

# Is the most cold-tolerant Australian eucalypt shifting its regeneration niche in response to climate change?

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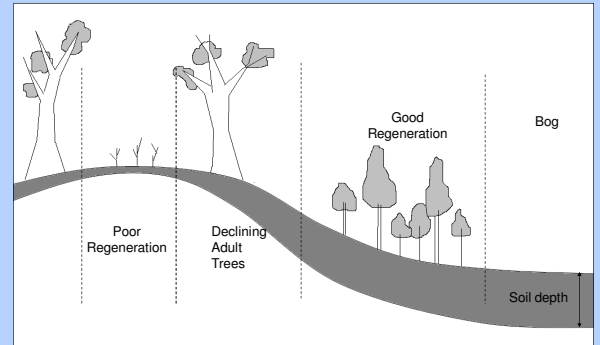
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## The Problem

*Eucalyptus gunnii*, the most cold-tolerant eucalypt in Australia (surviving temperatures as low as  $-22^{\circ}\text{C}$ ), has dramatically declined in the last 30 years. The most cold-tolerant subspecies, *E. gunnii* ssp. *divaricata*, is restricted to the Central Plateau of Tasmania and is now listed as endangered. Drought and grazing pressure (from stock and native browsing mammals) are considered the major factors in this decline. At Liawenee, mean annual rainfall has fallen from 1000 to 700mm and has become more seasonal, while mean annual temperature has risen by  $0.7^{\circ}\text{C}$  over the last 50 years.

## Observation

In declining stands of *E. gunnii* ssp. *divaricata* not grazed by livestock (e.g. Fig 1) seedling and sapling regeneration is occurring lower in the landscape than the sites occupied by the declining adult trees.



**Figure 2:** Profile diagram showing the division of the population into the four strata: declining adult trees, poor seedling/sapling regeneration, good seedling/sapling regeneration and the waterlogged bog.



**Figure 1:** The study sites on the west side of the Great Lake, near Liawenee in the Central Plateau, Tasmania (image: Google maps)

## Approach

Five sites consisting of pure stands of *E. gunnii* ssp. *divaricata* were chosen, each on rocky outcrops within a boggy depression (Figure 1). The boggy depressions are waterlogged for most of the year and may be subjected to intense frost in any month. Stratified random sampling was used to divide the sites into four classes that were based on the condition of seedling/sapling regeneration and surviving adult trees. The four strata included: 'poor regeneration' (generally on the tops or the rocky outcrops); 'declining adults' (on upper slopes of the outcrops); 'good regeneration' (lower slopes of outcrops); and 'bog' with no seedlings or trees (on shallow slopes and in depressions; see Figure 2 and Figure 3). At each site five 5x5m quadrats were randomly placed within the poor regeneration, good regeneration and bog stratum. For the declining adult strata quadrats were placed around 5 randomly chosen adult trees.

In each quadrat measurements were made of site (soil depth, soil moisture, shape of topography and slope), understorey (shrub cover and average height) and seedling/sapling (DBH, height and condition) characteristics.

Nested ANOVA was used to assess the effect of site and understorey characteristics on the four strata.

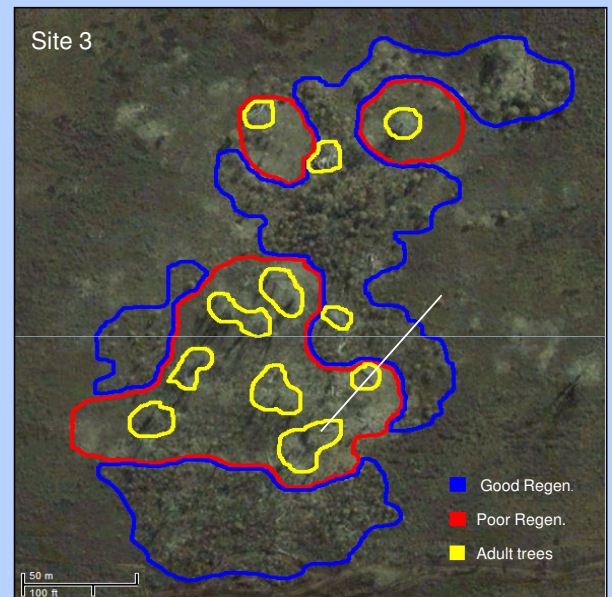
## Outcome:

These preliminary results suggest that water may be a limiting factor in the regeneration of *E. gunnii* subsp. *divaricata* as healthier seedling/sapling regeneration is occurring on deeper soils which have greater water holding capacities. The regeneration is also occurring on lower slopes of rocky outcrops with concave topography, which are now less waterlogged under a lower rainfall regime. This suggests that the regeneration niche has moved down slope along the gradient in water availability.

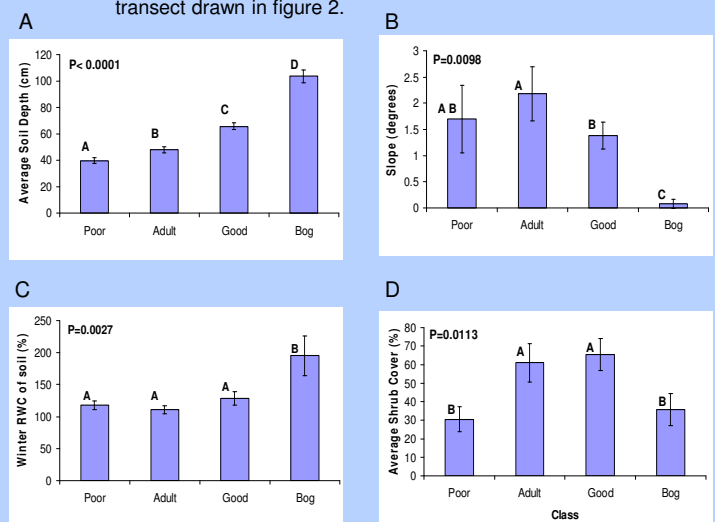
Soil moisture (RWC) did not differ between strata as soils were still saturated following winter rains.

A correlation between shrub cover and good regeneration may indicate shrubs provide protection from native mammalian browsers. *E. gunnii* subsp. *divaricata* has sugar rich sap which makes the foliage very palatable to herbivores.

Future experiments will investigate water relations and mammalian browsing pressure on *E. gunnii* subsp. *divaricata*.



**Figure 3:** Stratification of site 3 showing declining adult trees (in yellow), poor seedling/sapling regeneration (in red), good seedling/sapling regeneration (in blue). The remaining area is the waterlogged bog (image: Google Maps). White line represents the transect drawn in figure 2.



**Figure 4:** Mean and standard error of A) soil depth, B) slope, C) RWC (%) of surface soil during winter, and D) shrub cover for the four strata: poor regeneration (poor); declining adults (adult); good regeneration (good); and waterlogged plain (bog). Columns with the same letter are not significantly different. P values give significance of the associated tests