Crown decline in Wandoo

Update for 2004

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Observations from Wundabiniring Brook 1999-2004.

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Summary of observations and conclusions

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.

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 and 6 May 2004 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 were discarded due to poor color saturation.

1. **Observation:** Wandoo stands in Talbot Block exhibit a range of canopy decline between individual tree crowns (Plate 1A-C.). Tree crown conditions range from no branch die-back between June 1999 and May 2004 (Plate 2A and B), through severe branch die-back (Plate 4A and B), to death of some trees (Plate 4C).

   Conclusion: Factors at within-site and within-stand scales are operating in the canopy decline process.

2. **Observation:** Onset of branch die-back is not synchronous between all canopies within stands (Plate 5A). Although the most rapid loss of foliage occurred by autumn 2000 (Plates 3B, 4A and 4B, 5A.).

   Conclusion: Conditions for the onset of decline persist for more than one year.

3. **Observation:** Branch die-back is present in singleton trees (Plate 3A-E), as well as in dense regrowth stands (Plate 5A-D).

   Conclusion: Presence and severity of branch die-back is largely independent of stand density.

4. **Observation:** Some relatively unaffected tree crowns occur within stands of severely affected crowns (Plate 1A).

   Conclusion: Individual tree characteristics are an important factor in expression of crown decline.

5. **Observation:** Evidence of branch-boring Cerambycidae was found in both unaffected (Plate 7) and severely affected crowns (Plate 6) on branches up to about 50mm diameter. Branch death is possibly related to insect boring activity.

   Conclusion: Tree responses to the activity of branch borers appear to be an important aspect of expression of canopy decline.

6. **Observation:** Evidence of Cerambycid larval activity on dead tree trunks greater than 100 cm diameter was not always present.

   Conclusion: Tree death was not necessarily related to girdling of large stems by borers.

7. **Observation:** Changes to leaf area within crowns since 2001 have been subtle, there seems to be stabilization in most crowns. Loss of foliage is at least equalized by development and thickening of epicormic foliage by May 2004.

   Conclusion: Factors leading to branch and epicormic die-back are abating at this site.

8. **Observation:** Tree mortality is about 5%-10% in some stands.

   Speculation: Further deaths of the least vigorous trees are possible. Most trees will probably survive and rebuild their canopies should favorable rainfall conditions prevail. The net result is likely to be a small thinning of stand density in the most severely affected stands.

Some hypothetical mechanisms of Wandoo crown decline

Long-term (6 years) observations of declining Wandoo crowns at the Wundabiniring Brook site clearly indicate that individual tree responses are an important factor in the rate and extent of development of branch die-back. Cerambycid branch-borers are active in relatively intact crowns adjacent to or within stands with severe branch die-back. There are differences between crowns in onset time of branch die-back. These observations indicate that individual tree response to branch borer activity or perhaps pathogens associated with branch–borers determine the extent of development of branch die back. The mechanisms for differences between tree crowns are unknown at this stage but it is possible to state the following:

Tree response hypotheses:

Hypothesis 1. There is variation between trees in response to branch-borer activity (and/or associated pathogens).

Hypothesis 2. There is variation in response within trees to branch-borer (and/or perhaps associated pathogens) activity as tree vigour changes. The effect of damage increases as Wandoo vigour declines because cambium growth is reduced and the mechanical effects of larval feeding increase (and/or pathogenicity of associated

organisms increases). In particular, there is an increased incidence of branch and stem death of less vigorous trees.

In addition to the tree response hypotheses, some hypotheses relating to Cerambycid branch-borer populations can be stated:

Borer population fluctuation hypothesis:

Damage to Wandoo branches increases due to increased populations of branch-borers. Populations increase because key mortality factors during the borer life cycle change.

Branch-borer population and drought stress hypothesis:

Borer populations and consequent damage increase as drought stress increases. There is much evidence from studies of *P. semipunctata* that bark conditions greatly affect the attractiveness of host trees and survival rates of larvae. Trees subject to water stress have decreased bark moisture content and increased concentrations of soluble sugars in the bark. Survivorship of *P. semipunctata* larvae in stressed trees is inversely correlated with bark moisture content. It is not unreasonable to speculate that stress induced changes to bark qualities might affect other bark feeding Cerambycidae, including those active on Wandoo.

Future research

Clearly, the mechanisms underlying tree responses to branch borer population, and the dynamics of branch borer populations and how they interact with tree responses to edaphic conditions are likely to be complex.

Priority areas for research into crown decline in Wandoo are:

- Elucidation of the identity, life cycles and key mortality factors of branch boring Cerambycidae.
- Identification of pathogens associated with damage caused by branch-boring Cerambycidae
- Manipulation of tree vigour and investigation of the responses of pathogens and branch boring larvae. e.g. Altering tree vigour by: Imposing different fire regimes to influence nutrient availability; preventing the infiltration of rainfall by the use of ground sheets.

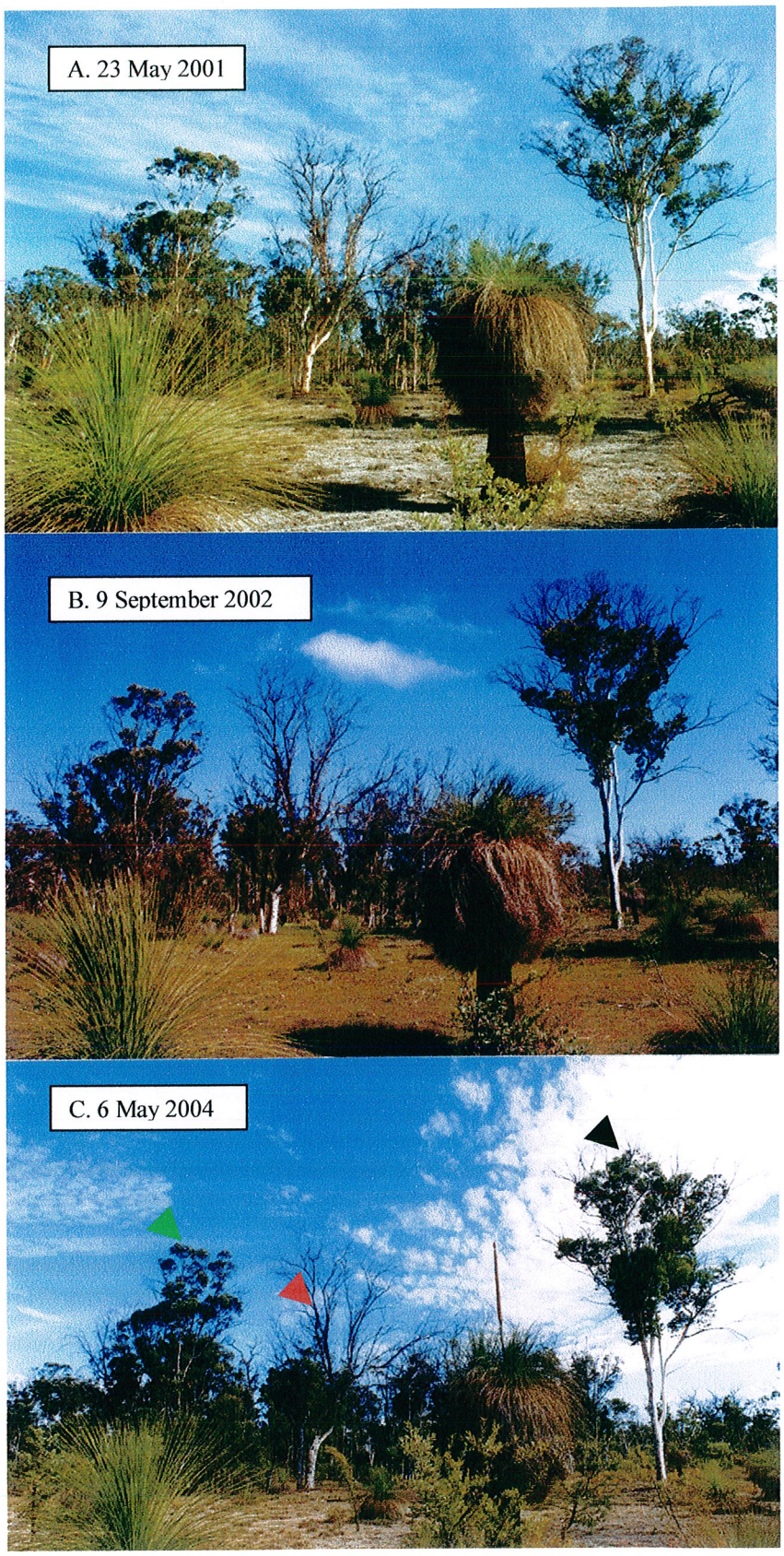


Plate 1 A, B and C. Different trees show canopy decline to differing extents. Note severe die-back of canopy before 2001 and ongoing collapse of epicormic growth (Red arrow); some loss of terminal leaf clusters since 2001 (Green arrow); loss of terminal foliage before and after 2001 and thickening of remaining foliage by 2004 (Black arrow).

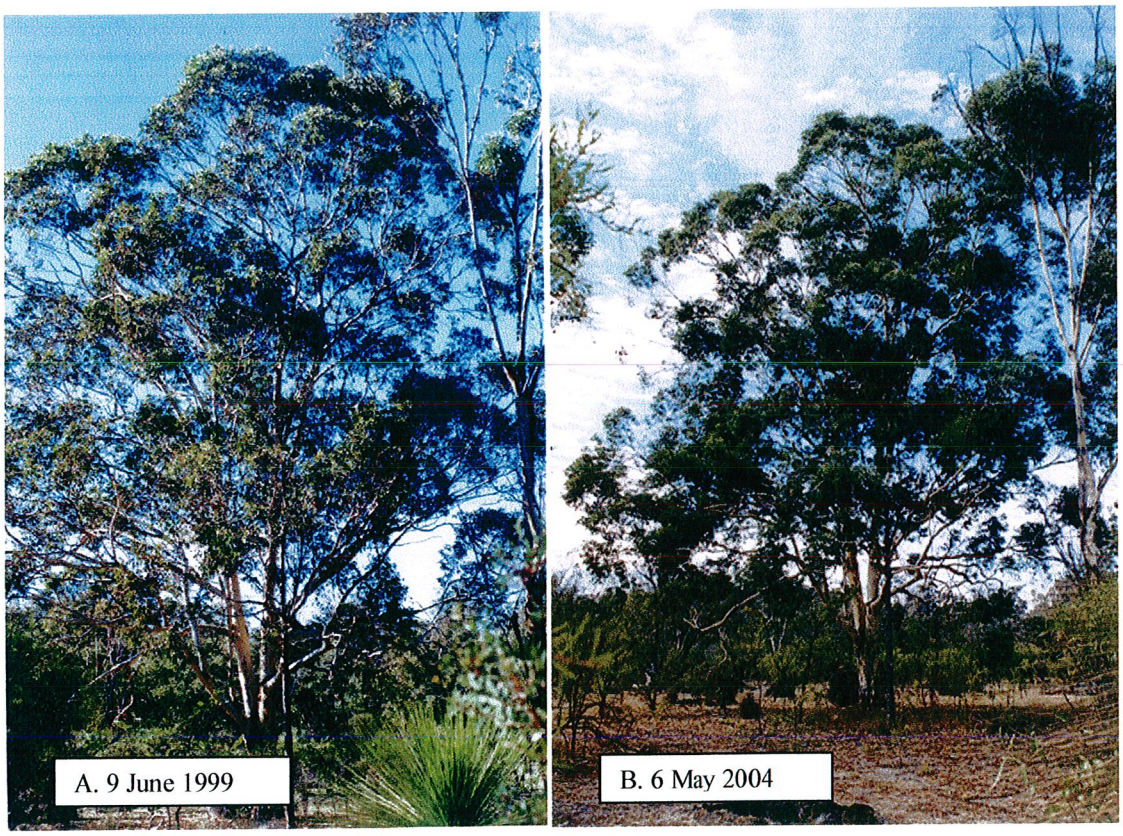
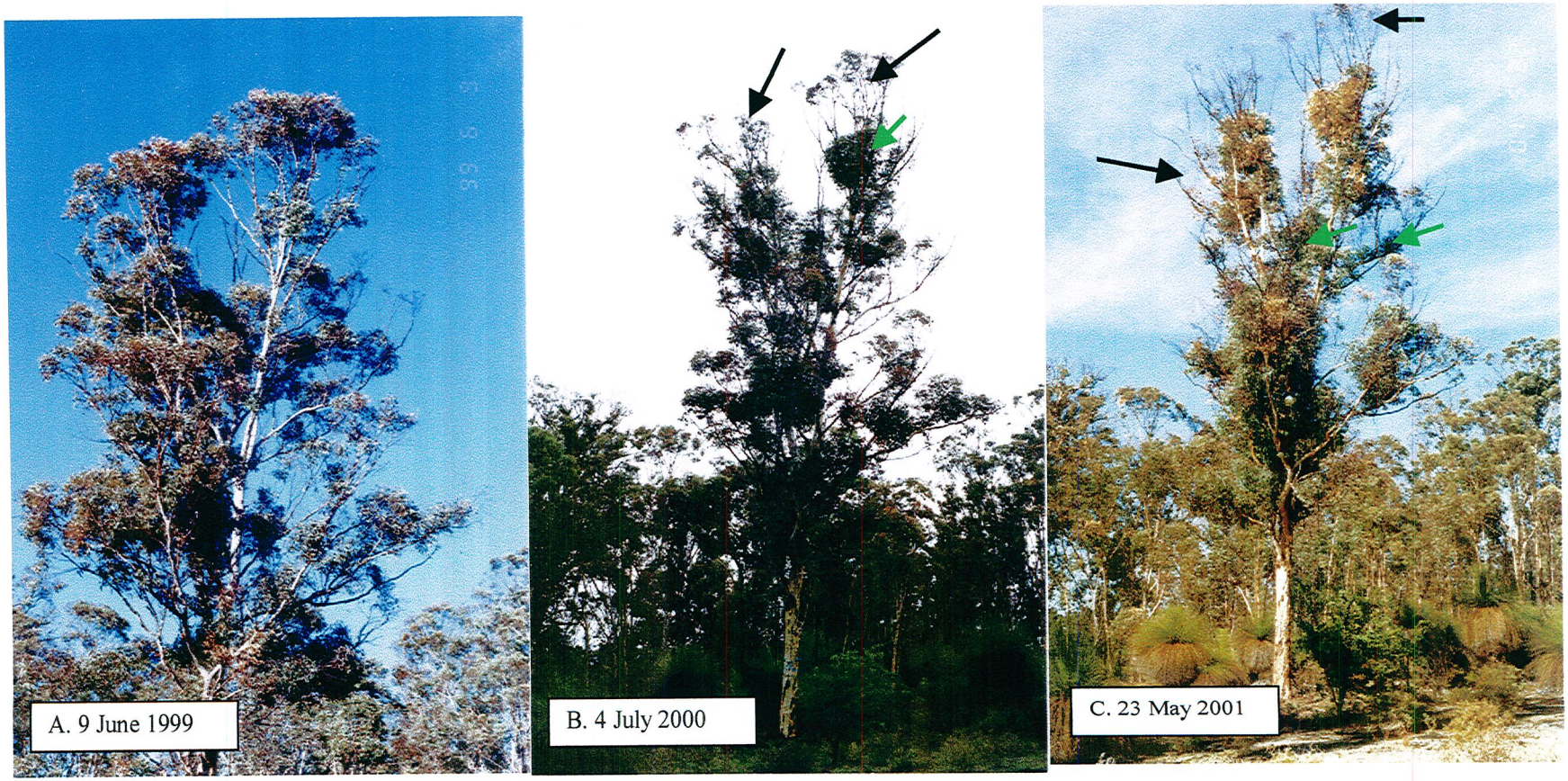


Plate 2 A, B. Difference in expression of decline can be persistent. A tree showing minimal changes to the canopy since June 1999.

Plate 3 A, B. Evidence of crown decline can persist for very long time spans. A very old crown showing different episodes of crown die back. Uppermost branches are dead in Plate 3A from an earlier crown decline. Note overall loss of terminal foliage and branch die-back, and thick epicormic growth by May 2004 in Plate 3B. Crown decline events are probably an important part of the process of hollow formation (green arrow).


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

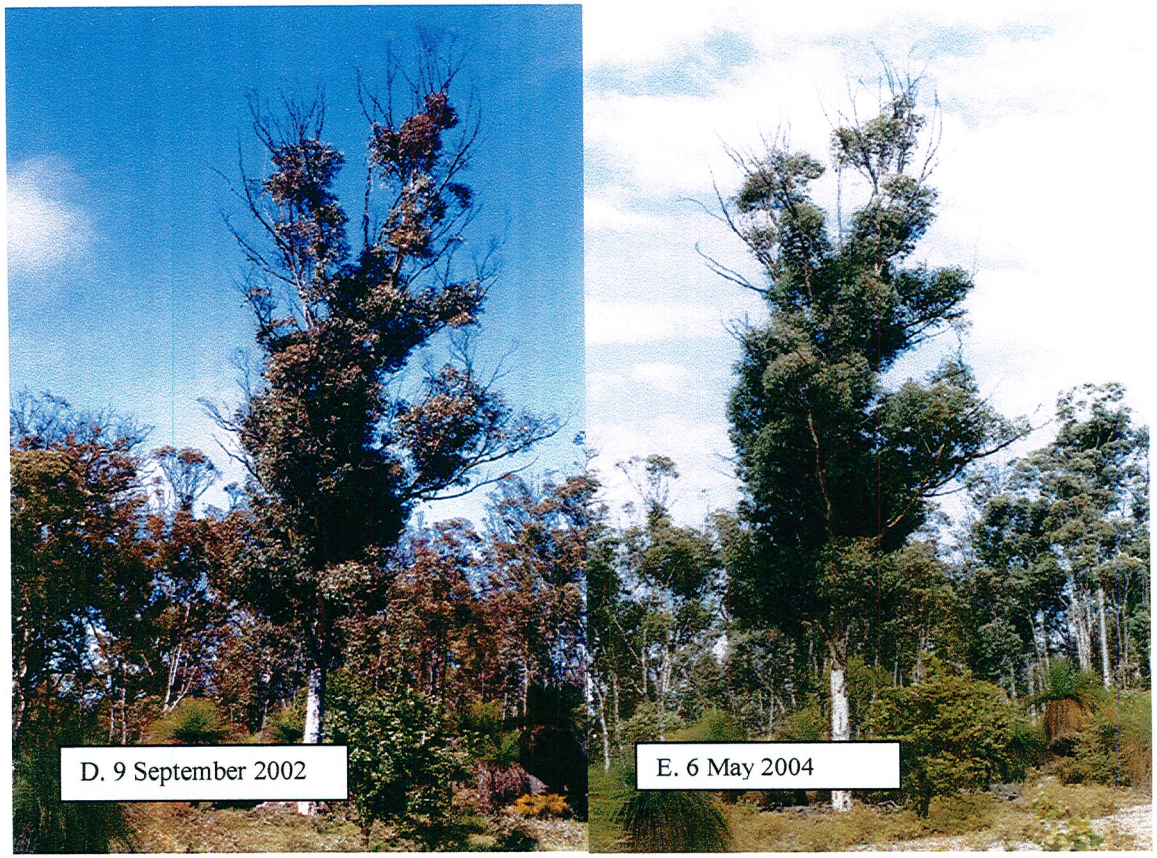


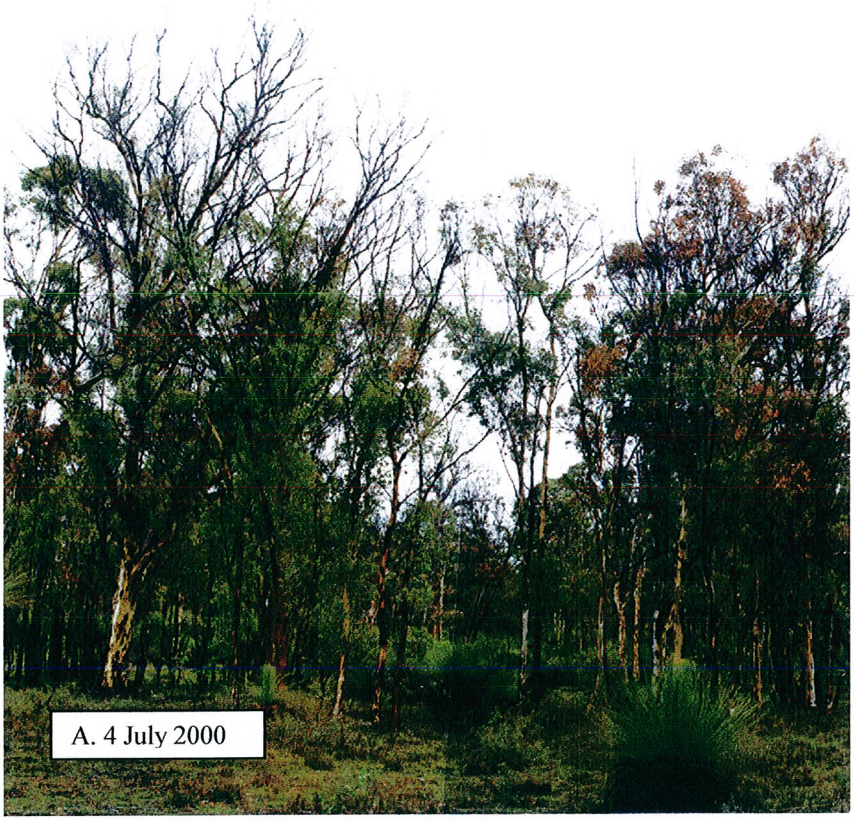
Plate 3 A-E. Onset of crown decline in one tree. A. Some thinning of foliage and initiation of epicormic growth prior to June 1999. B. Heavy thinning of foliage in upper crown (black arrows) and thickening of epicormic growth (green arrows). C. Continued loss of terminal foliage (black arrows) and thickening of epicormic foliage (green arrows). D and E. Continued thickening of foliage.


A. 9 June 1999


B. 4 July 2000


C. 23 May 2001

Plate 4 A-E. A small stand severely affected. A. Thinning of terminal foliage and initiation of epicormic foliage by June 1999. B. Further loss of terminal foliage and thickening of epicormic clusters. C. Some loss of epicormic leaves . Some thickening of foliage . Dead tree arrowed red. D and E. Continued thickening of epicormic clusters.


A. 4 July 2000

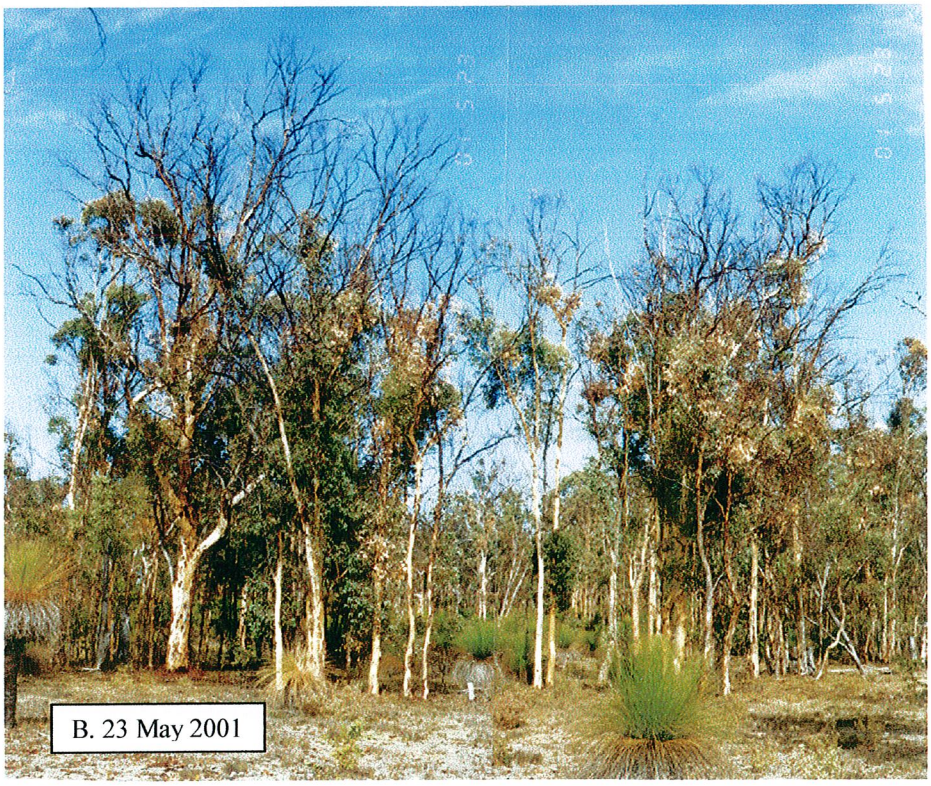

B. 23 May 2001

Plate 5 A-D. A severely affected stand. Decline has progressed at different rates in different parts of the stand. A. Onset of decline first in left half of stand probably before 1999 followed by right half of stand in 1999-2000. B and C. Continued loss of epicormic clusters in 2001 and 2002. D. Thickening of epicormic growth by May 2004.

Plate 6. Cerambycid borer damage associated with branch die-back. Green arrow indicates empty pupation chamber. Red arrow indicates characteristic 'J' shaped gallery. Dead bark has been removed. Stem diameter about 50 mm.

Plate 7. Borer activity on branches of Wandoo showing almost no branch die-back (inset). Borer galleries overgrown by bark arrowed red and green. Branch diameter about 50 mm.