

Goolwa to Wellington Local Action
Planning: *Learning on the Run*

Pink Gum Management Demonstration

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EXECUTIVE SUMMARY

Often associated with poor Pink Gum (*Eucalyptus fasciculosa*) health, Box Mistletoes (*Amyema miquelii*) are a semi-parasitic plant that extract nutrients and water from their host plants while manufacturing their own energy via their leaves (Miles 2008). Removal of some or all Box Mistletoe from a tree is thought to improved Pink Gum health as a short term strategy (Miles 2008).

This demonstration has been designed to investigate this concept through removing different levels of Box Mistletoes present on selected Pink Gums, both within a fenced remnant patch and scattered within paddocks (two management zones). Each management zone is therefore just to act as a comparison as to how the Pink Gums respond under these different conditions, not to examine the effect of fencing on Pink Gum health. The demonstration applied three levels of treatment for the removal of Box Mistletoe in each management zone:

- Level 1 No removal
- Level 2 Removal 1/3rd Box Mistletoe
- Level 3 Removal 2/3rd Box Mistletoe

Field baseline measures were collected in 2008 with follow-up monitoring undertaken in 2009.

The results from the demonstration show an improvement in health for the majority of the trees. At both the level 2 (1/3 removal) and level 3 (2/3 removal) treatments there was an overall increase (2 out of 3 trees improved) in the health of the Pink Gums, with the Pink Gums with level 3 treatment within the protected remnant showing the best improvement, with all three trees moving up a tree health category. Interestingly, an improvement in health (2 out of 3 trees improved) was also found within the level 1 (no removal) trees within the paddock and this then brings into doubt whether the treatments are responsible for the improvement in Pink Gum health or whether the improvement in health could be accounted for by other processes (not investigated within the demonstration).

This demonstration needs further monitoring to determine if the removal of the Box Mistletoe have affected the Pink Gum health, as no conclusions can be drawn from the current results. Longer term monitoring to establish the number of Box Mistletoe present on the trees will also be required to provide an indication of the recruitment of the Box Mistletoe and whether follow-up removal would be required.



1 BACKGROUND

1.1 PINK GUM HEALTH AND MISTLETOES

Box Mistletoes (*Amyema miquelii*) are often associated with poor Pink Gum (*Eucalyptus fasciculosa*) health (defined by the percentage of healthy canopy found on the tree) in the Mt Lofty Ranges (Miles 2008). Removal of some or all Box Mistletoe from a tree is thought to improved Pink Gum health as a short term strategy (Miles 2008). Previous studies have found that Pink Gum trees in remnant vegetation do not differ in their health significantly whether they are hosts to Box Mistletoe or not (Ward 2005) where as other studies have shown that the removal of Box Mistletoes in paddock situations has lead to an increase in tree health over the short term (less than 5 years) (Reid and Fittler 2008; Reid et al. 1994).



Figure 1 Box Mistletoe on a Pink Gum tree (Catherine Miles)

This demonstration has been designed to demonstrate the findings of these studies in the Goolwa to Wellington Local Action Planning area and to provide some recommendations for the management of Pink Gums with Box Mistletoe.

Box Mistletoes were not completely removed from any of the trees as they are an important part of the Australian ecosystem, providing food, nesting sites (*Figure 2*), and a forage substrate for many native birds and animals (Miles 2008). In South Australia, Box Mistletoes are also protected under the *Native Vegetation Act* 1991, with an exemption for the clearance of up to 70% of Box Mistletoe present on an individual tree, providing the tree is showing significant signs of dieback (at least 30%



foliage lost) and the Native Vegetation Council guidelines are followed. This demonstration followed these guidelines when removing the Mistletoe and as such, did not removal more than the accepted 70%.



Figure 2 Bird nest within a Mistletoe plant (Catherine Miles)

The demonstration was established in spring 2008 and the initial health of the selected trees was measured.

This report documents the health of the trees in May 2009, six months after the demonstrated treatments have been implemented to illustrate any differences in the health of the trees and make recommendation based on the findings for future management of Pink Gums with Box Mistletoes within the area.

1.2 LEARNING ON THE RUN

The Goolwa – Wellington LAP were one of the LAP groups that published *Learning on the Run: Incorporating Trials and Experimentation into the Management of Natural Resources* (O'Connor *et al.* 2006). This trial is one of a number funded through the South Australian Natural Resources Management Board that puts *Learning on the Run* into practise.

The design for this demonstration is based as closely as possible on the experimental design principles in *Learning on the Run* (O'Connor *et al.* 2006). However, there is no replication of management zones; therefore the design is not a true experiment whereby theories are tested and analysed.

1.3 OBJECTIVE

The objective of the project is to demonstrate the results of different levels Box Mistletoe removal from Pink Gums within two management situations (fenced remnant shrub and scattered within a paddock) in the Milang district.



2 METHODS

2.1 DEMONSTRATION SITE

The demonstration site was located on one property on Kindaruar Road near Milang. Native vegetation has been heavily cleared in this district, with most remnants in small patches on roadsides and sand dunes. The average annual rainfall is slightly below 400mm and the soil type is white sands on flats and dunes.

Box Mistletoe (*Amyema miquelii*) removal from Pink Gums (*Eucalyptus fasciculosa*) was undertaken in two management zones:

- Fenced remnant vegetation with stock excluded
- Paddocks used for cropping and grazing with scattered Pink Gums

Each of the management zones are described below.

2.1.1 Fenced Remnant

The small remnant of 2.5 ha is a typical size for the district. It has been fenced and stock excluded for four years. The vegetation within the remnant patch is a mix of Ridge-fruited Mallee (*Eucalyptus incrassata*) and Pink Gum over Kangaroo Thorn (*Acacia paradoxa*). Box Mistletoe occurs on many of the Pink Gums, but not the Ridge-fruited Mallee, and Harlequin Mistletoe (*Lysiana exocarpis*) was also found on the site in lower observable abundance than the Box Mistletoe. Evidence of old wind erosion 'blow-outs' indicates the site was degraded in the past, most likely through stock grazing, but recovery is evident through the presence of regeneration of native species.

Perennial Veldtgrass (*Ehrharta calycina*) is the dominant weed species on the site, but Bridal Creeper (*Asparagus asparagoides*) and some woody weeds are also present.

2.1.2 Paddocks

Mature Pink Gums are scattered throughout pasture and cereal cropping paddocks in densities much lower than found in remnant patches. Many trees have been lost through clearance and very little recruitment is occurring as is evident from the presence of mature trees of similar ages with no juveniles. Pastures are predominantly annual grasses grazed by sheep.

2.2 DEMONSTRATION SPECIES

Pink Gum (*Eucalyptus fasciculosa*) health was assessed as part of the demonstration and only Box Mistletoe (*Amyema miquelii*) was removed.

2.3 TREATMENTS

The demonstration applied three levels of treatment for the removal of Box Mistletoe in each management zone:

- Level 1 No removal



- Level 2 Removal 1/3rd Box Mistletoe (Total present on each tree counted prior to removal so exactly 1/3 could be removed)
- Level 3 Removal 2/3rd Box Mistletoe (Total present on each tree counted prior to removal so exactly 2/3 could be removed)

As there are a limited number of suitable Pink Gums on the sites each treatment was only applied three times per management zone. Removal of the Mistletoe followed the procedure set out in the '*Design for Mistletoe Removal and Vegetation Management impact on Pink Gums Demonstration*' (Miles 2008).

2.4 TRIAL LAYOUT

Within each management area, three groups of three Pink Gums of similar size and health were selected. Each of the Box Mistletoe treatments was randomly applied to one tree from each group of three. Figure 3 illustrates the location of each tree and associated treatment.

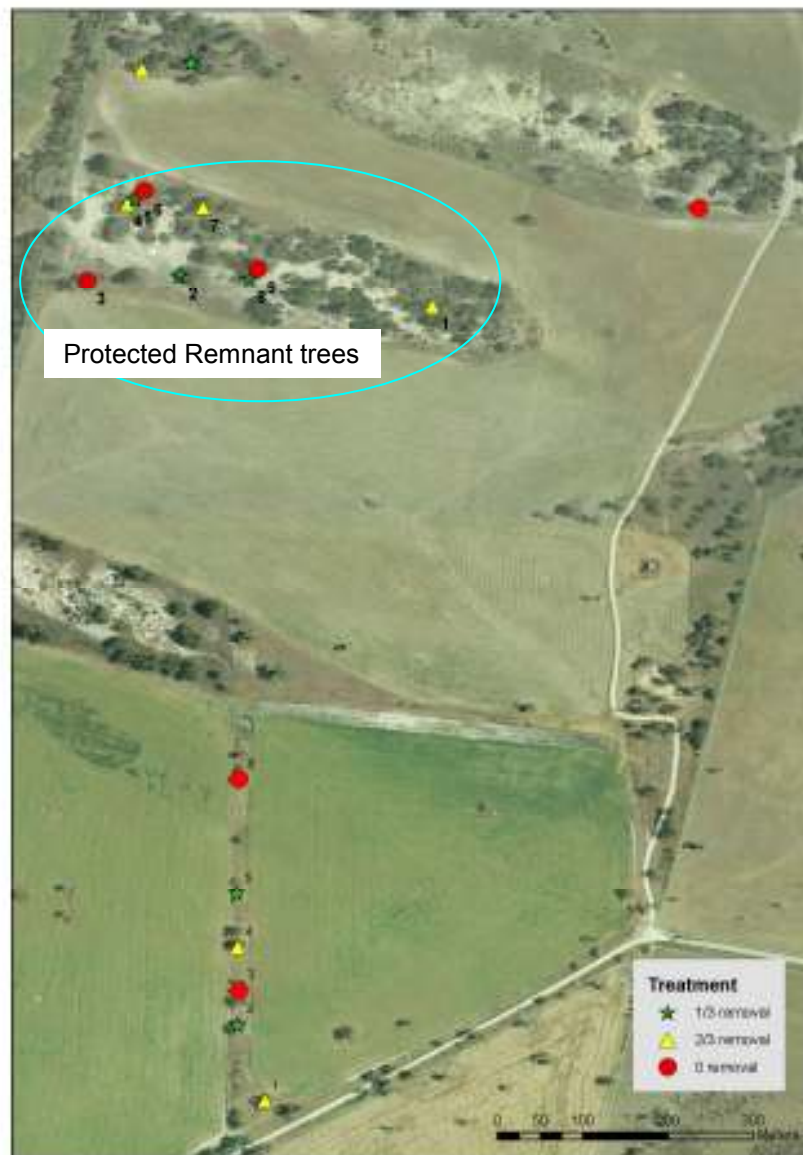


Figure 3 Location of Pink Gums and associated treatments



2.5 MEASUREMENTS

Prior to mistletoes being removed, the following site variables were assessed for each Pink Gum in the trial (spring 2008 Monitoring round):

- Density of surrounding **canopy cover** as a percent projected foliage cover for the tallest stratum (Croft *et al.* 2005 p. 10) within a 50m radius of the tree being assessed
- **Groundcover** as a percent cover of groundcover within a 20m radius of the trees being assessed.
- **Distance between tree and edge of remnant** (nearest remnant in the case of paddock trees).

The following tree health parameters were recorded for each tree within the spring 2008 monitoring round, prior to mistletoe being removed, and in the May 2009 monitoring round:

- **Circumference at breast height**, the circumference of the trunk(s) measured 1.5 from the ground, where the individual tree is multistemmed, all trunks are measured.
- **Mistletoe infestation level**, a visual estimate of the percent of mistletoe of the total biomass present, based on Reid *et al.* (1994).
- **Number of live mistletoe**, Box Mistletoe only based on the number of haustoriums¹.
- **Relative foliage biomass**, a visual estimate of the percent biomass of the host compared with the potential biomass of a healthy tree as indicated by the extent of the canopy, based on Reid *et. al* (1994).
- **Tree health score** (based on Pink Gum Health Scorecard developed in conjunction with this project, Miles 2008)
- A **photograph or digital image** taken at a distance of 20-30m from the north side of each tree.

¹ Anchor-like structure by which the Mistletoe attaches to the host plant.



3 RESULTS

Three main parameters have been examined to determine differences between the monitoring rounds and therefore the differences between each treatment. The three values are: the % of overall tree canopy that is Box Mistletoe (% MT), the number of individual Box Mistletoe plants present (# MT), and the tree health score (TH). These parameters were chosen for discussion as they provide the best indication of Pink Gum health and the presence of Mistletoe, both important when making recommendations for Mistletoe management in Pink Gums.

3.1 PROTECTED REMNANT MANAGEMENT ZONE

3.1.1 Level 1 treatment- No Mistletoe removal

A comparison of the three parameters of the three trees treated with level 1 within the protected remnant is shown below:

Table 1 Relevant parameters for protected remnant trees for 2008 baseline measurements and subsequent 2009 autumn measurements.

	Spring 2008			Autumn 2009		
	% MT	# MT	TH	% MT	# MT	TH
Tree #3	40	9	2	25	11	2
Tree #6	30	11	2	30	11	2
Tree #9	15	9	3	15	9	3

These results show no change in score between the sampling dates for the tree health score, percent and number of Box Mistletoe for trees # 6 & 9.

The only difference between the monitoring rounds is between the percent and number of Box Mistletoe recorded for tree # 3. Tree #3 has recorded a higher number of individual Box Mistletoe plants but a lower percent of Mistletoe within the total canopy. This indicates the deaths of larger Mistletoe but also the growth of new, smaller plants, (for example, see Figure 4, below).

Overall, there is no difference between the health of the trees. This would be the expected result as level 1 treatment was removing no mistletoe.





Figure 4 Darker, brown leaves of dead Mistletoe illustrating the deaths of some large Mistletoe.

3.1.2 Level 2 treatment- 1/3 Mistletoe removal

A comparison of the three parameters of the three trees treated with level 2 within the protected remnant is shown below:

Table 2 Relevant parameters for protected remnant trees for 2008 baseline measurements and subsequent 2009 autumn measurements.

	Spring 2008			Autumn 2009		
	% MT	# MT	TH	% MT	# MT	TH
Tree #2	40	14	3	30	9	3
Tree #5	30	15	2	15	11	3
Tree #8	30	21	3	20	24	4

In trees #5 and #8, the overall tree health scores (TH) have improved by one category, with a decrease in the percentage of the tree's canopy comprised of Mistletoe (% MT) also occurring in the two trees, as well as in tree #2. In tree #8, the number of individual Box Mistletoe plants has increased and it was noted that on this tree that many of these were small plants, indicating their recent establishment since the beginning of the demonstration when the Box Mistletoe were initially removed. This is also supported by the decrease in percentage of the tree's canopy comprised of Mistletoe (% MT) which has decreased, indicating the removal of larger Box Mistletoe plants that would be occupying a greater percent of the tree's canopy.

3.1.3 Level 3 treatment- 2/3 Mistletoe removal

A comparison of the three values of the three trees treated with level 3 within the protected remnant is shown below:



Table 3 Relevant parameters for protected remnant trees for 2008 baseline measurements and subsequent 2009 autumn measurements.

	Spring 2008			Autumn 2009		
	% MT	# MT	TH	% MT	# MT	TH
Tree #1	80	51	1	50	30	2
Tree #4	20	6	2	10	4	3
Tree #7	10	6	3	5	2	4

Across all three trees, the tree health scores have increased by one category and both the percent and number of Mistletoe have decreased. In both tree #1 and #4, the number of Mistletoe present are higher than what would have been present immediately after the treatment was applied (as shown in Appendix 1, where the total number of Mistletoe removed is listed). This indicates that whilst the trees have improved in health, the Mistletoe are still recruiting.

3.2 Paddock Management Zone

3.2.1 Level 1 treatment- no Mistletoe removal

A comparison of the three parameters of the three trees treated with level 1 within the paddock management zone is shown below:

Table 4 Relevant parameters for paddock trees for 2008 baseline measurements and subsequent 2009 autumn measurements.

	Spring 2008			Autumn 2009		
	% MT	# MT	TH	% MT	# MT	TH
Tree #3	25	8	2	30	6	3
Tree #6	45	9	1	20	6	2
Tree #9	5	3	3	15	3	4

These results show an improvement in the tree health score (TH) by all three trees, each moving up a health category, despite an increase in the overall percent of Mistletoe within the tree's canopy (% MT) in trees #3 and #9. The results also show a decrease in the number of Mistletoe present (# MT), consistent with the trend noted across the site where some Mistletoe were found dead in the trees whilst others still seemed to be thriving.

3.2.2 Level 2 treatment- 1/3 Mistletoe removal

A comparison of the three parameters of the three trees treated with level 2 within the paddock management zone is shown below:

Table 5 Relevant parameters for paddock trees for 2008 baseline measurements and subsequent 2009 autumn measurements.

	Spring 2008			Autumn 2009		
	% MT	# MT	TH	% MT	# MT	TH
Tree #2	40	12	1	20	7	2
Tree #5	20	14	3	20	7	3
Tree #8	5	3	4	5	3	5



In trees #2 and #8, the overall tree health scores have improved by one category. A decrease in the percent of Mistletoe within the tree's canopy (% MT) for #2 is also recorded. The number of Mistletoe present in trees #2 and #5 have decreased by more than were removed, despite tree #5 still maintaining the same level of Mistletoe canopy cover.

3.2.3 Level 3 treatment- 2/3 Mistletoe removal

A comparison of the three parameters of the three trees treated with level 3 within the paddock management zone is shown below:

Table 6 Relevant parameters for paddock trees for 2008 baseline measurements and subsequent 2009 autumn measurements.

	Spring 2008			Autumn 2009		
	% MT	# MT	TH	% MT	# MT	TH
Tree #1	30	18	1	25	8	2
Tree #4	90	20	1	70	6	1
Tree #7	20	7	2	5	2	3

There has been an increase in the tree health scores (TH) by one category for trees #1 and #7, although the percent of the tree's canopy comprised of Mistletoe (% MT) and number of Mistletoe (# MT) has decreased for all three trees.



4 CONCLUSION

Reviewing the results from the demonstration over both management zones, some trees with both the level 2 (1/3 removal) and level 3 (2/3 removal) treatments have shown improvements in the health of the Pink Gums (four out of six trees treated with level 2 and five out of the six trees treated with level 3 improved by one tree health category). An improvement in health was also found within the level 1 (no removal) trees within the paddock management zone (all three trees improved by one health category). Using the tree health score as the primary parameter to determine the effect of the treatments, no conclusions can be made as to whether the treatments have positively impacted on the health of the Pink Gums within this demonstration. While tree health has improved in some trees with Mistletoes removed since the baseline measurements were recorded, the improvement in health by some trees without Box Mistletoe removal may suggest that there are other factors influencing the health of the trees not measured within this demonstration.

Reviewing the percent of the tree's canopy comprising of Box Mistletoe and the number of individual Box Mistletoe plants shows that there were no consistent trends observed, with some trees recording a drop in the percent and number of Mistletoes, whilst others recording an increase in the percent and number of Mistletoes. There are several conclusions that may account for these results:

- Conclusion 1 (relevant to trees #9 and #5 in the paddock management zone(PA)): *no change* in number of Mistletoe, *increase* in percent of Mistletoe or *decrease* in the number of Mistletoes and *no change* in the percent of Mistletoe. Growth of the Mistletoes present on the trees can account for this in both cases.
- Conclusion 2 (relevant to trees #3 and #8 in the protected remnant management zone (PR)): *decrease* in the percent of Mistletoes but *increase* in the number of individual Mistletoes. The removal of large Mistletoes but the subsequent recruitment of young, small Mistletoes can account for this result.
- Conclusion 3 (relevant to trees #6 and #9 in PR, and tree #8 in PA): *no change* in either the number or percent of Mistletoe. For trees #6 and #9 this is accounted for by the fact that these were level 1 (no Mistletoes removed) treated trees, and represents an unchanged state of the Mistletoes, and as both these trees also had no change in health, the condition of the trees. In tree #8, treated with level 2 (1/3 removal) this scenario may have resulted in the subsequent recruitment and growth of the Mistletoe on the tree since the initial removal of Mistletoe. This tree experienced an improvement in the health score and this would then indicate that other factors not measured within the demonstration have influenced the health of the tree.
- Conclusion 4 (relevant to trees #6, 9, 2, 5, 1, 4, and 7 in PR, and trees #3, 6, 2, 8, 1, 4, 7): *decrease* in both the percent and number of Mistletoes. This scenario, for trees #2, 5, 1, 4, and 7 in PR, and trees #2, 8, 1, 4, and 7 in PA (all with either level 2 or 3 removal of Mistletoes), has resulted directly from the removal of individual Mistletoes and therefore the decrease in the percent of the tree's canopy comprising of Box Mistletoe. Trees #6 and 9 in PR both had level 1 treatment (no removal) so the subsequent decrease in both percent and number of Mistletoe has been a result of natural deaths of



Mistletoes within the trees caused by factors not measured within the demonstration.

The results show no clear pattern of either increased health of the trees or decreased percent or number of Mistletoe between the protected remnant management zone and the paddock management zone. The differences found in previous studies (Miles 2008) where by paddock trees increased in health following Mistletoe removal whereas there were no differences in health between trees with or without Mistletoes in remnant vegetation has not been demonstrated.



5 RECOMMENDATIONS

The results of the demonstration have not clearly indicated whether the removal of different amounts (either 1/3 removal or 2/3 removal) of Box Mistletoe have improved Pink Gum health. Based on these results alone, no treatment can be recommended for application in similar situations for improving Pink Gum health. Although, based on previous studies outlined in the '*Design for Mistletoe Removal and Vegetation Management impact on Pink Gums Demonstration*' (Miles 2008) the increases in health by the majority of trees in both the level 2 (1/3 removal) and level 3 (2/3 removal) treatments would support that the removal of some Mistletoes can improve Pink Gum health. The differences in the amounts of Mistletoe removed in the previous studies (1/3 removal and 2/3 removal) were in the length of time the removals positively impacted the trees health, with 2/3 removal leading to the improvement in health following the Mistletoe removal lasting for at least four years. As this demonstration has only been in effect for six months, these differences can not be seen.

Despite this, the following recommendations can be made in regards to the demonstration rather than wider management of Pink Gums:

- Monitoring of the demonstration should continue into the future to establish an overall pattern of tree health to eliminate seasonal differences and therefore determine the effect of the mistletoe removal
- Continued monitoring of the individual numbers of Mistletoes will help to establish the level of Mistletoe recruitment and therefore provide a basis for making decisions on further removal of Mistletoes
- Inclusion of other parameters may help to identify other influences of tree health (for example, rainfall, soil moisture, insect damage)
- Increasing the number of Pink Gums within the demonstration and replicating the management zones would make the demonstration into a trial whereby the hypothesis of 'Does the removal of Mistletoes increase the health of Pink Gums' could be tested.



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