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**Structural patterns and changes in
Callitris – Eucalyptus woodlands at
Terrick Terrick State Park, Victoria**

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ABSTRACT

Callitris – *Eucalyptus* woodlands originally covered vast areas of the eastern states of Australia from southern Queensland to northern Victoria, but are now poorly represented throughout this region. This study involved a survey and description of the *Callitris* – *Eucalyptus* woodland association at Terrick Terrick State Park in northern Victoria. Three distinct vegetation zones were recognised: (1) a dense *Callitris* zone dominated by *Callitris glaucophylla*, (2) an open woodland of mixed *Eucalyptus microcarpa*/*C. glaucophylla*, and (3) a rocky outcrop woodland dominated by *Eucalyptus melliodora*. The three zones occupied slightly different environments.

Size class analysis showed that *Callitris* and *Eucalyptus* species have recruited at different times in the past. Most *C. glaucophylla* trees resulted from a single recruitment pulse which is thought to have occurred between 1865 and the 1870s. In contrast, both *E. microcarpa* and *E. melliodora* have continually recruited throughout the past century. Between the 1870s and 1970s, no *C. glaucophylla* recruitment occurred except in a small plot from which grazing stock were excluded. *Eucalyptus microcarpa* has recruited abundantly in recent years, which may be due to the removal of grazing from within the Park after 1993.

A dendrochronological study of *C. glaucophylla* confirmed that the major recruitment pulse was between the 1840s and 1880s, but the technique failed to give exact dates.

Historical changes in *C. glaucophylla* stand structure were examined by sampling old tree stumps. Stump analysis suggested that *C. glaucophylla* density before the 1880s was only 6-11 trees/ha, although the true density may be underestimated. Successive silvicultural treatments in the dense *Callitris* zone have thinned the dense 1865 to 1870s recruitment from about 354 trees/ha in the early 1900s to 126 trees/ha now.

This study provides a valuable quantitative picture of historical changes in this remnant woodland.

CHAPTER 9. CONCLUDING SYNTHESIS

This study has investigated a number of aspects of the ecology of *Callitris* and *Eucalyptus* species in Terrick Terrick State Park. Initial chapters described the history of the reserve including management practices, and identified relationships between vegetation zones and soil types. Later chapters described the current stand structure of the vegetation, investigated tree ages using dendrochronology, and analysed stump to describe past tree densities. This chapter provides a summary of the major findings of previous chapters.

9.1 Vegetation and soil patterns

Within Terrick Terrick, three major vegetation zones were identified, which since the 1940s have remained in a relatively stable state. Evidence presented in this study showed that altitude and slope significantly influenced the distribution of vegetation zones. Open woodland and the dense *Callitris* zone both occurred on gentle slopes at low altitude, whereas rocky woodlands occurred in a significantly different environment, on steep slopes at higher altitude, near the three main rocky outcrops.

Edaphic factors also influenced the distribution of the three vegetation zones. Soil texture was found to be the greatest influence on these distributions. The dense *Callitris* zone occurred in areas with sandy clay loam, mildly acidic topsoils and sandy clay to clay loam subsoils. By contrast, the open woodland zone occurred in areas with clayier topsoils and subsoils. *Eucalyptus microcarpa* dominated these open woodland zones.

This species also occurred within the dense *Callitris* zone, but was once targeted by foresters for removal to promote the growth of *C. glaucophylla*. *Eucalyptus microcarpa* and *E. melliodora* preferred different soil types, with *E. microcarpa* preferring clay-textured soil types, and *E. melliodora* preferring sandier soils. The paucity of tree stumps in the open woodland zone indicated that this zone has not resulted from tree clearing, but has always been relatively open, as was described by Surveyor Willis in 1863.

9.2 Recruitment events

Stand structure analyses indicated that recruitment of *C. glaucophylla* stands occurred in two main pulses: between 1865 and the 1870s and the 1970s. The main pulse of recruitment between 1865 and the 1870s resulted in the occurrence of the even-aged dense *Callitris* zone. Local folklore indicates that this recruitment pulse dated from between 1865 and the 1870s, followed shortly after by the occurrence of a wildfire. An attempt to age this recruitment using dendrochronological techniques showed general agreement with this date, but failed to give exact dates. Results suggested that recruitment occurred between the 1860s and the 1880s, implying that either errors in ring measurement occurred, or that the recruitment period was much broader than folklore suggests. The ability to find time-scale variables, such as rainfall or temperature, which cross-date with ring widths, may provide stronger supportive evidence of recruitment periods.

The occurrence of fire however is interesting to note. Records from western New South Wales indicate that where fire occurred, *Callitris* seed were triggered and resulted in a mass of recruitment (Lacey 1973). The wildfire in Terrick Terrick during the early 1880s (c. 1885) occurred shortly before the run of above average rainfall from 1886 to 1891. Evidence from other areas suggests that *C. glaucophylla* recruitment is episodic, and is dependent on a run of successive wet years (Lacey 1973). The occurrence of dense recruitment in western New South Wales after the introduction of the myxomatosis virus in the 1950s was not evidenced at Terrick Terrick. This would suggest that continued grazing of stock until the early 1980s continued to prevent recruitment.

Experimental plots established in 1958 clearly indicated the potential for mass recruitment when grazing was excluded. The density of such stands was strongly influenced by the exclusion of stock and rabbits. Where both stock and rabbits were both excluded the density of individuals reached over 30,000 per hectare. No trees of similar age or size to these trees were found in the adjacent grazed areas of the Park, which further suggests that grazing has prevented *C. glaucophylla* recruitment.

Further recruitment occurred during the period of above average rainfall in the early 1970s. However, during this time grazing continued, and 1976 was a drought year. These factors led to the demise of much of the recruitment that did occur, and only limited numbers of individuals survived. More recent recruitment has occurred since the removal of grazing from the Park and the continued activities of rabbit control programs. Minor

The stump analyses proved a valuable method for determining past stand structures. The results provide supportive evidence of major changes in vegetation structure and composition since European settlement. In the 1860s the vegetation structure was described as being an “open forest of box, cypress-pine and she oak” (Willis 1863). No reference was given to the presence of a dense belt of *Callitris*. The dense stand of *C. glaucophylla*, which today exists divides the Park from east to west has grown since European settlement. Furthermore the composition of this new vegetation zone has been further altered by silvicultural management practices which encouraged *C. glaucophylla* and removed competing *Eucalyptus* species.

The 1983 recommendations of the Land Conservation Council, that the forest should be returned to ‘a structure more closely resembling the naturally occurring mosaic of cypress pine and grey and yellow box’ (Land Conservation Council 1983), implies that the system does not have the ability to do this itself. Evidence of recent recruitment suggests that all tree species occurring within Terrick Terrick have the ability to recruit where and when conditions are suitable. In this perspective, management actions would be unnecessary. However, to return the vegetation structure to one resembling more the structure prior to the dense recruitment of *C. glaucophylla* would require an intensive thinning program to thin the dense *Callitris* zone and to re-create the open forest described by Surveyor Willis in 1863.