed significant mortality when old, and other work we have undertaken (see Information Sheet 33/2010) shows continued increases in community structure over time, so the acceptable fire-return interval range appears broader, from ~30 to well beyond 55 years. Species from other trophic levels, for example the Malleefowl, may be more useful for defining fire intervals in this community.

Table 1. Acceptable fire-return intervals for individual serotinous, non-sprouting species based on relationships between vital attributes and time since fire.



Management Implications

Mallee-heath appears more sensitive to variation in fire interval than mallee.

- Currently, mean fire return intervals exceed 100 years in small remnants in the wheatbelt, and some species in mallee-heath are likely to be senescing. Active fire introduction may be an appropriate management response in this community.
- Both communities have species vulnerable to fire-return intervals < 25-30 years; thus reducing fire incidence in frequently-burnt landscapes (e.g. Great Western Woodlands) would be desirable.
- Fruit production and mortality is likely to vary with climatic conditions and fire events, so field validation in key species is recommended prior to applying prescribed fire. Seed quantity following fire will also depend on fire intensity and patchiness.
- The decision to introduce fire into reserves in fragmented landscapes must be underpinned by a thorough analysis of the risks to all biodiversity values, especially potential interactions with invasive species.

Beaufortia micrantha

This research is jointly funded by the DEC Saving Our Species initiative and CSIRO.

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