Crown decline in Wandoo

Observations from Wundabiniring Brook 1999-2005

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Introduction

The Science Division of the Department of Conservation and Land Management was alerted in early 1999 to foliage death in an extensive area of Wandoo (*Eucalyptus wandoo*) woodland in Talbot forest block visible from the York Road. Causes of initial foliage thinning at Talbot forest block were unclear, though initially attributed to below average winter rainfall in the winter of 1997.

Method

A series of Wandoo crowns in open woodland in the north end of Talbot forest block near Wundabiniring Brook (31° 53.103' S, 116° 30.511' E) were photographed on 9 June 1999, then rephotographed on 4 July 2000, 23 May 2001, 9 September 2002, 6 May 2004 and 28 April 2005 to facilitate a more rigorous and objective assessment of changes in crown condition. The site was photographed using a digital camera in May 2003 but these images had to be discarded due to unsatisfactory color saturation.

Observations

Decline symptoms
At the outset of monitoring in 1999 at the Wundabiniring Brook site, there was already variation between trees in time of onset and severity of decline symptoms. In least affected trees, i.e. trees that retained all the foliage on the terminals of branches, the earliest indications of crown decline were deaths of clusters of foliage. This death of leaf clusters is termed 'flagging' (Hooper 2004, Hooper and Sivasithamparam 2005). For trees with more advanced symptoms, flagging of terminal foliage and shedding of dead leaves resulted in branches that were bare of leaves to a variable extent between trees. Some trees lost all terminal foliage, others lost terminal foliage only from some branches, while some trees appeared completely unaffected. After the loss of terminal foliage, epicormic shoots were initiated about 1 to 2 m from below the ends of branches, indicating that branches had died back to this extent.

Flagging was not confined to terminal foliage. Epicormic clusters died in affected trees to an extent that was variable between trees. In some cases, the entire first flush of epicormic shoots died and a second flush of epicormic shoots was initiated further down the stem. In some cases the trees died without producing a second flush of epicormic growth. More commonly, only a proportion of epicormic clusters were affected. Flagging of epicormic foliage was most abundant in late May 2001. Trees

were inspected in September 2002 so a late Autumn comparison is not available for that year. By late Autumn 2003 and 2004 flagging had become relatively uncommon at this site. Flagging remained relatively uncommon in Autumn 2005.

At present, with some exceptions, trees appear to be rebuilding their crowns at this site. Epicormic clusters initiated after the loss of terminal foliage continue to grow and most trees now have dense canopies. Trees that were most severely affected, those that completely lost their first flush of epicormic foliage, appear to be those most likely to die suddenly. The ultimate cause of death of those trees that die is not clear although they were probably weakened by the decline process.

Assessing crown condition

For an indication of variation between trees or for assessing the impact on stands of trees, crown decline in individual Wandoo trees can be assessed in 3 ways:

1. Presence and amount of flagging in the tree crown. This gives an indication of whether decline agents are, or have been recently active in the crown, and the extent to which they are affecting or have most recently affected the amount of foliage in the tree crown. However, decline agents may be active in crowns and not cause physical symptoms.

2. Relative abundance of dead branches in the crown. This gives an indication of the cumulative effect of crown decline over several years as dead branches persist in the crown.

3. Extent to which branches die-back along stems, sometimes involving the death of epicormic shoots or death of the tree. This gives an indication of the pathogenicity of decline agents.

The range of crown conditions can either be considered as variation between trees at a single point in time (Plates 1-5), or as a progression of symptoms that a single tree might exhibit over a period of several years during the decline process (Plates 6A,B; 7A-F). This is possible because symptoms of the decline, especially abundance of dead branches and extent of die-back along branches persist for several years.

It is important that a standardized method of rating the crown conditions of trees is adhered to, otherwise comparisons between assessments cannot be made. A field methodology for assessing the condition of Wandoo crowns is available from the Wandoo Recovery Group (WRG 2005). Wandoo crown condition is classified into 6 categories of dead branches that reflect the impact of crown decline. These categories are:

- C1. No crown decline. All terminal foliage intact. Crown density may vary from tree to tree but no dead branches are present or only a few dead branches occur low in the canopy. (See Plate 1 for an example.)

- C2. Some decline evident. Loss of some terminal foliage although most terminal foliage is still present. Dead branches are present in the upper part of the canopy although most branches retain their terminal foliage. (See Plates 2 and 7A for examples.)

- C3. Absence of most terminal foliage. Most foliage consists of epicormic foliage. Dead branches are emergent from the canopy. (See Plates 7B and 7C for examples.)

- C4. All terminal foliage is absent. Abundant epicormic clusters. All foliage consists of epicormic foliage. Dead branches are emergent from the canopy. (See Plates 3 and 7D-F for examples.)

- C5. Death of initial flush of epicormic clusters. Later epicormic growth occurs further down stems. Death of epicormics on small stems, initiation of epicormic shoots further down the bole. (See Plate 4 for an example.)

- C6. Dead tree. No green foliage present. (See Plate 5 for an example.)

This rating system can be difficult to apply to veteran trees. The branch die-back in these trees may have occurred over long time spans and be caused by processes antecedent to and not apparently related to the most recent widespread crown decline event in surrounding stands. In veteran trees it is important to look for signs indicating the relative time of branch death such as weathering of branches (e.g. loss of twigs (recent death), or loss of progressively larger branchlets or branches (older events)), and whether there has been a flush of epicormic shoots that have subsequently died (progressive death down the stem).

Conclusions

Long-term (7 years) observations of declining Wandoo crowns at the Wundabiniring Brook site clearly indicate that individual trees respond differently with regard to the abundance and extent of development of branch die-back. These differences were not masked by differences between crowns in onset time of branch die-back because severe flagging, symptoms of recent activity of decline causing agents, was observed over 3 years from 1999 to 2001. These observations indicate that individual tree responses to decline causing agents may determine the extent of development of branch die back. The mechanisms for differences between tree crowns are unknown at this stage. The decline symptoms are expected to persist for at least two more years before crown recovery and loss of dead material from crowns begin to obscure variation. A question that may be worth pursuing is whether there is any genetic correlation with expression of decline symptoms.

References

Hooper R. (2004) *Investigation of possible disease factors in the decline of wandoo (Eucalyptus wandoo) in the Shire of York.* Unpublished Honours thesis. University of Western Australia.

Hooper R.J. and Sivasithamparam K. (2005) Characterization of damage and biotic factors associated with the decline of *Eucalyptus wandoo* in southwest Western Australia. *Canadian Journal of Forest Research* 35: 2589-2602.

WRG (2005) *Surveying The Impact of Wandoo Crown Decline. A Guide For Volunteers.* Wandoo Recovery Group and Department of Conservation and Land Management. Perth, Western Australia.

Plate 1. Crown condition C1. 28 April 2005. No crown decline apparent. Crown decline has not affected these trees.

Plate 2. Tree with crown condition C2. 28 April 2005. Some dead branches occur although most terminal foliage has been retained. Currently no flagging is present indicating this crown is recovering.

Plate 3. Crown condition C4. 28 April 2005. All terminal foliage is absent. All current foliage is derived from epicormic shoots. Current foliage is relatively dense and without flagging, thus indicating that this tree is recovering.

Plate 4A, B. Crown condition C5. 28 April 2005. All terminal foliage absent and early flush of epicormic foliage is dead. Crown severely contracted. Vestiges of dead epicormic shoots remain (detail on right).

Plate 5. Crown condition C6. 28 April 2005. Dead tree. Note flagging of epicormic branches on main stems. This tree progressed through crown condition C5 before dying in late 2004. The ultimate cause of death is unknown but large, girdling Cerambycid galleries were present on the main stems and bole.

Plate 6 A, B. Crown condition C1. Difference in expression of decline can be persistent. An example of a tree showing minimal changes to the canopy since June 1999.

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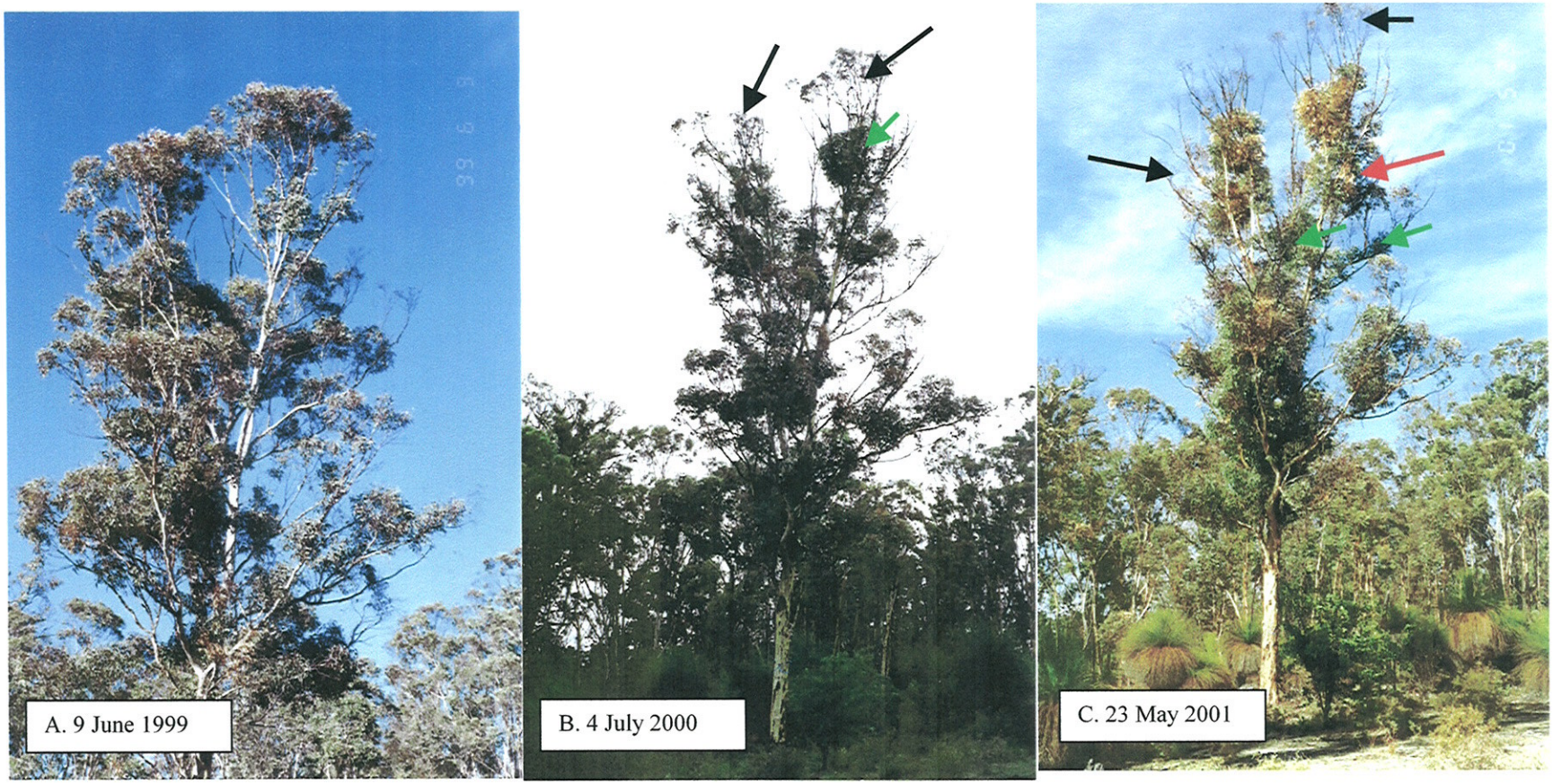
A. 9 June 1999
B. 4 July 2000
C. 23 May 2001

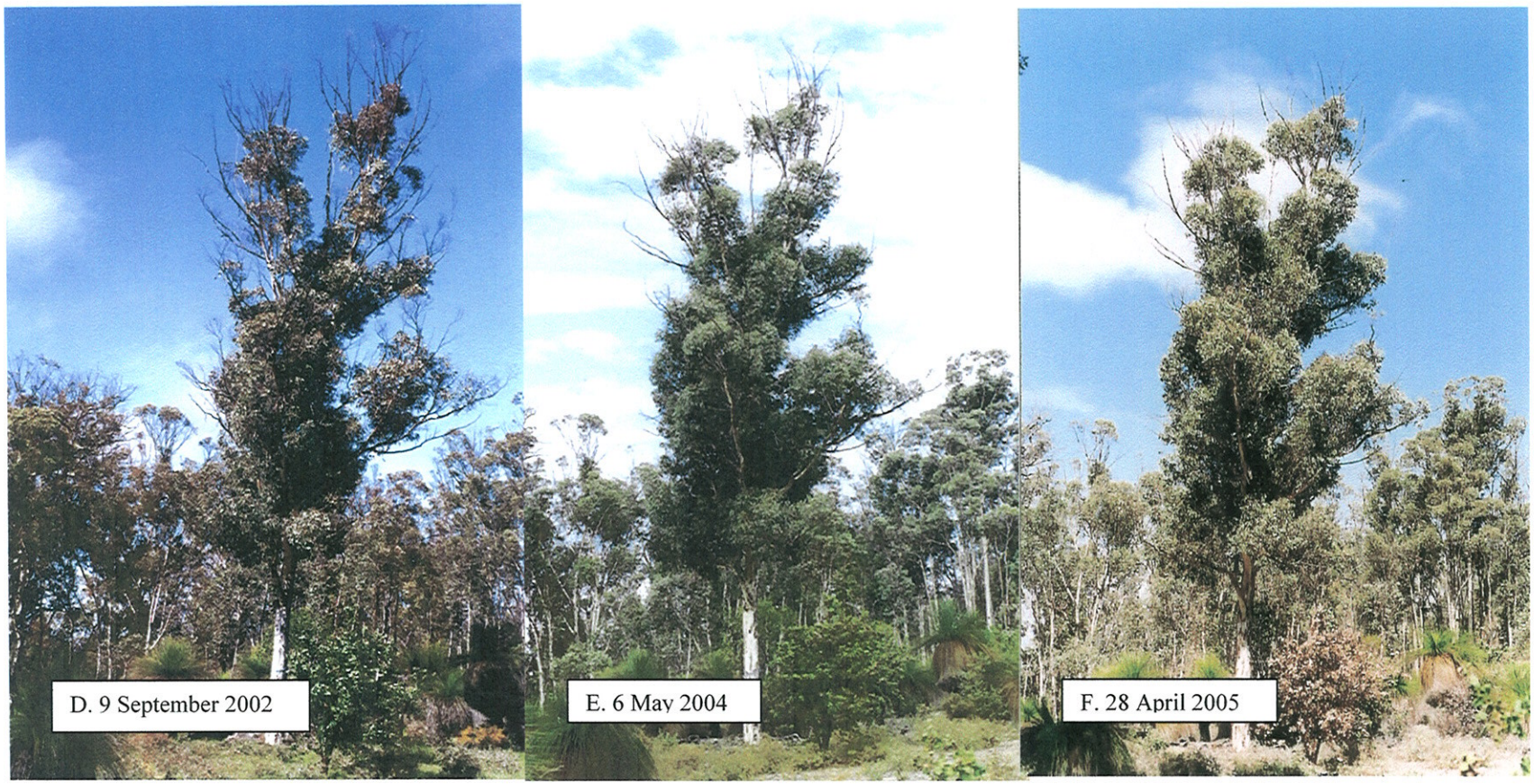

Plate 7 A-F. An example of the onset and progression of crown decline in one tree. A. Crown condition C2. Some thinning of foliage and initiation of epicormic growth prior to June 1999. B. Crown condition C3. Heavy thinning of foliage in upper crown (black arrows) and thickening of epicormic growth (green arrows) C. Crown condition C3. Continued loss of terminal foliage (black arrows), thickening of epicormic foliage (green arrows) and flagging foliage (red arrow). D, E and F. Crown condition C4. All terminal foliage absent. Continued thickening of foliage.