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Orchid diversity and occurrence in relation to past fire in Canberra Nature Park

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Background

This research was a collaboration between local residents and the Environment Division of the ACT Government. It was initiated by community concerns that fire management within nature reserves in Canberra was impacting orchid diversity and abundance. The project sought to:

- Survey orchid species occurring across a range of time-since-fire and fire frequency classes.
- Analyse the influence of fire history and terrain on orchid species richness and occurrence of individual orchid species.
- Inform on-going fire management planning and operations in Canberra Nature Park reserves, such that fire managers are able to find an appropriate balance between the protection of life, property and the environment.

Methods

Field survey

Between 24 September 2016 and 16 October 2016, 47 volunteers and research staff visited one or more of 114 nominated points in dry forest and woodland throughout Black Mountain, Aranda Bushland, Bruce Ridge, Gossan Hill and O'Connor Ridge nature reserves. These reserves share a Black Mountain Sandstone geology. Nominated points were selected to represent a range of fire history states and terrain positions (Figure 1).

Participants photographed all orchid species within 50m of the point, designated by a star picket. The photographs were loaded into the innovative cloud platform, *Naturemapr* via the *Canberra Nature Map* portal, where identification was confirmed by three orchid moderators, Tony Wood, Cath Busby or Tobias Hayashi. The GPS locations embedded in the properties within the images derived from smartphones or cameras were used to verify location.

Data analysis

Composition of orchid assemblages at each plot was analysed by Canonical Correspondence Analysis using the 'PAST 3' data analysis software package (Hammer, *et al.* 2001) using presence absence data for each species at each plot. 'Environmental' variables were included in the analysis to provide an indication of the fire history and terrain attributes correlated with the species occurrences.

Orchid species richness was analysed using generalised additive modelling (GAM) with a log link and Poisson

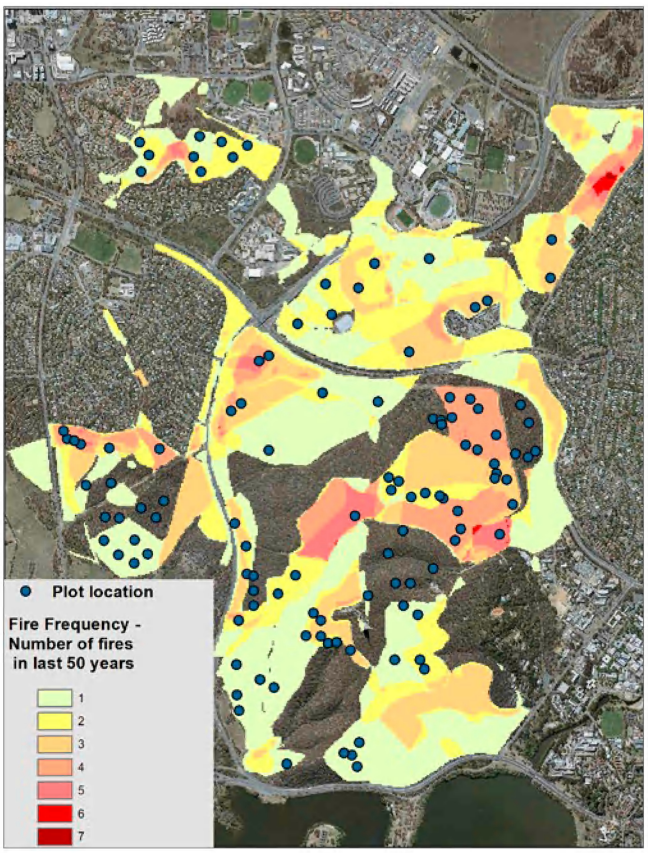

Figure 1: Plot location and fire frequency

error distribution (Hastie and Tibshirani 1990). The following explanatory variables were used: the logarithm (base 10) of the number of years since last burnt (time-since-fire), the number of fires in the previous 50 years (fire frequency), slope, and aspect.

Results

Thirty orchid species were recorded and identified from photographs taken in the plots. On average, just over five different species were recorded per 50m radius plot (0.8ha) with a range from 0 to 15 orchid species. The most widespread species were Dusky Fingers (*Caladenia fuscata*) and Wax Lip Orchid (*Glossodia major).* Twenty orchid species were only found in less than 5% of plots. The plots revealed previously unknown locations of eight orchid species considered rare in the ACT, or nationally.

Orchid species richness in relation to fire and terrain

Orchid species richness was significantly related to the logarithm of time-since-fire (LogTSF), slope and aspect, while fire frequency (FireFREQ) was not significant (Figure 2). Of these explanatory variables, slope was the strongest driver; but only about 19% of the variation in orchid richness was explained by the combination of all these variables. This suggests there may be other drivers of orchid richness that were not measured in this study, or that orchid occurrence has a large 'stochastic' element.

Orchid species richness was highest on gentle slopes, declining steadily on steeper slopes, and was highest on southerly aspects (Figure 2). The model predicts a u-shaped relationship between orchid richness and time-since-fire with slightly more orchid species within 3 or 4 years of fire (0.5 on log10 scale) then considerably more species again with longer periods without fire, particularly after about 30 years (1.5 on the log10 scale) (Figure 2).

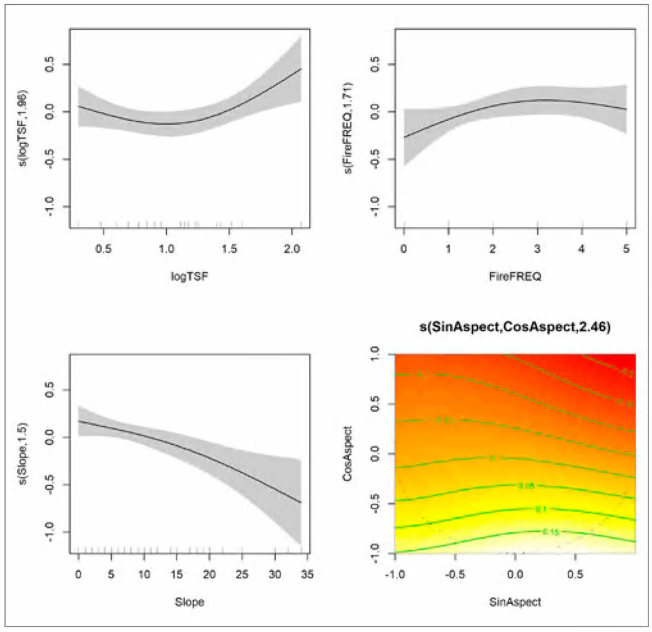

Figure 2. Term plots for partial contribution to generalised additive model of orchid species richness. Logarithm of time-since-fire (LogTSF), slope and aspect (interaction between SinAspect and CoasAspect) were significant terms in the model while fire frequency (FireFREQ) was not significant.

Orchid species fire responses

Widespread and common orchid species on Black Mountain Sandstone appear either not to be influenced by the area's fire history or to be slightly favoured by more frequent burning. This might be expected given that 79% of the 735 ha Black Mountain Sandstone area has been burnt at least once in the last 50 years, and 47% burnt at least twice in that time.

Nine nationally or regionally rare species were included in the analysis. Of these, Black Mountain Leopard Orchid (*Diuris nigromontana*), Mountain Beard Orchid (*Calochilus montanus*), Thin-clubbed Mantis Orchid (*Caladenia atrovespa*) and Small Duck Orchid (*Caleana minor)* are associated with or found in more frequently burnt areas and are likely to be robust to a continuation of current burning patterns. Black Mountain Leopard Orchid is endemic to the area of study, with an estimated population size of about 1,000. Although this species has a weak association with more frequently burnt areas, it is

widespread across Black Mountain and tends to occur on gentle north or north-westerly slopes and is uncommon on steep land.

Brown Beaks (*Lyperanthus suaveolens*) and Broad-sepaled Leafy Greenhoods (*Bunochilus umbrinus*) are associated with long-unburnt areas. Fire should be excluded from known habitats, and if subject to wildfire their responses should be monitored.

Horned Midge Orchid (*Corunastylis cornuta*), Rufous Midge Orchid (*Corunastylis clivicola*) and Common Gnat Orchid (*Cyrtostylis reniformis*) are weakly associated with a moderate fire history and are likely to require habitat that is neither recently or long unburnt.

Fire management

The variation in response of individual orchid species to fire demonstrated in this study suggests that to retain overall orchid diversity of the Black Mountain Sandstone it is imperative that a patchwork of recently burnt and long unburnt areas is maintained across the approximately 735 ha of these reserves. Given that long unburnt areas only constitutes 21% of the total area, continuing to exclude fire from the bulk of this area should be a management priority. Fire planning should continue to build a nuanced and patchwork approach focused on the location and particular fire requirements of the rare orchid species. At a finer scale, where planned burning is required, maintaining the current management goal of achieving patchy low intensity fire coverage within the overall footprint of each burn will help to retain diversity at the local scale

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Figure 3. Black Mountain Leopard Orchid – fire tolerant. Photo: Rosemary Purdie

Figure 4. Broad-sepaled Leafy Greenhood – fire sensitive. Photo: Ken Thomas