

CANOPY DIEBACK AND DECLINE IN PINK GUMS,
EUCALYPTUS FASCICULOSA, F.MUELL IN THE MT LOFTY
RANGES AND ADJOINING PLAINS

Sonia Julie Croft

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School of Biological Sciences

The University of Adelaide

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ABSTRACT

In Australia, widespread decline of *Eucalyptus* species has been occurring largely since the 1970s. In southern Australia, pink gums (*Eucalyptus fasciculosa* F. Muell) occur within a restricted area, and have been assigned a conservation rating due to perceived canopy decline. This study aimed to describe the population structure and canopy condition of pink gums in the Mt Lofty Ranges and surrounding plains, and to distinguish between causes of short-term dieback and long-term decline. I hypothesised that decline in pink gum woodlands was most likely to be because of one or more of the following: (1) long-term and continuous mistletoe infection; (2) declining annual rainfall commencing several decades ago, particularly for trees growing in deep sandy soils and (3) reduced groundwater availability that commenced well before 2003. Dieback was most likely to be associated with insect attack. Within the study region, pink gums occupy a wide gradient of rainfall, soil type and topography. A regional survey between 2009 and 2012 recorded that the mean canopy intactness for 2814 pink gums was 70%, but canopy condition varied widely between, and often within, pink gum woodlands. The habitat variables that contributed most to variation in canopy intactness were mistletoe prevalence, followed by insect damage. In almost 30% of populations there were no seedling pink gums.

Between 2009 and 2011, mean canopy intactness of 1751 pink gums declined from 71% to 66%, 21 pink gums died, and no recruitment was recorded. Leaf production in pink gums was greatest during the above-average rainfall in the summer of 2010/11. This was followed by localised high levels of gum leaf skeletoniser (*Uraba lugens*) and lerp (*Cardiaspina densitexta*). Canopy loss from these insects was concluded to be cyclic and short term.

The canopy intactness of 161 pink gums and their mistletoe load, was recorded between 2003 and 2015. The net number of live mistletoes declined by two thirds, with the greatest net decline occurring during three consecutive below-average rainfall years. While the mean canopy intactness of pink gums was the same in 2003 and 2015, pink gums whose canopy comprised at least 20% mistletoe, recorded significant canopy loss during consecutive years of below-average rainfall.

Comparison of aerial photographs between 1949 and 2005 for two pink gum woodlands indicated that canopy decline began in the mid-1970s, coinciding with lowering of groundwater levels and increased mistletoe infection, and the beginning of an ongoing decline in autumn

rainfall. These pink gums occurred on deep sands with approximately 500 mm annual rainfall, a habitat that would be more prone to autumn soil drying.

Because of the lack of recent recruitment at many pink gum woodlands, it may be necessary to restore and/or maintain populations with revegetation. A glasshouse experiment involving manipulating water supply to three pink gum provenances showed that there was genetic variation between provenances. This will provide the option in revegetation projects, of matching selection of seed sources to projected climate change. However, in a separate six year study, 12 of 34 pink gum juveniles remained the same height, with insect defoliators and competition from nearby trees considered largely responsible for suppressing growth. The potential slow growth rate of pink gums should be incorporated into revegetation planning.

This study provided evidence that pink gums may be at least partially groundwater dependent. Within the same woodland, where all habitat factors other than depth to groundwater appeared to be equal, pink gums sited over shallower groundwater tables were significantly taller and had greater canopy volumes.

A key finding was that pink gums occurring on deep sands with moderate mean annual rainfall for the study region and with high mistletoe loads, had low canopy intactness. Areas of future research should focus on: which populations of pink gums are at least partially groundwater dependent; the interaction between pink gum water stress and mistletoe abundance over long time frames; and differences between pink gum provenances in drought response and growth rates. Future monitoring of survey sites established in this study would provide information on pink gum canopy and population trends, and mistletoe population trends.

DECLARATION

Name: Sonia Julie Croft **Program:** Doctor of Philosophy

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