



# Baselining wandoo crown condition

Preliminary report of wandoo crown decline surveys, 2006

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#### Summary

In order to identify the geographic extent and severity of crown decline, the WRG is coordinating a project to assess the health of wandoo (*Eucalyptus wandoo*) trees across their natural range. Community volunteers are conducting transect surveys at specific sites within their local area and forwarding results to the WRG. The method used to assess and record crown decline in wandoo is described in the document *Surveying wandoo crown decline – A guide for assessors*, developed by the WRG.

Preliminary results from the 13 sites surveyed during 2005 and 2006 indicate that decline varies between sites. At some sites, crown decline is predicted to progress to advanced stages, whereas decline in other sites appears to have stabilised and recovery of tree canopies at these sites is likely. It appears that crown decline may progress to advanced stages at Karakamia, Yilliminning, Paruna and Kupara. However, we do not expect the decline to progress at Gorrie Rd, Milli Roo, Maylinga, Gooseberry Hill, Mission Rd or Strathairlie and are optimistic that the decline at Crossman, West Dale and Foxes Lair will stabilise and recovery will begin.

Continued annual or seasonal monitoring of these and other sites is the key to clarifying the progression and recovery cycle of this decline. This is important in understanding the factors linked to chronic decline, decline followed by recovery and no decline. Results from future surveys will extend the preliminary information provided in this report.

(Top) A healthy wandoo, (middle) initial flagging, (right) wandoo with advanced decline. Photos – P. Poot/A. Wills



#### Introduction

Crown decline has been observed in many areas throughout wandoo's geographic range. Although the reasons for the decline are currently unclear, a number of factors, including reduced soil moisture, salinity and possibly changed fire regimes, are seen as potential contributors.

Wood-boring insects are also involved and, although secondary in nature, cause visible symptoms of decline. The wood-boring insects are also thought to interact with fungal canker pathogens, causing 'flagging' – the browning and death of leaves that signify the initial stages of wandoo crown decline and current activity of decline causing agents. At this stage of the decline, the upper and outer leaves in the crown brown and begin to die off. The tree responds by establishing epicormic shoots lower along the branches. These epicormic shoots may subsequently die, resulting in progressive downward movement of the tree crown and redistribution of the canopy. Over several years there can be a noticeable decline in the tree canopy, sometimes culminating in the death of the tree.

This study reports results from surveys of wandoo crown decline by community groups and volunteers using the method developed by the WRG in 2005. Each survey is based on assessments of individual trees — in most cases along a 100m x 20m-transect within woodland blocks or along a road verge. In the survey, each tree is assigned to one of three diameter classes – 10 to 25cm, 25 to 50cm and more than 50cm – and assessed to determine the stage of decline (Figure 1) and the amount of flagging occurring in the tree crown.

Survey instructions and recording sheets are available from WRG Executive Officer Liz Manning on 0427 441 482, or by email (lizmanning@bigpond.com). Information can be downloaded from the 'Nature and Biodiversity' section of DEC's website at www.naturebase.net.



Figure 1. Line drawings of the six crown decline stages used to assess the degree of decline of individual trees. The use of this assessment scale and the associated survey procedure is described in *Surveying wandoo crown decline – A guide for assessors*, published by WRG.

## Surveying wandoo crown decline

During the latter part of 2005 and early 2006, WRG members and DEC officers conducted survey training workshops at several locations across the geographic range of wandoo. Community volunteers were instructed how to set up transect surveys and assess wandoo trees for crown decline. About 100 people attended the workshops, contributing to the collection of initial data (Table 1).

Thirteen monitoring sites have been established on a range of land tenures including private property, reserves and national parks in a north-south corridor from Chittering to Kojonup (Figure 2). During 2006, 32 transects were surveyed across the 13 monitoring sites. A total of 973 trees along 3350m of transects covering 6.7ha were assessed. Survey intensity ranged from one transect per site to seven transects per site.

Table 2 summarises the survey results and provides an interpretation of the status of decline at each site. Interpretation of the progression of decline is best on those sites with several transects. Our understanding of wandoo crown decline would be improved if more surveys were conducted, particularly on those sites where only one or two transects were surveyed.

Although sites are well spaced across the geographic range of wandoo, not all areas were assessed. Additional survey sites spread across the distribution of wandoo in areas such as Corrigin, Cranbrook, Stirling Range National Park, Three Springs, Dumbleyung and Bolgart would improve understanding of the extent and progression of decline.



Measuring tree diameter 1.3m from the ground. Photo – L. Manning

Table 1. Outcomes from crown assessment training workshops held during 2005 and 2006.

Date	Workshops	Attendance	Monitoring sites established
May 2005	Helena catchment	10	Data collected but not reported here
October 2005	Wongamine Nature Reserve	12	Data collected but not reported here
December 2005	Helena catchment	12	<ul> <li>Karakamia Sanctuary</li> <li>Paruna Sanctuary</li> <li>Gorrie Road – Helena catchment</li> <li>Gooseberry Hill National Park</li> </ul>
February 2006	Crossman	18	<ul> <li>Foxes Lair Reserve</li> <li>Yilliminning Reserve</li> <li>Crossman Reserve</li> <li>West Dale</li> </ul>
	Beaufort River	8	<ul> <li>Bush Heritage Reserve - Mission Rd</li> <li>South Bokal - Data received but not reported here</li> <li>Strathairlie Pastoral Lease- Boyup Brook</li> </ul>
April 2006	Chittering	25	<ul><li>Milli Roo</li><li>Maylinga</li></ul>
May 2006	Katanning	10	Kupara Park

Figure 2. The location of wandoo crown decline survey sites. The green boundary is the approximate limit of the distribution of wandoo (*Eucalyptus wandoo*). Small stands and single trees will occur outside this boundary.



Table 2. Summary and interpretation of wandoo crown decline survey results from 13 sites. Surveys based on the method described in WRG (2005).

Site name	Flagging summary	Crown decline stage summary	Summary interpretation for site	Number of transects	Number of trees surveyed	Trees per ha
Gorrie	Trivial	Early	Decline agents at very low activity levels. Most			
Road	flagging	decline	trees with the majority of their terminal foliage			
			intact. Probably decline will not progress?	4	101	126
Milli Roo	Trivial	Early	Decline agents at very low activity levels. Majority			
Property	flagging	decline	of trees with the majority of their terminal foliage			
			intact. Probably decline will not progress?	5	112	154
Maylinga	Trivial	Early	Decline agents at very low activity levels. Majority			
Property	flagging	decline	of trees with the majority of their terminal foliage			
			intact. Probably decline will not progress?	1	74	370
Gooseberry	Minor	Early	Decline agents at low activity levels. Majority of			
Hill	flagging	decline	trees with the majority of their terminal foliage			
National	on some		intact. Possibly decline will not progress?			
Park	trees			2	15	75
Mission	Minor	Early	Decline agents at low activity levels. Majority of			
Road	flagging	decline	trees with the majority of their terminal follage			
	on some		Intact. Possibly decline will not progress?		40	200
Strathairlio	Minor	Farly	Decline agents at low activity lovels. Majority of	I	40	200
Pastoral	flagging	decline	trees with the majority of their terminal foliage			
Lease	on some	decime	intact Possibly decline will not progress?			
Louise	trees			2	78	164
Crossman	Minor	Advanced	Decline agents at low activity levels. Majority of		, 0	101
Reserve	flagging	decline	trees with majority of terminal foliage lost.			
	on some		Possibly decline will stabilize and commence			
	trees		recovery?	7	175	125
West Dale	Minor	Advanced	Decline agents at low activity levels. Majority of			
	flagging	decline	trees with majority of terminal foliage lost.			
	on some		Possibly decline will stabilize and commence			
	trees		recovery?	4	85	106
Foxes Lair	Minor	Advanced	Decline agents at low activity levels. Majority of			
Reserve	flagging	decline	trees with majority of terminal foliage lost.			
	on most		Possibly decline will stabilize and commence			
	trees		recovery?	1	46	230
Karakamia	Extensive	Early to	Decline agents currently or recently active.			
Sanctuary	flagging	Intermediate	Majority of trees with the majority of their terminal			
	on some	decline	foliage intact. Progression to intermediate or		<b>F7</b>	005
Villiminning	Extensive	Intermediate	advanced decline likely.	I	57	285
Reserve	flagging	decline	Majority of trees with the majority of terminal			
Teserve	on some		foliage lost Progression to advanced decline			
	trees		likely	2	98	122
Paruna	Extensive	Intermediate	Decline agents currently or recently active			122
Sanctuary	flagging	decline	Majority of trees with the majority of terminal			
	on most		foliage lost. Progression to advanced decline			
	trees		likely.	1	76	127
Kupara	Extensive	Advanced	Decline agents currently or recently active.			
Reserve	flagging	decline	Majority of trees with majority of terminal foliage			
	on some		lost. Further decline into decline class C5 likely.			
	trees			1	16	160

\* Not all of the completed surveys are reported here as some data was not available at the time this report was produced. This data will be reported in subsequent reports.

#### Stand structure

Figure 3 shows the distribution of tree diameters determined from the surveys of each site. The average stand density of trees across the survey sites was 173 stems per ha with a diameter greater than 10cm (this ranged from 75 stems per ha at West Dale to 370 stems per ha at the Maylinga property).

Eleven of the 13 sites surveyed had size distributions skewed to the 10-25cm diameter class. Five of these sites were heavily skewed, with many more trees in the small diameter class than in the larger classes. Such skewed distributions of tree diameters are common. The intermediate, 25-50 cm, diameter class was most frequent on two sites.

Although distributions of tree diameters vary greatly across the landscape, data from Rose (1993) for two wandoo stands that have never been logged indicates old-growth stands have a relatively flat distribution of tree diameters with approximately equal numbers of trees in each of the three diameter classes. The skewed distributions on many of the survey sites may be due to historical timber harvesting.

# Flagging

At the time of the surveys, 35 per cent of all trees surveyed had some flagging. Approximately 70 per cent of this flagging was minor, affecting less than 20 per cent of the tree crown.

The small (10-25cm) and large (over 50cm) diameter classes had equal proportions of flagging trees (33 per cent of the trees in each class), while the intermediate size class (25-50cm) had the greatest proportion of flagging trees (40 per cent of trees in the class). From this data, there appears to be little relationship between the proportion of flagging in the tree crown and the tree diameter - all sizes of trees appear equally likely to experience flagging.

The presence of active crown decline was determined from the amount of flagging observed on the sites. Of the 13 sites, evidence of active crown decline was very low on three sites (Gorrie Rd, Milli Roo, and Maylinga), low on six sites and currently or recently active on four sites (Karakamia, Yilliminning, Paruna and Kupara).



Figure 3. The number of stems per hectare at each site in the three diameter classes.

#### Overview of crown decline

Figure 4 shows the percentages of trees in each of the six crown decline stages at each site, and the proportion of flagging leaves in the tree crown at the time of assessment.

Based on consideration of the crown decline stage and the presence of active crown decline (flagging) (Figure 4), summary interpretations were made for each site (Table 2). The summary interpretations are based solely on the survey data so may not adequately describe sites that only have one or two transects.

Wandoo crown decline is most likely to progress and seriously impact those sites that have both a large amount of active crown decline (flagging) and trees in the early through to advanced crown decline stages (shown in Figure 1).

Based on the available survey data, Kupara Reserve appears to be the site most threatened by wandoo crown decline. Karakamia, Yilliminning and Paruna also have extensive active decline and a wide range of crown decline stages (Figure. 4). It is likely that decline will progress to advanced stages at these sites.

We are more optimistic about the progression of decline at the other nine sites. We do not expect the decline to progress at Gorrie Rd, Milli Roo, Maylinga, Gooseberry Hill, Mission Rd, or Strathairlie. It appears likely that crown decline at Crossman, West Dale, and Foxes Lair will stabilise and recovery will begin.



# Future directions and recommendations

Our understanding of wandoo crown decline would improve if more surveys were conducted at each site (particularly those where only one or two transects were surveyed). It is recommended that at least three transects per site are surveyed. Where possible transects must be at least 100 metres in length.

Photographs of transects or of representative trees may assist interpretation of the data, particularly if photos for consecutive surveys are taken from exactly the same location and the dates are recorded.

Follow up surveys are essential to record the progress of decline.

Additional monitoring sites spread across areas such as Corrigin, Cranbrook, Stirling Range National Park, Three Springs, Dumbleyung and Bolgart are needed to broaden our understanding of the extent of wandoo crown decline.

WRG would appreciate comments on and corrections to this report.



Crown assessment training workshop at Crossman Reserve West. Photos – R. Hooper



Figure 4 (left hand side) The percentage of trees at each site assigned to the six crown decline stages. (Right hand side) The proportion of flagging leaves in the tree crown at the time of assessment. Classes are 0%; < 20%; 20%–50%; and 50%–100%.

#### Conclusions

The crown assessment training workshops conducted in 2005 and early 2006 were well attended and helpful in instructing community volunteers on the survey technique to help ensure a consistent standard in the results.

The conclusions are based on limited data that may not fully reflect the extent of decline occurring at some sites. This is due to the low number of transects and very few trees recorded on these sites. More surveys are needed on current sites where only one or two transects were completed.

Based on the survey data available, it appears that the crown decline may progress to advanced stages at Karakamia, Yilliminning, Paruna and Kupara. However, it is not expected that decline will progress at Gorrie Rd, Milli Roo, Maylinga, Gooseberry Hill, Mission Rd or Strathairlie. It appears likely that crown decline at Crossman, West Dale and Foxes Lair will stabilise and recovery will begin.

Additional sites are being sought in areas not covered in the 2006 surveys. Data from new sites will be reported in the next report. Continued periodic monitoring will greatly assist our understanding of the progression and recovery cycle of this crown decline event. Volunteers are strongly encouraged to continue annual monitoring of their sites for at least five years.

#### References

Churchill, D. M., 1961. *The Tertiary and Quaternary vegetation and climate in relation to the living flora in south western Australia*. PhD Thesis, University of Western Australia.

Rose, P. W., 1993. *Production of habitat hollows by wheatbelt eucalypts: final report*, Save the bush research grant 1991/92, project R053 / prepared by Paul W. Rose for Department of Conservation and Land Management., Western Australia. Vol. 31, [25] leaves.

Western Australian Herbarium, 1998. Flora Base – *The Western Australian Flora*. Department of Environment and Conservation. http://florabase.dec.wa.gov.au.

Wandoo Recovery Group, 2005. *Surveying wandoo crown decline - A guide for assessors*. Wandoo Recovery Group and Department of Conservation and Land Management, Kensington, Western Australia

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