Fire responses of plants on rocky outcrops

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Rocky Outcrops: Unique Places for Biodiversity

Rock outcrops in southern Australia are often home to rare or endemic plant species. They have also been found to support high numbers of obligate seeders: plants that are killed by fire and rely on regeneration from seed.

Characteristics of rocky outcrops include:
- shallow soil and low water availability
- low and discontinuous fuel loads

It has been hypothesised that some bushfires are less likely to burn into rock outcrops, or burn patchily and less intensely on these sites. Therefore, they may provide a 'refuge' for obligate seeders that cannot persist in surrounding habitats where fires are too frequent for their seedlings to reach maturity.

Study Area: The Australian High Country

In January 2003, extensive fires burned over 1.4 million hectares across Australia's High Country. One year later, plant fire-responses were collected by five different research teams in 175 sites*, providing an opportunity to observe the fire-response of plants on rocky outcrops, and elsewhere, at a standardised time-since-fire. These sites stretched across a steep elevation gradient from Burrinjuck (NSW) to the Brindabella Ranges (ACT), Kosciuszko and Merambego (NSW/VIC border).

The aim of this study was to investigate the composition of plant communities on rocky outcrops compared with other habitat types and determine:

Are obligate seeders more likely to be found on rocky outcrops than in other habitats?

Obligate seeder hotspots

Obligate seeders were infrequent in the study area. However, woody obligate seeders (shrubs/trees) were more likely to be found on rocky outcrops than other habitats (Fig 1).
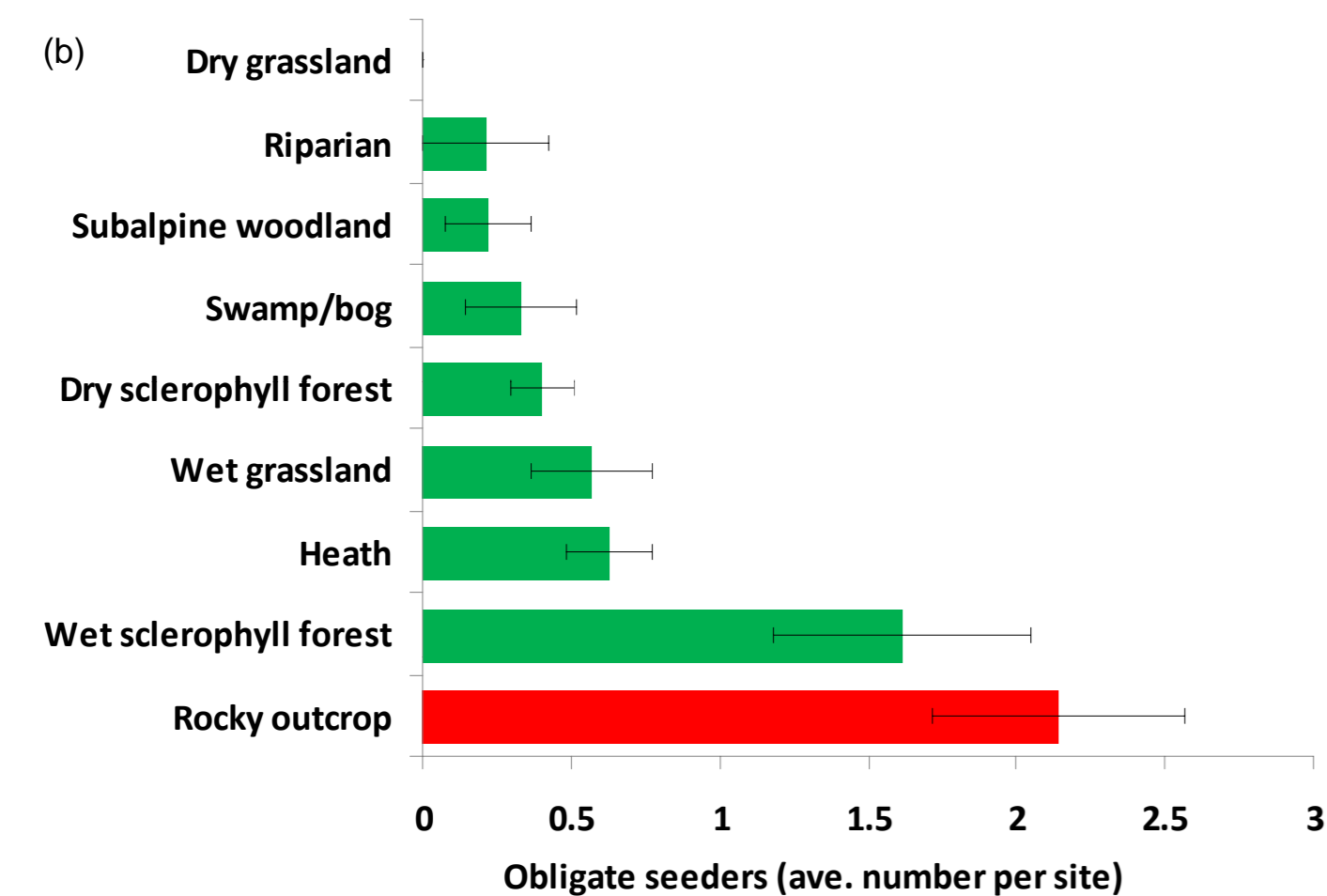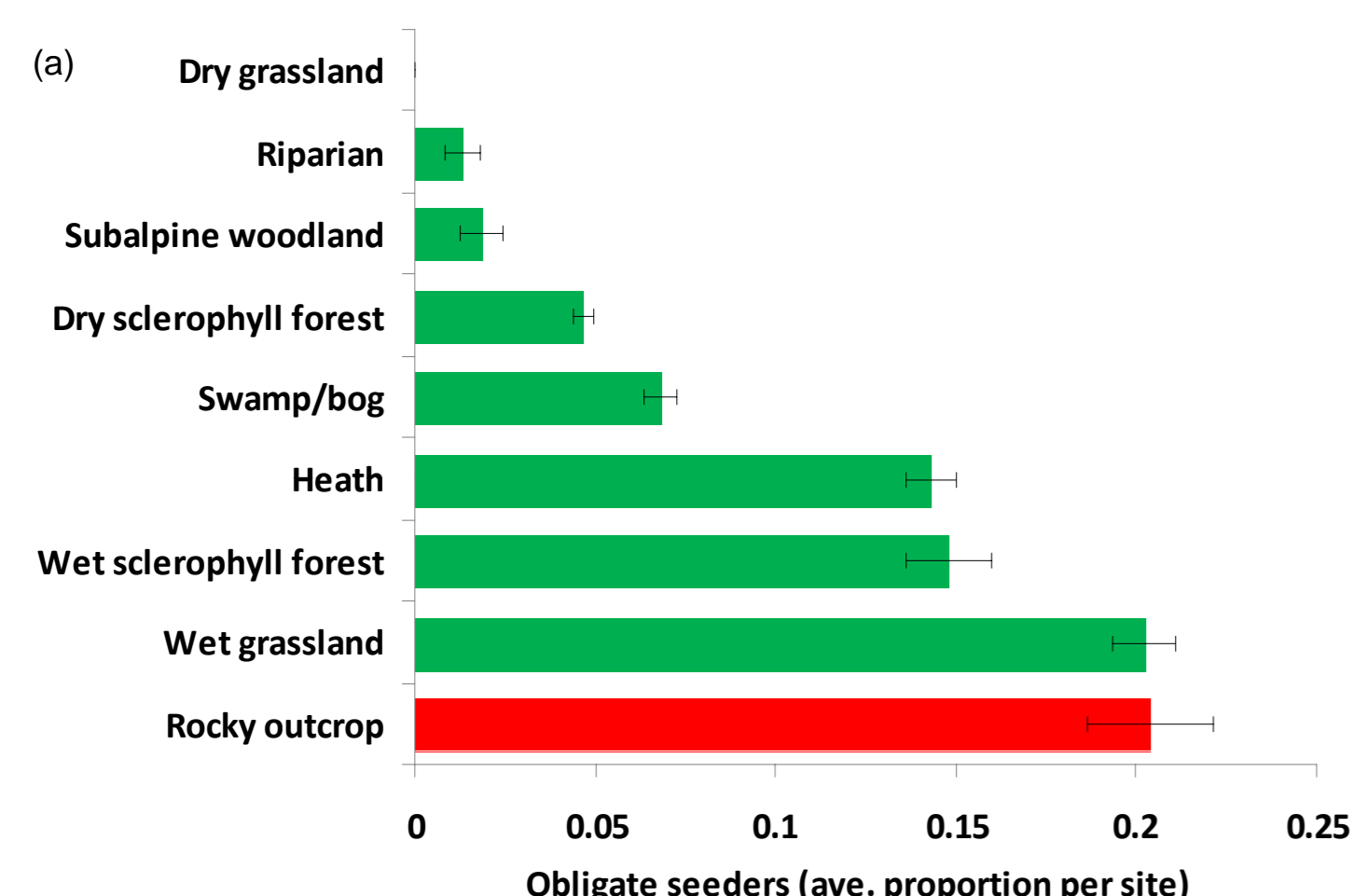

(a) Obligate seeders (ave. proportion per site) by habitat: Dry grassland, Riparian, Subalpine woodland, Dry sclerophyll forest, Swamp/bog, Heath, Wet sclerophyll forest, Wet grassland, Rocky outcrop. X-axis: 0, 0.05, 0.1, 0.15, 0.2, 0.25

(b) Obligate seeders (ave. number per site) by habitat: Dry grassland, Riparian, Subalpine woodland, Swamp/bog, Dry sclerophyll forest, Wet grassland, Heath, Wet sclerophyll forest, Rocky outcrop. X-axis: 0, 0.5, 1, 1.5, 2, 2.5, 3

Fig. 1: Average (a) proportion and (b) number of obligate seeding species in different habitat types (woody species only).

Fire intervals

Average inter-fire intervals at sites in the study area ranged from 42 years to over 60 years (Fig 2). Vegetation cover and average inter-fire interval length on rocky outcrops were similar to other treeless habitats (Fig 2).
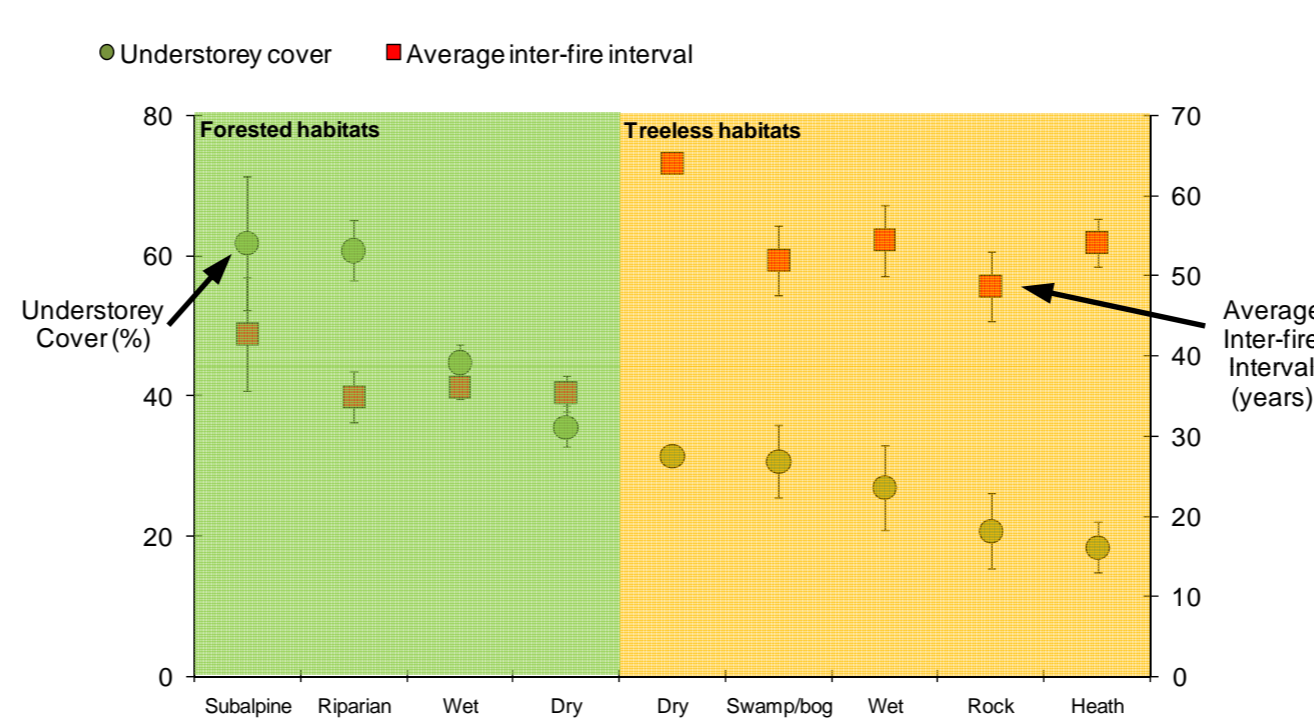

Fig. 2: Understorey cover and average inter-fire intervals between habitat types

Although inter-fire intervals on rock outcrops were longer than those in forested habitats, intervals across the study area more broadly did not appear to be short enough to limit the persistence of obligate seeders to rocky outcrop refuges.

This suggests that other factors specific to rock outcrops are influencing the high occurrence of obligate seeders in these habitats.

However, rock outcrops may be more important as 'refuges' in regions that experience more frequent fire, particularly where intervals are likely to be shorter than species' primary juvenile periods.

Further research...

Obligate seeders were more likely to be found on rock outcrops than in other habitats.

However, fire intervals were much longer than the time taken for seedlings of obligate seeders to reach maturity (Fig 3). As such, the causes of this pattern remain unclear.

Fig. 3: Seedling regeneration after fire on a rocky outcrop in the Tinderry Ranges, NSW

Although the number of obligate seeding species in a region can be low, they are often the dominant canopy species at a site.

Therefore, further research to understand why rock outcrops are obligate seeder hotspots is critically important. Future research topics should include:

- Investigating fine scale patterns of fire regimes on, and surrounding, rocky outcrops
- Quantifying microhabitat characteristics of rocky outcrops, particularly soil nutrients and water availability
- Investigating soil seed bank dynamics
- Comparisons of rock outcrop dynamics in regions that experience dissimilar fire regimes

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