Quantifying long-term regional scale impacts of prescribed burning on wildfire incidence and extent in SW Australian eucalypt forests

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Prescribed burning is being advocated both for its capacity to reduce fuel loads, and thereby mitigating large high-intensity wildfires, and as a means to re-introduce a natural disturbance to inherently fire-prone ecosystems. However, for many such environments the field evidence or ecological understanding to predict the benefits of prescribed burning is lacking, for either wildfire hazard reduction or conservation. This study analyses a 52-year fire history from the Warren Region in south-western Australia[1]; one of the few regions in the world where prescribed burning has been practised at adequate spatiotemporal scales for assessing long-term impacts on regional fire regimes and ecosystem functioning.

Quantile regression identified the longevity of the influence of prescribed fire treatments on wildfire incidence and extent. Anomalies in the frequency-size distribution of unplanned fires were identified through a relative risk mapping using kernel density estimates. Changes in the spatial distribution of fuel age were quantified using patch metrics, while generalized additive models were applied to estimate effects of fuel age patterns on the incidence and extent of unplanned fire.

Widespread prescribed burning, introduced in the 1960s, has profoundly changed the spatial patterning of fuel age across the landscape while reducing the incidence and extent of unplanned fires. Increases in total annual area treated by prescribed burning are in general weakly correlated with a decreasing number and extent of unplanned fires in the same or subsequent years, decaying to insignificance for time lags greater than six years. However, when summed over six-year periods, the fraction of the area treated by prescribed burning explained 24% and 71% of the variation in the mean annual frequency and extent of unplanned fires, respectively. From the results we estimate that every unit area reduction in the mean annual extent of unplanned fire required about four area units of prescription fire. The incidence of large unplanned fires was significantly less than the long-term average for the region when the annual extent of prescribed fire was at a maximum and significantly more when the annual extent of prescribed fire was at a minimum. The spatial patterning of fuel age alone explained 21% and 64% of the variation in the annual frequency and extent of unplanned fires, respectively. Since the 1960s, the length of time that sites remain unburned by wildfire has increased from ~5 to ~10 years, independent of the previous fire being planned or unplanned fire.

Our findings provide strong empirical evidence of the effectiveness of prescribed burning for mitigating wildfire hazard in SW Australian forests. However, ongoing research and development is needed to implement managed fire regimes that integrate wildfire mitigation with conservation of biodiversity and other environmental values.

[1] Boer et al. (2009). *Forest Ecology and Management* **259**: 132-142