TECHNICAL NOTE 2009/25

Department of Water, Land and Biodiversity Conservation

METHOD MANUAL FOR THE VISUAL ASSESSMENT OF LOWER RIVER MURRAY FLOODPLAIN TREES.

RIVER RED GUM (*EUCALYPTUS CAMALDULENSIS*).

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INTRODUCTION

This document details a visual assessment method for river red gum (*Eucalyptus camaldulensis*) on the floodplain of the Lower River Murray in South Australia. The method has been developed to assess the status and monitor the effect of management interventions on water stressed river red gum. The processing and analysis of data collected using this method will be detailed separately.

RIVER RED GUM

River red gum (*Eucalyptus camaldulensis*) is a single–stemmed medium sized to tall tree (up to 20 to 50 m) with a robust trunk (Bren and Gibbs 1986; Jessop and Toelken 1986; Roberts 2001). River red gums most commonly occur along riverbanks and watercourses, and on floodplains subject to frequent flooding (Costermans 1989; Roberts 2001).

CONCEPTUAL BASIS OF THE ASSESSMENT METHOD

The tree assessment method is based on a conceptual model of the symptoms of red gum decline due to water stress and recovery as conditions improve, either naturally or as a result of management intervention. This method uses a dynamic conceptual model which provides an assessment of current condition and the direction of travel along a decline/recovery trajectory. A dynamic system has been developed as static assessment methods, such as the modified Lay and Meissner Index (Holland 2002; Tucker 2003) and the Grimes (1987) crown assessment (used to assess river red gum by Jolly et al (1996)) are unable to determine trajectory and are thus less informative for management. A further problem with the modified Lay and Meissner Index is that it does not separately assess the different condition and trajectory variables. For example a tree with a health index of 2 is described as having <25% of the original canopy present; some main branches dead (<50% of remaining canopy) and predominantly epicormic growth (>50% of remaining canopy). Such a system lacks flexibility as trees may exhibit suites of characters not described by a particular score and there is a lack of transparency when such trees are forced into the available categories.

These problems are addressed in the current method by basing assessments within a trajectory based conceptual model and making discrete assessments of each tree condition and trajectory variable.

REFERENCE TREE

Visual assessments of each of the condition and trajectory attributes are assessed against an absolute reference tree. UN/ECE (2006) describes absolute reference trees as “the best possible trees of a genotype or species, regardless of site conditions, tree age, etc.” It should be noted that our absolute reference tree refers to a lower River Murray floodplain river red gum in optimal condition. This tree will have an intact and dense crown (Figure 1). Living examples of a reference tree would typically be found in the flushed zone[1] of the lower River Murray. An absolute reference tree approach has been chosen as the data are amenable to spatial and temporal analyses (UN/ECE 2006).

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[1] The flushed zone is an area of floodplain that has fresh river fed groundwater available within the root–zone and typically occurs above locks and inside meander bends.

Figure 1. **Absolute reference tree for river red gum, depicting maximum crown extent and maximum crown density.**

SELECTION OF TREES

ESTABLISHMENT OF PLOTS/TRANSECTS

Trees should be selected according to statistically sound principles. This is important as the haphazard selection of trees may compromise the analysis and interpretation of the data, leading to difficulties in accurately determining tree condition and the efficacy of floodplain management actions. In some cases it may be possible to select all trees surrounding a wetland or along a transect. If this is not possible a random selection of trees must be made. Trees may be randomly selected using a four point cross cluster (UN/ECE 2006) or 'Zig zag' sampling (Hnatinuk, Thackway and Walker in prep). A suggested minimum of thirty trees, preferably those in early mature age classes (trees that if in good condition would contribute to recruitment and regeneration) should be chosen at each site. Further information on the establishment of assessment sites may be found in the draft report 'The Living Murray methodology for field assessment of tree condition' which is to be incorporated into The Living Murray Icon site condition monitoring plans.

MARKING, MEASURING AND MAPPING OF TREES

Trees should be marked for repeat surveying using either plastic cattle ear tags marked on both side with a permanent marker or aluminium tree tags hammered into the trunk. Plastic cattle ear tags have the advantage of being easy to find but may have a negative visual impact. Thus their use in visually sensitive locations should be considered before use. Aluminium tree tags are visually less obtrusive but consequently harder to relocate. The location of each tagged and assessed tree should be recorded with a Global Positioning System with the waypoint recorded in cell A on the data sheet. Diameter at breast height, 1.3 m above ground (DBH), is to be recorded in cell B for each tree as follows (in: Draft: The Living Murray methodology for field assessment of tree condition and adapted from Forests NSW Operations, G. Miller pers. comm.).

Rules for measuring DBH are:

- Breast height is 1.3 m above the ground measured along the stem. Where the tree is on a slope, 1.3 m is measured on the uphill side of the tree. Where the tree is on a lean, 1.3 m is measured on the underside of the lean.
- For a tree with multiple stems at 1.3 m, the DBH of each stem is to be recorded.
- Where a swelling or limb occurs at 1.3 m, two unaffected points equally spaced above and below 1.3 m are measured and averaged to give an estimate of DBH.
- The measurer should paint the point(s) on the tree where the diameter measurement(s) have been made.
- The measuring tape should be at 90° to the axis of the stem at 1.3 m, if there is lichen or loose bark at 1.3 m it should be gently cleared so as not to remove any firm bark from the tree.

AGE EFFECTS

Age related decline may confound attempts to measure the effects of management. Many of the symptoms of crown deterioration and defoliation may be due to age related decline in over mature trees (Ellis, Mount and Mattay 1980; Smith and Long 2001). Thus when measured against an absolute reference, over mature trees are likely to score poorly as a result of age rather than environmental conditions. Over mature trees may also respond poorly to environmental watering due to their age and thus should not be relied upon to assess management interventions.

Young saplings are also to be avoided as they are likely to self–thin as they age. This self–thinning is a natural process which will occur under favourable environmental conditions. Thus saplings may die independently of management intervention, rendering them inappropriate as indicators of management.

Ideally a sufficient number (>30) of early age class mature trees should be selected for monitoring. River red gums with a diameter at breast height of between 30 – 50 cm are ideal for monitoring the effects of management intervention. However with intervention projects this may not be possible as areas of stressed trees requiring intervention are often not frequently flooded and hence do not have a range of size classes. In these cases the selection of trees available for monitoring may be limited.

Long term dead trees, those which have shed their bark and have lost all of their medium and fine branches (Figure 2) should not be chosen for monitoring.

Figure 2. Long-term dead river red gum.

CONDITION

Condition is measured by estimating crown extent and density. Crown extent and density are entered into data sheet cells C and D respectively.

- Crown extent is the extent to which the crown outline fills the space that would be occupied by the normally foliated crown of a reference tree of similar age and shape. Extent will diminish as foliage is progressively lost from the branch tips, leading to larger gaps appearing as whole branches become completely defoliated.
- Density is assessed as the inverse of the commonly assessed measure of foliage transparency; the amount of skylight visible through the live, normally foliated portion of the crown (UN/ECE 2006) i.e. the lower the transparency the higher the density.

Crown extent and density are assessed separately using a six category scale (Table 1). Both crown extent and density are assessed using a conceptual model of water stress induced decline and recovery. Observers assess each tree in terms of its position along a conceptual trajectory of decline and recovery and how many extent and density categories (Table 1) the tree needs to pass through if the tree were to be fully foliated or entirely bare. The percent classes provided in Table 1 are a guide to the relative widths of each class and are not the primary method used to assign trees to the various classes. Trees are assessed first and foremost using the conceptual model and assessing each trees position along the decline and recovery trajectory. The category scale has finer width classes at the ends of scale and a broad middle category (moderate)[2]. Observers should also assess crown extent before density as density cannot exceed extent under the reference tree model. A range of trees depicting differing extent and density are provided in Appendix B.

Table 1. Crown extent and density categories

Category/score	Crown extent and density
0	None (0%)
1	Minimal (1-10%)
2	Sparse (11-25%)
3	Moderate (26-75%)
4	Major (76-90%)
5	Maximum (91-100%)

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[2] In the draft 'The Living Murray methodology for field assessment of tree condition' the moderate category is divided into three subcategories: sparse – moderate (20-40%), moderate (40-60%) and moderate-major (60-80%). If necessary these categories can be assigned once either crown extent or density have been assessed as being in the overall moderate category. The difference of five percent at either end of the scale in the two methods is likely to be of minimal importance when making an assessment. The data sheet contains columns within which to record both crown extent and density to the nearest 10% (cells E and F respectively) so that conversions between systems may be made.

CONCEPTUAL TRAJECTORY MODEL OF DECLINE AND RECOVERY

The assessment against an absolute reference tree defines the relationship between crown extent and density as density must be less than or equal to, but cannot exceed extent (Figure 3). For each tree estimates of crown extent and density were made after establishing where it was located along the following water stress model. This model provides an understanding of each trees condition and aids in the assessment of extent and density. These issues of recovery and decline are also captured in the trajectory attributes.

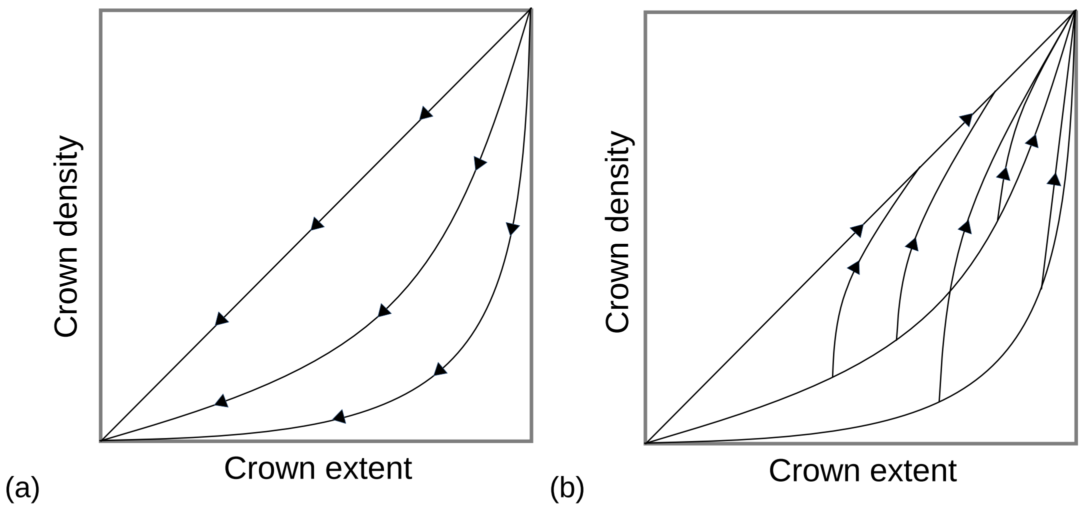

Figure 3. **Conceptual diagram showing the relationship between crown extent and density for red gum (a) decline and (b) recovery.**

Decline

In response to dry conditions river red gum shed leaves to reduce leaf area and hence water demand and heat load (Gibson, Bachelaard and Hubick 1994; Roberts 2001). This behaviour is common to eucalypts (Jacobs 1955; Pryor 1976) and has been observed in stressed river red gum located away from a direct water source. Stress induced defoliation will reduce both crown extent and density. A change in density will most often be noticeable prior to changes in crown extent as older leaves near the bases of branches are shed before younger leaves which are generally located at the periphery of the crown (Figure 4). As defoliation progresses, the crown extent will begin to thin and fragment as leaves at the tips are lost, followed by entire branches losing their leaves. Accompanying this is a continued loss of crown density (Figure 5, Figure 6, Figure 7, Figure 8). At this point crown density may be equal to, or be less than crown extent. If the tree continues to undergo prolonged and severe stress the crown will become entirely defoliated and the tree will eventually die. This conceptual model of tree decline varies from the concept of dieback as it is describes the behaviour of trees dealing with water stress. A central theme of the assessment is that as the tree declines crown density may equal or be less than crown extent, but may not exceed crown extent (Figure 3a).

Recovery

At any point along the conceptual trajectory of decline, short of death, a tree may respond to favourable conditions. However, depending on the position of the tree along this trajectory the nature of the response will differ. A tree in good condition will respond with growth at the edge of the crown increasing both crown extent and density. In this scenario crown extent should increase at an equal or faster rate than density (Figure 3b). A mild to moderately stressed tree will respond to favourable conditions through epicormic growth either from peripheral branches, the larger more central branches or the trunk of the tree. As stress increases, a tree’s ability to respond with growth at the crown edge will decline and crown re–growth and epicormic growth may occur together. Further stress resulting in much reduced crown extent and density will only respond through epicormic growth (Figure 9). As the outer crown is severely reduced or lost the production of epicormic growth results in crown contraction, a shift of growing shoots away from the small peripheral branches towards the larger more central branches and trunk (Stone, Coops and Culvenor 2000). This epicormic growth produces a local increase in density. However when compared against the absolute reference tree a flush of epicormic growth often has little immediate affect on crown extent (due to the phenomenon of crown contraction) and the highly localised density is diluted by the absence of leaves throughout the rest of the potential crown (Figure 9). Thus the localised high density produced by epicormic growth transfers to a relatively low assessment of crown density. In the long term as the epicormic growth develops into a new crown it will increase both crown extent and density (Figure 10). Thus because an absolute reference tree is used to assess crown extent and density, crown density may equal, but not exceed an estimate of crown extent.

Figure 4. River red gum decline – depicting the decrease in density as old leaves at the base of branches are lost whilst the crown extent remains intact. Maximum crown extent and major crown density.

Figure 5. River red gum decline – crown extent has decreased as leaves on the periphery are shed and a small number of minor branches have lost all their leaves. This and the further loss of older leaves decreases overall density. Major crown extent and moderate crown density.

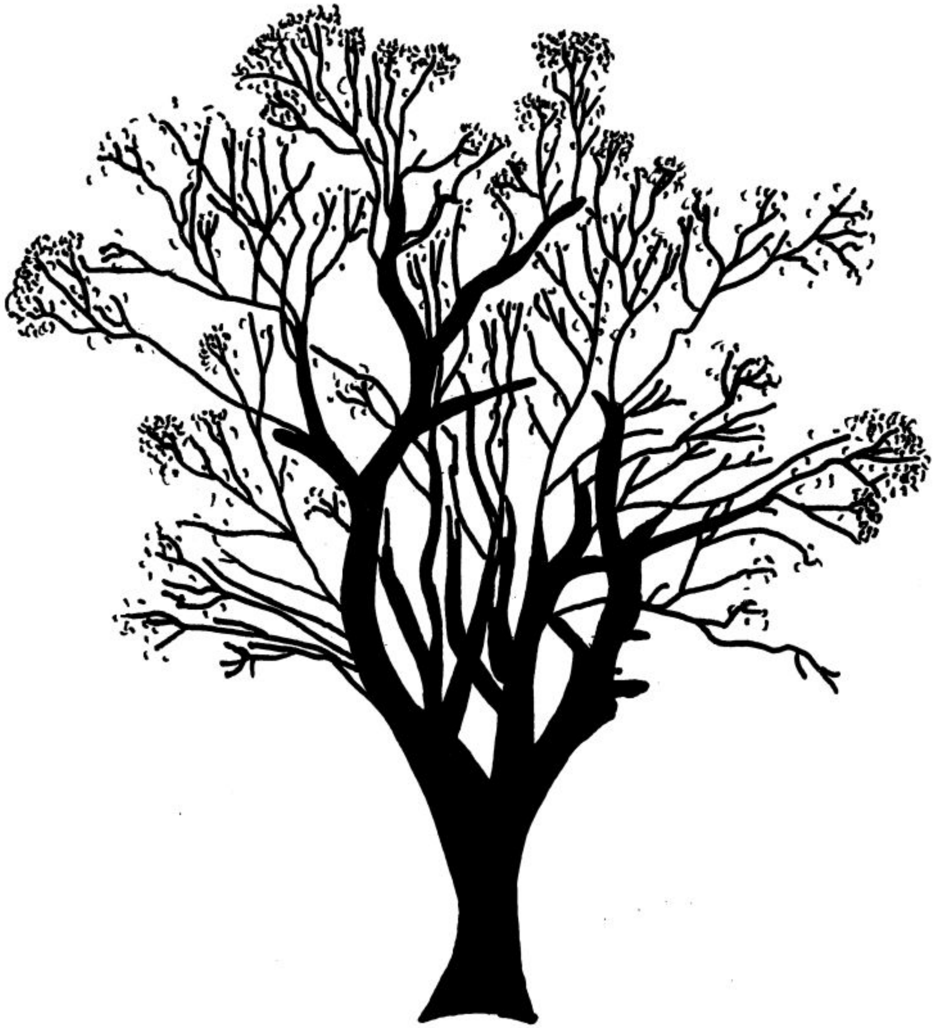

Figure 6. River red gum decline – further thinning in the outer crown is evident reducing extent, this and the further loss of old leaves further reduces density. Moderate crown extent and moderate crown density.

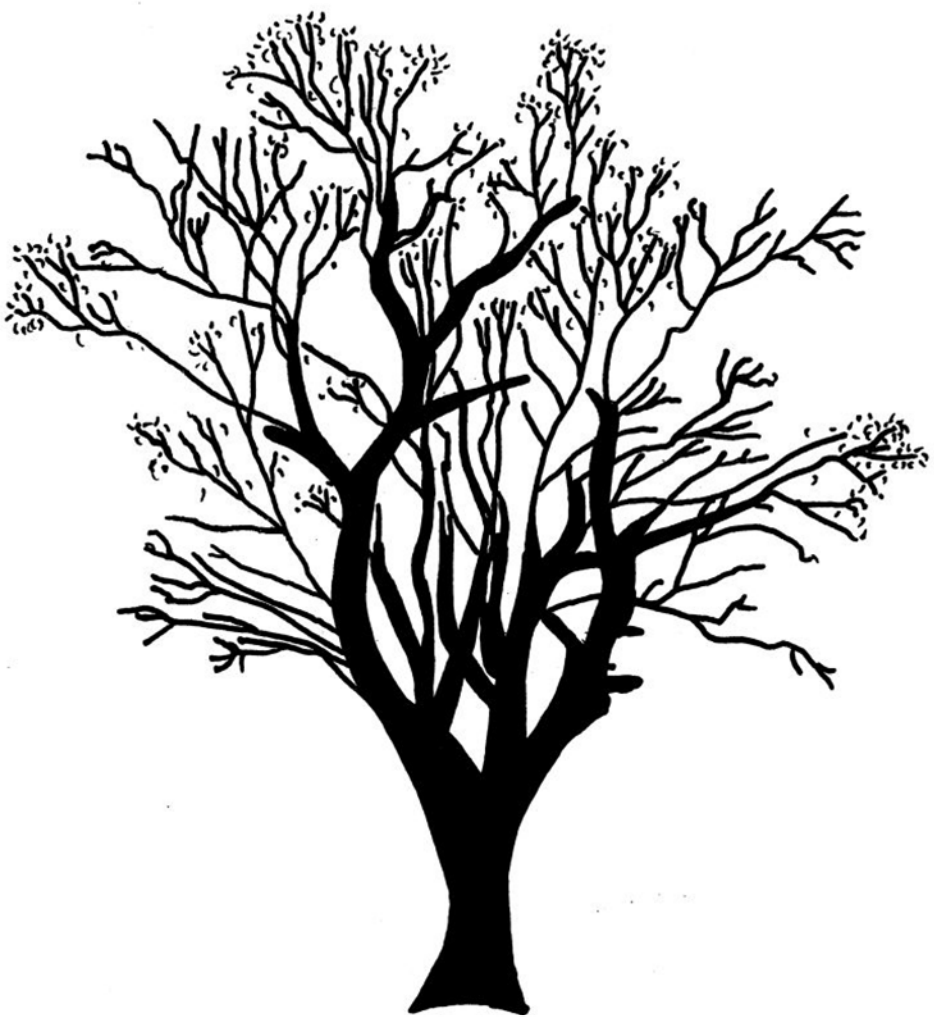

Figure 7. River red gum decline – large numbers of branches are now entirely bare and the remaining sparse leaves are located on the periphery of the crown. The presence of large areas devoid of leaves has caused a great reduction in density. Sparse crown extent and minimal crown density.

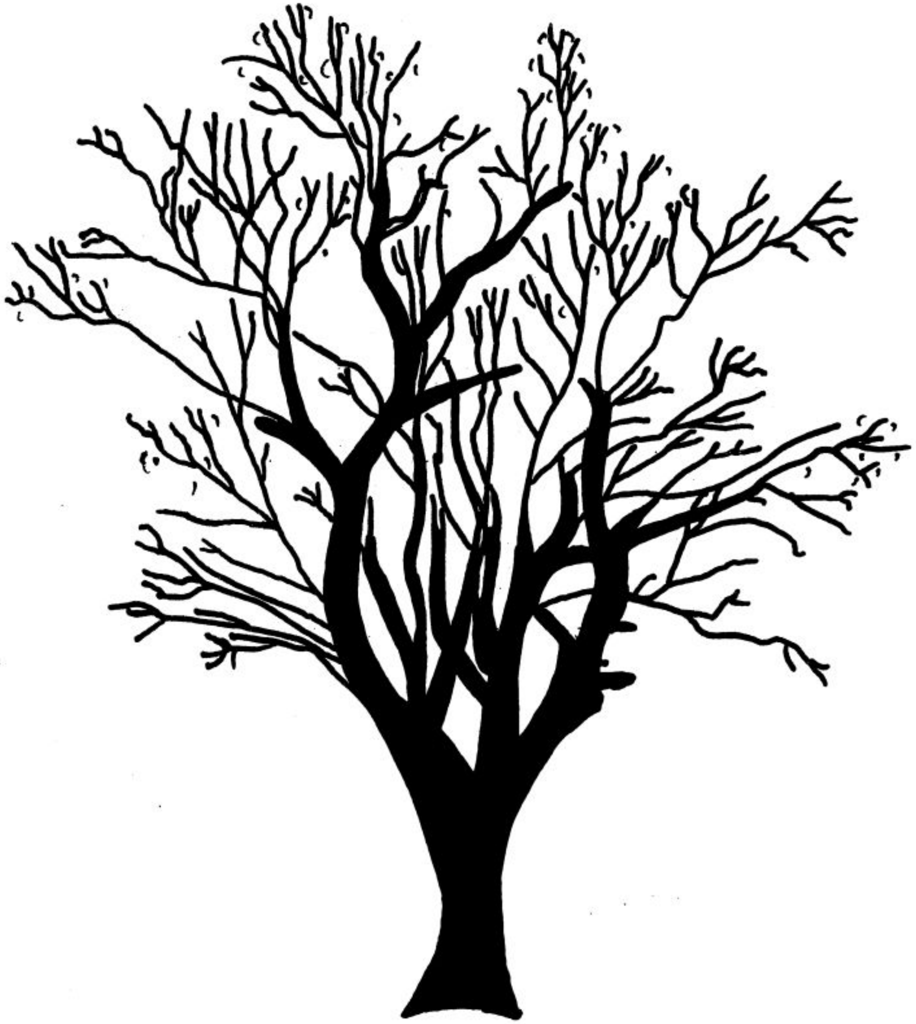

Figure 8. River red gum decline – few leaves remain on the tree. Minimal crown extent and minimal density.

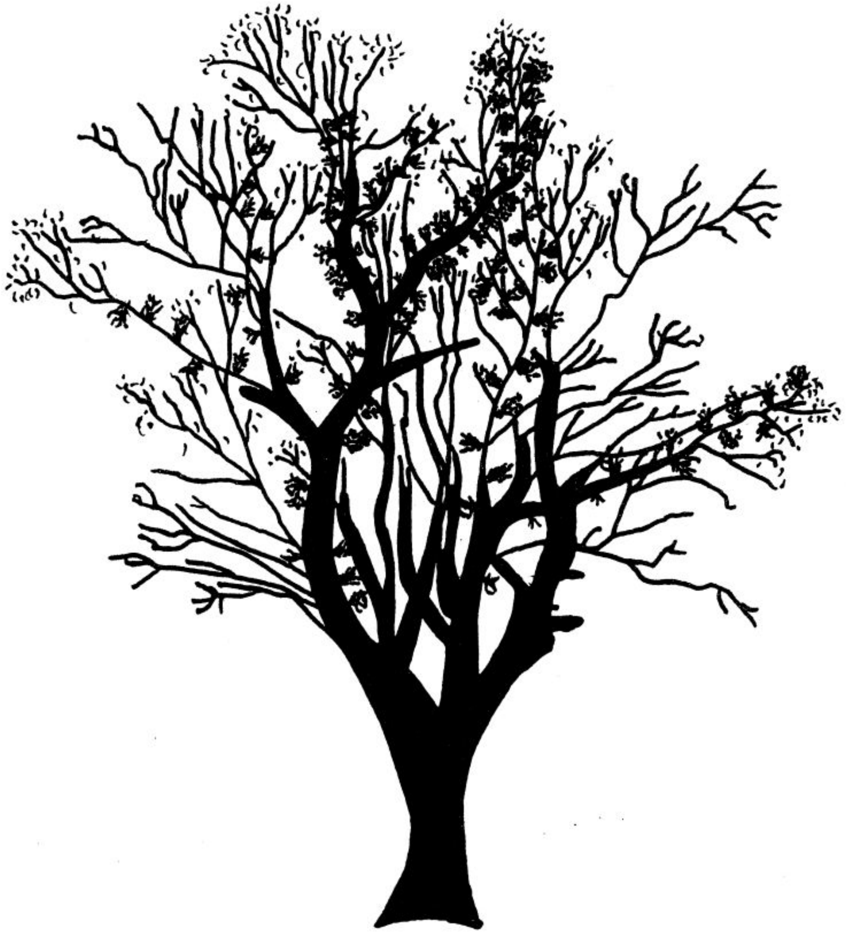

Figure 9. River red gum recovery – depicts a tree in poor condition responding to favourable conditions through epicormic growth. This early response is so far insufficient to increase extent or density. The epicormic growth is classed as common at this early stage rather than abundant. Sparse crown extent and minimal crown density, common epicormic growth.

Figure 10. River red gum response – the epicormic growth is now dense enough to have increased the overall density of the tree. However this is only to a level equal to crown extent. Extent cannot increase until the epicormic growth (and potentially crown tip growth) has begun to re-develop the crown, as has begun to happen in this picture. Sparse crown extent and sparse crown density, abundant epicormic growth.

TRAJECTORY

Seven trajectory attributes are used to assess response and are measured on a four category scale (Table 2). Three of the trajectory attributes are positive: epicormic growth, signs of reproduction (buds, flowers fruit), and crown (tip) growth. The presence of positive attributes suggests the tree will either maintain or improve its current condition. Four of the trajectory attributes are negative: leaf die off, leaf damage (insect), mistletoe, cracked bark. The negative attributes suggest that condition will likely decline if environmental conditions do not improve. Cracked bark is recorded as present if observed, rather than assessed using the trajectory attributes scale (Table 2).

Table 2. Trajectory attributes scale.

Category	Description
0	Absent, effect is not present
1	Scarce, effect is not obvious in a cursory examination but is present
2	Common, effect is clearly visible
3	Abundant, effect dominates the appearance of the tree

POSITIVE TRAJECTORY ATTRIBUTES

Epicormic growth

Epicormic growth is the sprouting of new shoots from the main trunk or primary (and less commonly secondary) branches of the tree (Figure 11, Figure 12). Epicormic growth is produced by a tree under physiological stress. The extent to which a tree has the capacity to produce epicormic growth depends on the prevailing conditions and the trees physiological capacity to respond. The extent of the epicormic growth is assessed first (Table 2) and entered into datasheet cell G. Then the state of the growth is recorded to distinguish between active and inactive epicormic growth (cell H). Active epicormic growth is growing in response to favourable conditions and will have new yellow–green tips. Inactive epicormic growth has stopped growing before it has had the chance to fully develop and merge into the crown. Inactive growth can be observed as small epicormic branches with darker green mature leaves and no new growth at the tips. The state of the epicormic growth is recorded as either active or inactive.

Figure 11. Common active epicormic growth

Figure 12. Abundant active epicormic growth.

Reproduction

As tree condition declines so too does its ability to reproduce. River red gum in poorer health (health measured primarily as crown condition) may produce fewer seeds and the timing of seed fall may be altered (George 2004). River red gum in poor condition suffer reduced flowering, both in relative volume and number of trees flowering (George 2004). Bud development is also impacted by health as poor specimens had stunted bud sizes, a slower rate of bud development, and fewer trees with buds (George 2004).

Measuring reproductive status is confounded by seasonality and the cyclical nature of bud crop development. For river red gum in the Lower River Murray buds formed in the Austral summer (January – February) and began flowering in the following spring – early summer (September – December) (George 2004; Jensen, Walker and Paton submitted for publication). Mature fruit may be retained for up to 24 months before being shed (Jensen, Walker and Paton 2008). Jensen, Walker and Paton (submitted for publication) reported that the majority of red gum display a biennial cycle of flowering. Thus the lack of, or reduced flowering in a tree may be a result of a biennial cycle rather than as a result of stress, potentially confounding the results.

Due to the confounding nature of seasonality and the cyclical nature of the bud crop the reproductive behaviour is recorded as the combined relative abundance of buds, flowers and or fruit (Figure 13; Figure 14). Record reproductive behaviour using the scale provided in Table 2 entered in cell I on the datasheet.

Figure 13. River red gum buds (bottom) and fruit (top).

Figure 14. Old river red gum flowers.

Crown (tip) growth

Crown (tip) growth is growth of new shoots from the peripheral tips of the tree branches at the edge of the crown; (Figure 15, Figure 16). New shoots are yellow–green in colour and grow from the tips of mature shoots at the edge of the crown (Figure 17). New growth (either crown (tip) or epicormic) can be confused with the growth of buds especially high in the crown. However new shoots tend to be yellow–green in colour whilst buds have a red tinge (Figure 18). Record crown (tip) growth using the scale provided in Table 2 entered in cell J on the datasheet.

Figure 15. Common crown (tip) growth is evident in the lighter coloured leaves on the edge of the crown.

Figure 16. Abundant crown (tip) growth.

Figure 17. Close up of crown (tip) growth showing the yellow–green colour.

Figure 18. Yellow–green new shoots and red tinged new buds. This responsive tree is in the process of converting epicormic growth into a new crown.

NEGATIVE TRAJECTORY INDICATORS

Leaf die off

Leaf die off (Figure 19) records the relative abundance of dead leaves on the tree, whether it be a section of the crown or the full crown (Figure 20). Record leaf die off using the scale provided in Table 2 entered in cell K on the datasheet.

Figure 19. Leaf die off in a juvenile river red gum. Note that the leaves have dried off and do not appear to have suffered insect damage.

Figure 20. Abundant leaf die off, note that the dead leaves are largely located towards the edge of the crown. There are a large number of dead leaves at the bottom left of the crown.

Leaf damage (Insect)

Insect herbivory is a cause of dieback in eucalypts (Lowman and Heatwole 1992) and numerous insects will feed on red gum leaves. Stone and Bacon (1994) identified forty–nine phytophagous insects from river red gum canopies at Gulpa Island State Forest. It is rare not to observe a tree without some leaf damage. The most commonly observed form of leaf damage is irregular shaped leaves with jagged edges (Figure 21). As leaf damage is commonly observed in healthy trees, such damage is unlikely to be causing the tree undue stress. Thus for a tree to be assessed as having common leaf damage the effect must be clearly visible and obvious at a distance (Figure 22). For abundant damage the tree should be suffering overwhelming insect attack possibly caused by outbreaks of *Uraba lugens* (gumleaf skeletoniser) (Dalton 1990) and *Doratifera* spp. (cup moths) (CSIRO 2004). Record leaf damage (insect) using the scale provided in Table 2 entered in cell L on the datasheet.

Figure 21. Irregular shaped river red gum leaves with jagged edges.

Figure 22. **Common leaf damage.**

Mistletoe

Across Australia *E. camaldulensis* are host to thirteen species of mistletoe (Downey 1998). Infestations are often localised and trees already stressed by drought or insect attack may be more susceptible (CSIRO 2004). Severe mistletoe infestation can cause tree death (Dalton 1990). A tree with 1–2 live mistletoe would be classified as scarce; 3–6, common (Figure 22) and greater than 6 abundant (Figure 23). This data is entered in datasheet cell M.

Figure 23. Common mistletoe infestation, mistletoe outlined in black.

Figure 24. Abundant mistletoe infestation, mistletoe outlined in black.

Bark form

Very stressed red gums have cracked bark - vertical cracks in the bark of the trunk and major support branches which exposes the heartwood (Figure 25). River red gum bark cracks under severe water stress and occurs when trees have either very few or no leaves. Red gum trees with cracked bark are recorded as observed. Bark form is entered into datasheet cell N.

Figure 25. Cracked bark on the trunk of a river red gum.

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APPENDICES

A. FIELD DATA SHEET

Department of Water, Land and Biodiversity Conservation - Tree Assessment Field Data Sheet

Site:
Date:
Observer:
Transect/Plot #

Condition

Crown extent and density	Category/score
None (0%)	**0**
Minimal (1-10%)	**1**
Sparse (11-25%)	**2**
Moderate (26-75%)	**3**
Major (76-90%)	**4**
Maximum (91-100%)	**5**

Trajectory

Epicormic growth, reproduction (buds, flowers, fruit), crown growth, leaf die off, leaf damage, Mistletoe	Category
Absent, effect is not present	**0**
Scarce, effect is not obvious in a cursory examination but is present	**1**
Common, effect is clearly visible	**2**
Abundant, effect dominates the appearance of the tree	**3**

Bark form: cracked, intact

Epicormic state: active, inactive

Tree#	Species	Crown extent score	Crown extent %[3]	Crown density score[3]	Crown density %	Epicormic growth	Epicormic state	Reprod'n	Crown (tip) growth	Leaf die off	Leaf damage	Mistletoe	Bark form	DBH	Wayp't	Comments
		C	E	D	F	G	H	I	J	K	L	M	N	B	A	

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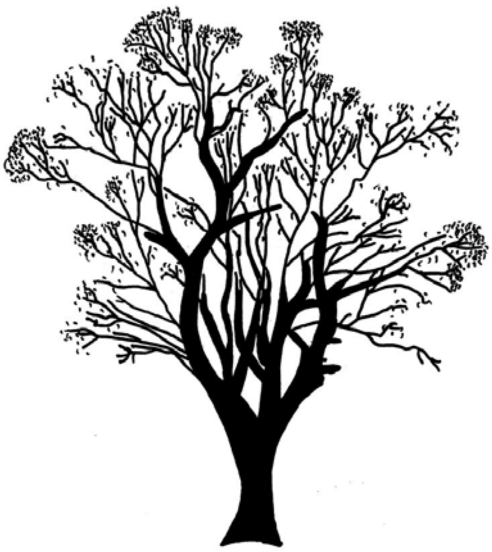
[3] For TLM Icon site monitoring Moderate is subdivided into three categories: sparse-moderate (20-40%), moderate (40-60%) and moderate-major (60-80%). If conversion to this system is required, record the crown extent and density to the nearest 10%.

Maximum extent and density

Maximum extent; major density



Moderate extent; moderate density

Sparse extent; minimal density

Minimal extent; minimal density

Sparse extent; sparse density

B. EXAMPLE RIVER RED GUM PHOTOGRAPHS

The extent and density of each tree is presented along with additional information such as the level of leaf die off and epicormic growth.

Maximum extent

5: Maximum extent (91-100%)
5: Maximum density (91-100%)

5: Maximum extent (91-100%)

5: Maximum density (91-100%)

5: Maximum extent (91-100%)

4: Major density (76-90%)

5: Maximum extent (91-100%)
3: Moderate density (76-90%)

5: Maximum extent (91-100%)
4: Major density (76-90%)

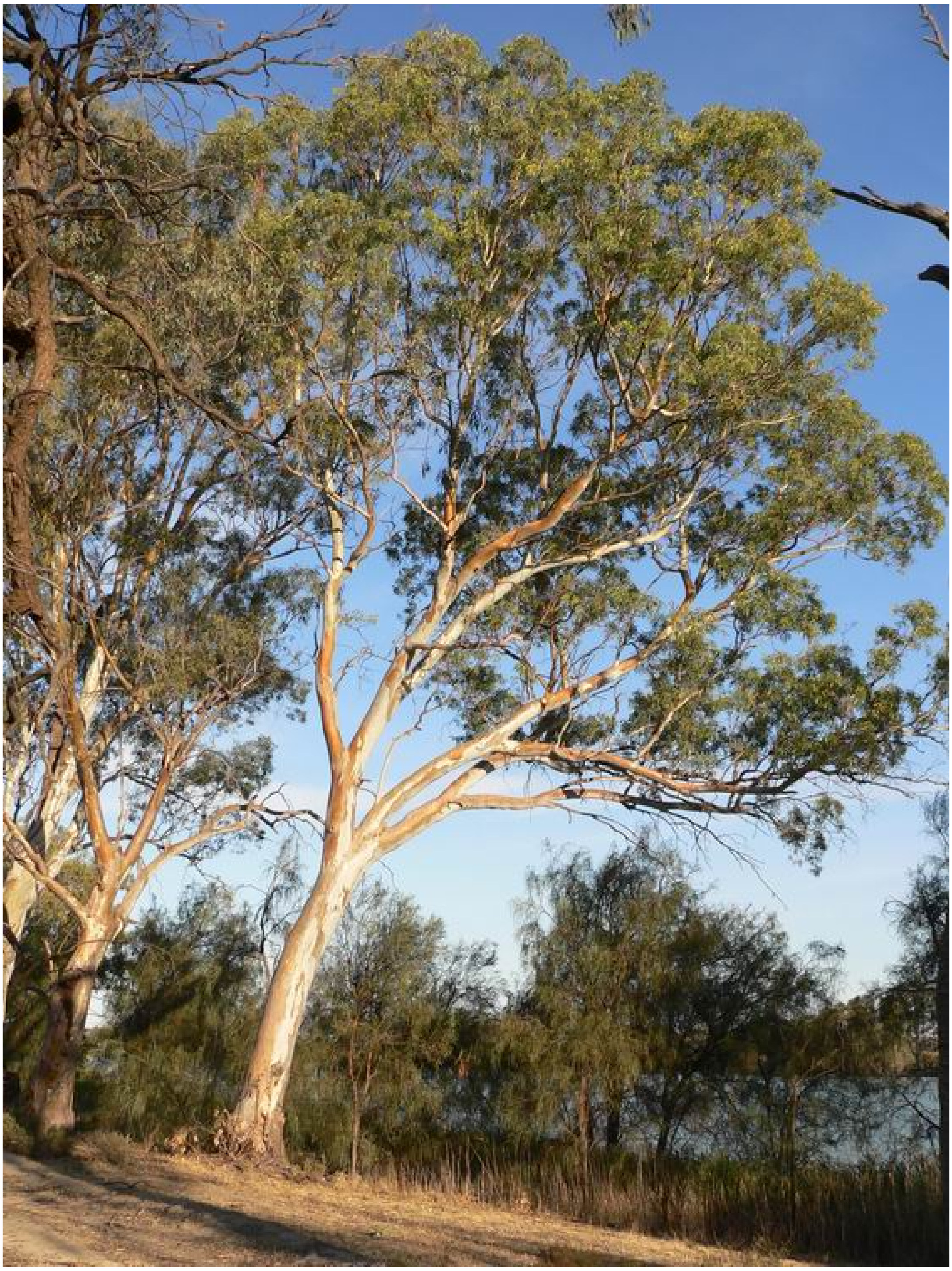
5: Maximum extent (91-100%)
4: Major density (76-90%)

Major extent

4: Major extent (76-90%)

4: Major density (76-90%)

Note the large dead branches and thinner crown outline on the branches to the lower right, which classifies the crown extent as major.



4: Major extent (76-90%)

4: Moderate density (26-75%)

4: Major extent (76-90%)

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4: Moderate density (26-75%)

4: Major extent (76-90%)

4: Moderate density (26-75%)

Note that despite the loss of large branches the tree has recovered to such an extent that a new relatively intact crown has developed.

4: Major extent (76-90%)

4: Moderate density (26-75%)

Moderate extent

3: Moderate extent (26-75%) 3: Moderate density (26-75%)

3: Moderate extent (26-75%)

3: Moderate density (26-75%)

3: Moderate extent (26-75%)

3: Moderate density (26-75%)

2: Common mistletoe

3: Moderate extent (26-75%)

3: Moderate density (26-75%)

3: Moderate extent (26-75%) 2: Sparse density (11-25%). This is a borderline example between sparse and moderate density.

3: Moderate extent (26-75%) 2: Sparse density (11-25%)

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

Note that dead leaves are considered when estimating extent and density.

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

2: Mistletoe common

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

3: Moderate extent (26-75%)

3: Moderate density (26-75%)

3: Abundant crown growth

Although quite dense there are dead twigs on the crown outer edge, limiting the intactness of the extent to moderate

3: Moderate extent (26-75%)

3: Moderate density (26-75%)

3: Moderate extent (26-75%) 3: Moderate density (26-75%) 2: Common epicormic growth 2: Common mistletoe

3: Moderate extent (26-75%)

3: Moderate density (26-75%)

3: Abundant epicormic growth

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

3: Abundant epicormic growth

This is a borderline example between sparse and moderate density

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

2: Common epicormic growth

3: Abundant Mistletoe

3: Moderate extent (25-75%)

2: Sparse density (11-25%)

2: Common epicormic growth

3: Moderate extent (26-75%)

2: Sparse density (11-25%)

2: Common epicormic growth

Sparse extent

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

3: Abundant leaf die off

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

3: Abundant epicormic growth

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

3: Abundant epicormic growth

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

2: Common epicormic growth

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

2: Common epicormic growth

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

2: Common epicormic growth

2: Sparse extent (11-25%)

2: Sparse density (11-25%)

2: Common epicormic growth

Minimal extent

1: Minimal extent (<10%)

1: Minimal density (<10%)

1: Minimal extent (<10%)

1: Minimal density (<10%)

2: Common epicormic growth

1: Minimal extent (<10%)

1: Minimal density (<10%)

2: Common epicormic growth

1: Minimal extent (<10%)

1: Minimal density (<10%)

2: Common epicormic growth

1: Minimal extent (<10%)

1: Minimal density (<10%)

2: Common epicormic growth

1: Minimal extent (<10%)

1: Minimal density (<10%)

3: Abundant leaf die off

No extent

0: No extent (0%)

0: No density (0%)