Wildfire return intervals in semi-arid southern Western Australia: effects of fuel age and spatial structure

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Importance of understanding natural fire regimes
- Basis for developing appropriate fire management strategies
- Historical context to assess significance of ‘extreme’ fire events and potential influence of climate change in Lake Johnston region, Western Australia
- Extensive area (15,500 km²) of relatively undisturbed semi-arid shrubland & woodland at the eastern margins of the southern Wheatbelt (Fig. 1)
- Lightning-caused wildfires are common, and intervention for fire management has been minimal

Relatively ‘natural’ fire regime

Spatial controls of a ‘natural’ fire regime
Effect of fuel structure and age on wildfire return intervals
- We tested the effect of fuel structure and age on fire interval length by comparing fire interval distributions among vegetation types (with differing fuel structure) using survival analysis
- We generated fire interval distributions by fitting the 2-parameter Weibull model to empirical fire return interval data (1940-2007)
- Vegetation types defined by Beard (1976) were reclassified into 5 groups based on the structural distribution of fuels (Fig. 2)

We compared fire interval distributions based on the estimated values for the two Weibull parameters:
- ‘b’ (Scale) parameter: ‘typical’ fire interval length, or the interval that will be exceeded 36.79% of the time,
- ‘c’ (Shape) parameter: indicates the degree of age dependency, or the rate of change in probability of burning with time since fire (fuel age). Values close to 1 indicate a fire regime operating independently of fuel age, values close to 2 indicate a linear increase in probability of burning with fuel age, while values greater than 2 indicate exponential growth in probability of burning with fuel age (Moritz 2003).

Two forms of the Weibull distribution:
- The cumulative probability form (Mortality Function) indicates the probability of burning before time, t (Fig. 3a)
- The Hazard of Burning form indicates the instantaneous probability of burning at time, t, given that a fire has not already occurred (Fig. 3b).

Fire interval length is dependent on veg type (fuel structure)
- The typical fire interval length (parameter b; Fig. 3a) for Woodland (414 yrs) is much longer than both Mallee (63 yrs) and Shrubland (47 yrs).
- Typical fire interval length for shrubland is comparable to that of the California chaparral (33-42 yrs) (Moritz 2003).

Fuel age-dependency varies with vegetation type
- Fire regimes in Shrublands show moderate age dependency - exponential growth in the probability of burning with fuel age (Fig. 3b)
- Fire regimes in Mallee show some age dependency - linear growth in probability of burning with fuel age (Fig. 3b)
- Fire regimes in Woodlands are independent of fuel age – relatively constant low probability of burning despite increases in fuel age (Fig. 3b)
- All vegetation types show a reduced probability of burning following fire. Probability of burning is below that of an age-independent regime (i.e. c = 1) for 26 yrs for Shrubland, 34 yrs for Mallee and 117 yrs for Woodland following fire (data not shown).

References: