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Fire response and seedling emergence patterns of *Leucopogon* (Epacridaceae) in South-Eastern Australia

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FIRE RESPONSE AND SEEDLING EMERGENCE PATTERNS OF
LEUCOPOGON (EPACRIDACEAE) IN SOUTH-EASTERN
AUSTRALIA

A thesis submitted in partial fulfilment of the requirements
for the award of the degree

MASTER OF SCIENCE (HONOURS)

from

THE UNIVERSITY OF WOLLONGONG

by

Mark Ooi

B.Env.Sci

DEPARTMENT OF BIOLOGICAL SCIENCES

2002

CERTIFICATION

I, Mark Ooi, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Master of Science (Honours), in the Department of Biological Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Mark Ooi

18th December 2002

Smoke and fire at Heathcote National Park during the 1999 hazard reduction burn.

Abstract

There is a lack of understanding of the ecology of many Australian plant species. In fire prone habitat, natural fire regimes have shaped the evolution, and subsequently the demography and life history traits, of the associated flora. Critical life history stages, like germination and recruitment, are often linked to fire in species that occur in fire-prone habitats.

Knowledge of plant demography in relation to fire is important, particularly for threatened species. Management decisions are based on understanding the effect of factors such as fire frequency and season of burn and ensuring that the fire regimes implemented do not have a negative impact on the vegetation community.

The Epacridaceae are a large family of plants confined mainly to Australasia. Although common and widespread in fire-prone systems, epacrid ecology is poorly understood. *Leucopogon* is the largest genus within the Epacridaceae. The aims of this study were designed to improve the understanding of the demographic processes of *Leucopogon* in relation to fire. I addressed these aims by focussing on the threatened species *L. exolasius*, and some common congeners, *L. setiger*, *L. esquamatus* and *L. ericoides*, in the fire-prone vegetation of the Sydney region in south-eastern Australia. Specifically, the questions asked were:

- (i) What is the fire response of established plants?
- (ii) Is there a delayed or seasonal component to seedling emergence?
- (iii) Are germination cues linked to the passage of fire?

Fire response and seedling emergence patterns were compared between species. Data were collected after four fire events between August 1999 and September 2002.

To determine fire response of the four study species, individuals were tagged and measured, then subsequently burned. Survivorship was monitored post-fire for up to 12 months.

All four study species were fire sensitive (classified as mortality after 100% leaf scorch). However, some plants survived in areas that remained unburnt after the low intensity burns. The proportion of established plants that survived was therefore dependent on fire patchiness. Topography, such as rocky outcrops, contributes to patchy fuel conditions and represents a mechanism for adult plant survival. This finding supports some studies that suggest that rare species, particularly obligate seeders, are concentrated in parts of the landscape where fires are less frequent. The rare species, *L. exolasius*, occurs almost exclusively on rocky sandstone riparian hillsides where some individuals are likely to remain unburnt during low intensity burns.

In areas like the Sydney region, where large wildfires are a common event, recruitment from the seed bank would still be essential for the long term persistence of a species. In the event of two fires occurring in quick succession, a dormant seed bank could represent a buffer to population decline.

The role of fire on germination cues and seedling emergence was examined in three of the species (*L. ericoides* excluded) by monitoring the numbers of newly emerged *Leucopogon* seedlings over time. Permanent quadrats were established under mature plant canopies. After fire, quadrats were monitored approximately every three months, and the number of seedlings counted. Quadrats were also established in unburnt *L. exolasius* and *L. esquamatus* habitats.

All three *Leucopogon* species displayed a flush of seedling emergence after fire. Time elapsed until the onset of emergence differed between fires but not between *Leucopogon* species. Seedling emergence was restricted, in all *Leucopogon* species and after all fires, to the autumn (primarily late autumn) and winter period. The same seasonal pattern was found in unburnt habitat, though at much lower seedling densities. Emergence of *Leucopogon* species was delayed when compared with other fire sensitive species that co-occurred in the habitat.

These results indicate that the magnitude of delay to the onset of emergence is dependent upon the timing/season of the fire event. Also, combinations of fire-related and seasonal factors are necessary to maximise germination. A residual seed bank is left

after fire, with germination timing still linked to season, and some inter-fire recruitment may occur. Seasonal dormancy in *Leucopogon* is likely to have developed over evolutionary time scales, and although fire has provided a strong influence on germination cues, variable rainfall patterns in the Sydney region may have allowed the persistence of seasonal dormancy traits.

Results from the study were combined with data collected on species distribution, historical decline and threats, to make an assessment of the threatened species, *L. exolasius*, using a modified version of the IUCN Red List Criteria. The conclusion reached was the recommendation that the threat status of the species should be upgraded from vulnerable to endangered.

This research has several implications for the management of *L. exolasius*. Firstly, hazard reduction burns should primarily be conducted outside of the late autumn/winter period in *L. exolasius* habitat, to reduce the magnitude of delay of emergence after fire. Secondly, inter-fire intervals of greater than 10 years are recommended for the long-term persistence of *L. exolasius* populations. Primary juvenile periods are thought to be relatively long, and this amount of time is required for individuals to mature and replenish the seed bank. Finally, the threat status of the species on the Schedules of the NSW *Threatened Species Conservation Act* (1995) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* (1999) should be changed from vulnerable to endangered.

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