A Habitat Management Plan for the South-eastern Red-tailed Black-Cockatoo[1]

Richard Hill and Tim Burnard

Birds Australia

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(The Red-tailed Black-Cockatoo Habitat Management Plan comprises this report and a series of maps of potential and existing feeding and nesting habitat. Copies of these maps can be obtained by contacting the Recovery Team on 1800 262062).

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Summary

The South-eastern Red-tailed Black-Cockatoo is an endangered cockatoo with a population size of 650-1000 individuals restricted to south-west Victoria and the lower south-east of South Australia. The factors limiting total population size are considered to be extent and quality of their stringybark feeding habitat, and highly-variable nesting success arising from possum predation of nests, food availability close to nesting sites, and in the long-term, a possible shortage of nest sites due to the ongoing loss of dead and live hollow-bearing trees. For recovery of the population, the Red-tailed Black-Cockatoo Recovery Team has set a goal of 1000 adults in the population, which means an increase in the existing population of 30-100%. This management plan identifies existing and potential habitats of the Red-tailed Black-Cockatoo, which will be the focus of the efforts to recover the population. We aim to achieve recovery by increasing food availability of existing feeding habitat on public and private land, establishment of additional feeding habitat through planting of food species in potential feeding habitat areas, and protection of dead and live potential nest trees in potential nesting habitat areas. This plan has an interim aim to put into place mechanisms to increase food supply by 25% over 5 years. The plan also aims to establish controls across the breeding range to protect dead potential nest trees. Important studies into Red-tailed Black-Cockatoo use of stringybark and Buloke Woodlands are in progress, and are likely to significantly improve and refine the identification and management of Red-tailed Black-Cockatoo habitats. Thus this plan will be revised when results from these studies become available.

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1 Introduction

The South-eastern Red-tailed Black-Cockatoo is an endangered subspecies of the Red-tailed Black-Cockatoo restricted to south-west Victoria and south-east South Australia (Figure 1). The Red-tailed Black-Cockatoo Recovery Team has investigated the causes of its rarity since late 1997. Although nesting success is quite variable and can be very low as a result of nest predation (Jarmyn 2000), recruitment into the population as measured through the age-structure of flocks appears similar to other subspecies of Red-tailed Black-Cockatoo (Hill 2000). Whereas previous research suggested that perhaps only 10% of the population bred possibly due to a shortage of nest sites (Joseph *et al.* 1991), we now consider that the availability of both stringybark *E. arenacea/ E. baxteri* and Buloke *Allocasuarina luehmannii* feeding habitat are likely to be the main determinants of the total population size of South-eastern Red-tailed Black-Cockatoos.

The total population size of the South-eastern Red-tailed Black-Cockatoo is estimated to be between 650 – 1000 individuals. Hill (2000) calculated that 23% of the population were sub-adults and juveniles, and thus the estimated total adult population was between 500 – 770. Garnett and Crowley (1996) set a goal of 1000 adults for recovery to lead to the downlisting of this subspecies from Endangered to Conservation Dependent. Given that food availability is considered to be the main determinant of population size, population recovery to 1000 individuals requires that total food availability be increased by between 100-30%.

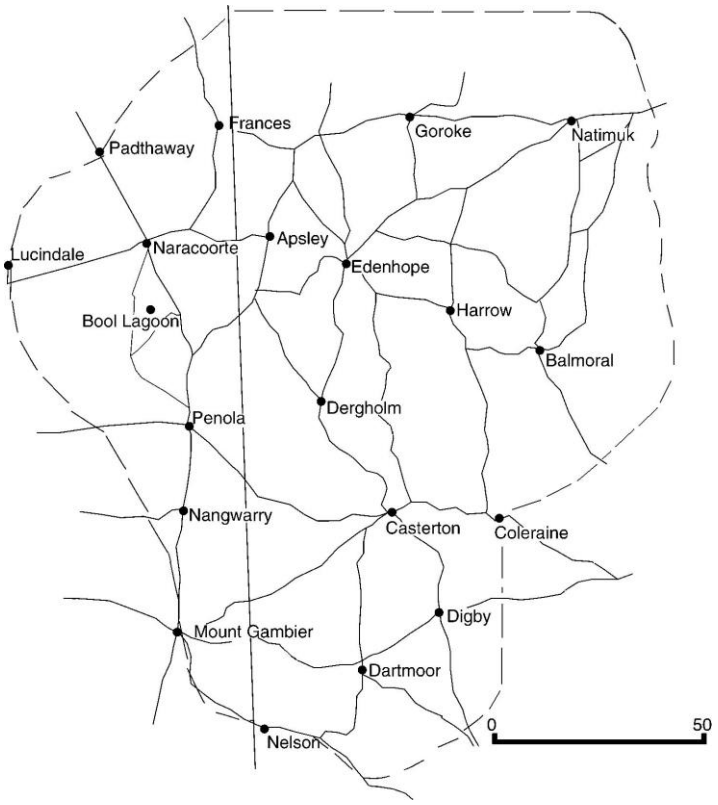


Figure 1: The approximate boundary of the South-eastern Red-tailed Black-Cockatoo distribution.

Food availability is thought to be a key determinant of population size (Hill 2000) and current and past fire management practices are believed to have significantly reduced food availability in stringybark woodlands (Koch unpublished data). This is because most

fire, whether wildfire or deliberate fire for fuel-reduction purposes, scorches or removes some or all of the stringybark canopy, producing a sustained reduction in fruit production for 5-10 years after the fire (Koch unpublished data). Natural Resources and Environment Victoria suspected that fire might suppress stringybark food production and introduced a moratorium on block burning 12 years ago in the Red-tailed Black-Cockatoo range within the Horsham Forest Management Area, burning perimeter strips instead. This moratorium has almost certainly increased stringybark food availability in that time (Koch unpublished data). Block burning of stringybark woodland still continues in the Portland FMA at a 15-20 year interval. Burning of privately-owned stringybark woodland in Victoria is commonplace and may occur at a much higher frequency than on public land (Hill, personal observation). In South Australia burning of native vegetation requires a permit from the Native Vegetation Council. Reserves managed by Department for Environment and Heritage tend not to be burnt for management reasons (P. Copley pers.comm.) but land managed by Forestry South Australia is burnt on a 7-12 year rotation. Most native vegetation in the lower south-east of South Australia occurs on private land, where fire regimes are unknown.

Based on estimates of current fire frequencies, substantial areas of stringybark woodland in the south-east of South Australia and south-west Victoria, particularly south of the Horsham Forest Management Area in Victoria and in South Australia, have suppressed seed production, however, more detailed analysis is required before estimates of actual areas affected can be made. Nevertheless substantial gains in food availability appear to be achievable through reducing fire frequency/canopy scorch in stringybark woodlands (P. Koch pers.comm.).

Food availability may also be increased by protecting degraded stringybark and Buloke woodlands from grazing, leading to an improvement in tree health, which should, in turn, lead to increased fruit production by existing trees. Semi-permanent or permanent removal of grazing should lead to regeneration of these sites, increased tree cover and consequently fruit production. Red-tailed Black-Cockatoos are known to feed in 10 year-old coppiced stringybark and have also been regularly observed feeding on stringybark saplings. Increased food availability will also be achieved by replanting of stringybarks and Buloke. This management plan will identify priority areas on public and private land for the protection, rehabilitation, and re-establishment of stringybark and Buloke woodland

Recovery Plans written under the new EPBC Act are now required to identify, where possible, critical habitat for the purpose of implementing the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). The regulations to the act define critical habitat as follows:

Identification of critical habitat

> (1) For subsection 207A (1) of the Act, the Minister may, in identifying habitat, take into account the following matters:
>
> (a) whether the habitat is used during periods of stress;
>
> (b) whether the habitat is used to meet essential life cycle requirements;
>
> (c) the extent to which the habitat is used by important populations;
>
> (d) whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development;
>
> (e) whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements;
>
> (f) whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation;

(g) any other way in which habitat may be critical to the survival of a listed threatened species or a listed threatened ecological community.

(2) The Minister must, when making or adopting a recovery plan, consider whether to list habitat that is identified in the recovery plan as being critical to the survival of the species or ecological community for which the recovery plan is made or adopted.

(3) Before listing habitat in the register, the Minister must:

(a) consider any advice from the Scientific Committee about whether the habitat is critical to the survival of a listed threatened species or listed threatened community; and

(b) if the habitat is not in a Commonwealth area, be satisfied that reasonable steps have been taken to consult with the owner of the property where the habitat is located.

A new recovery plan for the South-eastern Red-tailed Black-Cockatoo is being prepared. The following descriptions of Red-tailed Black-Cockatoo habitat requirements will form the basis of the definition of critical habitat in the new plan, along with maps produced by habitat modelling.

Critical Habitat

Red-tailed Black-Cockatoos are highly mobile within their known distribution and move around this range probably largely in response to changes in availability of stringbark seed (P. Koch pers.comm.). Stringybark seed production and availability in a particular area is influenced by several factors including tree species (*E. baxteri* or *E. arenacea*), age of fruit, and time since fire. At least some Red-tailed Black-Cockatoos breed throughout the known range, breeding in an area while food is available, possibly for several years, and then moving in response to food shortage to another area and breeding there. Few known breeding areas have an annual history of breeding. Important feeding sites may only be used very infrequently. For example, Red-tailed Black-Cockatoos are only occasionally recorded from Rennick State Forest, but in summer of 1986 a flock of approximately 360 birds was recorded in the area (P. Scott pers.comm.). Thus vital elements of this cockatoo's habitat requirements may not be used annually. This management plan will identify all suitable Red-tailed Black-Cockatoo habitat.

All suitable habitat within the existing range of the cockatoo, regardless of evidence of use by Red-tailed Black-Cockatoos, is Critical Habitat.

This management plan will identify priority areas for the re-establishment of feeding habitat, which will be considered essential for the recovery of the population.

These potential feeding habitat areas will also be identified as Critical Habitat for the Red-tailed Black-Cockatoo.

2 Feeding Habitat

South-eastern Red-tailed Black-Cockatoos feed largely on the seeds of two species of stringybark (*E. baxteri* and *E. arenacea)*. The distribution of these two species within the cockatoo's range is not clear, but preliminary results suggest that *E. baxteri* is most common south of Dergholm-Penola and that *E. arenacea* is the common species north of that line (P. Koch pers. comm.)(Figure 1). Patterns of flowering and fruit production of the two species differ and are the subject of studies by the University of Adelaide. Floristic plant community mapping in South Australia, carried out from 1987 aerial photography for the Lower South-East Biodiversity study (Croft *et al.* 1999), identifies four floristic plant communities dominated by tree species *E. baxteri* and/or *E. arenacea* (communities 11, 12, 80, 97). Ecological Vegetation Class mapping for south-west

Victoria, carried out in 1999 for the Regional Forest Agreement, identifies EVC's which are dominated by a range of eucalypts which may include *E. baxteri* or *E. arenacea*. Most records of Red-tailed Black-Cockatoos are in two of these EVC's; they are Heathy Woodland and Herb-rich Heathy Woodland. Other EVC's which may contain these two species of stringybark and be potential feeding habitat are listed in Appendix 2.

Red-tailed Black-Cockatoos also feed on the seeds of Buloke, a much depleted plant species, which occurs in the north of the cockatoo's range. In South Australia Buloke-dominated 'Low Woodland' was mapped in the lower south-east (Croft *et al.* 1999) and in Victoria EVC's identified with Buloke were Plains Woodland, Plains Sedgy Woodland, Wimmera Plains Grassland, and Wimmera Plains Grassy Wetland (Anon 1999). Buloke may provide an important food resource during its December to March fruiting season

Red-tailed Black-Cockatoos have favoured patches to which they return, and, at least in the short term, they tend not to use other nearby areas (RH unpublished data). On the other hand, most stringybark trees within the range of the Red-tailed Black-Cockatoo show signs of pruning by Red-tailed Black-Cockatoos (P. Koch pers. comm.). If this latter observation is substantiated, it provides important evidence to support the view that availability of feeding habitat is limiting total population size. Identification of priority remnants and of areas suitable for rehabilitation for both Buloke and stringybark is warranted.

The main stringybark plant communities dominated by either *E. baxteri* or *E. arenacea* have not been cleared as extensively as other plant communities used by Red-tailed Black-Cockatoos (Table 1), although perhaps significantly, the more fertile *E. baxteri* communities have been extensively cleared for pine plantations (Glenelg Plain Damp Sands Herb-rich Woodland; Yugovic *et al.* 1999).

Table 1: The main floristic groupings used by Red-tailed Black-Cockatoos in Victoria and South Australia and their original and current extent and conservation status where available. Data from Croft *et al*. 1999 and Anon 2000.

Vegetation Community	Pre-European areal extent (ha)	Current area (ha)	% remaining	Status	% on private land	% pre-1750 in conservation reserve
Victoria						
Heathy Woodland	220,661	179,030	81%	-	11%	56%
Herb-rich Heathy Woodland	41,458	21,788	53%	-	32%	12.4%
Damp Sands Herb-rich Woodland	180,072	43,042	24%	V	11.9	10.5%
Plains Grassy Woodland	1,210,000	36,104	4%	E	30%	1%
Plains Woodland	439,583	4,349	1%	E	54%	0.03%
South Australia						
E. camuldulensis woodland	171,844	16,742	9.7%	V	95%	0.4%
E. arenacea/baxteri open forest	176,300	46,490	26%	-	70%	7%
E. arenacea +/- E. *fasciculos*a low woodland	167,580	36,100	22%	-	75%	14%
Allocasuarina luehmannii	18,389	530	2.9%	E	93%	0.0%

Woodlands dominated by Buloke have been almost completely cleared within the range of the Red-tailed Black-Cockatoo (Table 1). This is because the high fertility soils on which they grow are very suitable for agriculture. Most remaining Buloke occurs as remnants on farmland with small areas along roadsides. Significant regeneration of Buloke on roadsides has occurred in some areas since their use as travelling stock routes declined in the 1960's, and grazing of the roadside vegetation decreased.

South-eastern Red-tailed Black-Cockatoos feed in scattered paddock trees as well as in blocks of woodland. In the Naracoorte area, for example, where most Red-tailed Black-Cockatoo habitat occurs as either privately-owned blocks or degraded woodlands in grazed paddocks, cockatoos use paddock trees extensively (62% of records). There the areas chosen by cockatoos tended to be 'degraded woodlands' where the distance between trees was generally considerably less than 50 m, but cockatoos were recorded using stringybark trees which were 60 m from the nearest other tree. Red-tailed Black-Cockatoos use Buloke feed trees in similar ways. Cockatoos have been observed feeding in paddock Buloke trees isolated by as much as 65 m from the nearest neighbouring tree.

The degree to which cockatoos can use scattered paddock trees is still being investigated and presumably suitable feed trees can be too isolated to be found by Red-tailed Black-Cockatoo. Cockatoos will willingly cross large treeless paddocks and a single tree can provide several hours of foraging for a flock of cockatoos. It is likely that cockatoos can use paddock trees which are even more isolated than our data indicate.

3 Nesting Habitat

Red-tailed Black-Cockatoos require large hollows in eucalypts in which to make their nest. Workers in the early 1990's suggested that there was a shortage of nest hollows due to a decline in number of old hollow eucalypts and the difficulty in finding nests.

Twenty-five supplementary (natural hollows) and 25 artificial nest boxes (PVC pipe) were erected at this time (Emison 1996). Red-tailed Black-Cockatoos have nested successfully in supplementary hollows on several occasions, but only in areas where nesting in natural hollows had previously been recorded. To the best of our knowledge artificial nest boxes have not been used by Red-tailed Black-Cockatoos.

Improved nest finding and monitoring techniques has markedly increased the number of nests found each year. Recruitment as measured by the age structure of flocks does not suggest that a shortage of hollows is preventing a significant proportion of the adult population from nesting. Thus a broad-scale program to provide additional nest sites is currently not warranted. Supplementary nest boxes, where a hollow from a fallen tree is placed in a dead tree or on a power pole, are used by Red-tailed Black-Cockatoos. Four nesting attempts in poles with supplementary hollows were reported in 1999-2000 of which at least two were successful (O. Pahl pers. comm.). On the other hand, these nest sites are expensive to erect and require ongoing maintenance. For example, a forestry company will pay $20,000 to erect 15-18 poles with supplementary hollows on a property where existing nest trees were removed without permission. Supplementary hollows can provide nest sites where known nest sites have been lost, but clearly it is preferable to maintain existing nest sites.

Nest sites were located by DNRE researchers between 1989 and 1994, and Birds Australia researchers from 1997 to 1999. Nests were found by questioning landowners, advertising for information, following birds from watering or feeding areas in the late afternoon, or searching in areas where pairs or single birds were known to be active in spring and summer. Details of 115 nests were collected in that way, 51 by DNRE, and 64 by Birds Australia researchers.

Several measurements of each tree were taken as well as details of its location, the number of trees in a one hectare area around the tree, and the distance to the nearest block of stringybark woodland and fresh water. Nests were found in Red Gum *Eucalyptus camuldulensis*, Yellow/Blue Gum *E. leucoxylon,* stringybark *E. baxteri (*and possibly also *E. arenacea),* and Rough-barked Manna Gum *E. viminalis cygnatensis,* but were much more likely to be found in *E. camuldulensis*. Nest trees ranged in height from 8-32 m (mean = 17.5 ± 5.0; n = 69) and diameter at breast height ranged from 48 – 198 cm (115.5 ± 30.0; n = 74). Nests were much more likely to be found in dead trees (81% of trees, n= 97). Nests were 11.4 ± 3.0 m (n=80) above the ground and were more likely to be found in 'spouts' rather than hollows in trunks. Where hollow entrances were not vertical, hollow entrances tended to face north or south, rather than east or west. Nest trees tended to be in farmland rather than woodland and tree density in farmland in a one hectare quadrat around and including the nest tree was 3.1 ± 1.7 trees (n=32). Nest trees were 0.40 ± 0.24 km (n=39) from the nearest potential drinking site (dam/trough/lake).

Red-tailed Black-Cockatoo's nests were most often found in farmland with scattered, large, live and dead Red Gums, a remnant of one of several Ecological Vegetation Classes described in Victoria or two floristic plant communities in South Australia. In both states these plant communities have been extensively cleared. In South Australia pre-European Settlement vegetation mapping data indicate that the remaining Red Gum communities in the lower-south east are Vulnerable with 9.7% of the estimated original area extant. Only 0.3% of this is in the government reserve system (Croft *et al.* 1999). In Victoria the main Red Gum community mapped in the south-west, Plains Grassy Woodland, is Endangered with an estimated 4% remaining, of which 1.5% is in the government reserve system (Anon 1999).

Small numbers of nests have been found in extant woodlands of stringybark and gum. However, Hill (2000) has suggested that considerably more nesting may take place in

woodlands than is indicated by the nesting data. This is because such nests are much harder to locate than nests in farmland. Nests have been found in *E. arenacea/baxteri* trees in Heathy Woodland, and in Red Gum trees in Plains Grassy Woodland.

Red-tailed Black-Cockatoo nests are often clumped and 2 or more pairs may nest within a 50 ha area. Red-tailed Black-Cockatoos tolerate conspecifics close to active nests (minimum recorded distance between active nests is 40 m), but have not been recorded sharing nest trees like their relative, the Glossy Black-Cockatoo *Calyptorhynchus lathami halmaturinus*. Red-tailed Black-Cockatoos will share nest trees with Yellow-tailed Black-Cockatoos *Calyptorhynchus funereus xanthotus*.

Nest reuse rate is low compared with other cockatoos. Only 4 out of 12 nests were used in successive years (Hill 2000). Red-tailed Black-Cockatoos may not nest in the same area every year. In 1998/99 and 1999/2000 150-350 Red-tailed Black-Cockatoos were in the Casterton area, and 16 nests were found in the first year in the Casterton area and 13 in the second. Some nesting areas and nest trees were used in both years. In the 2000/2001 breeding season, only 30 birds remained within this area and only one nest was recorded in the 13 nest trees found in the previous season (B.Jarmyn pers.comm.; RH unpubl. data).

Rate of loss of natural hollows in dead trees

Most known nests of Red-tailed Black-Cockatoos are in dead trees, many of which were ringbarked early last century. Many dead trees are felled for firewood or when management of farmed areas changes from grazing to a more intensive use. Environmental Significance Overlays in the known breeding distribution in West Wimmera Shire and some parts of the Glenelg Shire require permits for the removal of potential dead nest trees, but natural decay and weathering is also responsible for tree fall. No data on the extent of this treefall across the cockatoo's range has been collated. In two known breeding areas near Edenhope 25 nests were located between 1989 and 1994. In 2000 only 15 (60%) of these could be relocated and, after conversations with the landholders, the remaining 10 were presumed to have fallen over naturally. The annual rate of loss of dead nest trees in this example was 4-7%.

The degree to which Red-tailed Black-Cockatoos depend on dead trees for nesting is unclear. Although most nests are found in dead trees, these nests are, by far, the most visible and easy to find. Where dead trees are now very rare, such as along the Naracoorte Range, Red-tailed Black-Cockatoos persist and breeding success, as measured by recruitment in flocks, is not different to flocks living in areas where dead trees remain common. The rate of loss of dead trees is high throughout the range of the cockatoo, and the efforts to conserve these trees through education and legislation will continue.

Protection of nests from ground predators

Jarmyn (2000) showed that egg survival increased markedly with collaring of nest trees to exclude ground predators. She also showed experimentally that Brushtail Possums *Trichosurus vulpecula* were the most common ground predator of eggs in artificial nests. Evidence from Jarmyn (2000) indicate that Brushtail Possums can markedly reduce nesting success in farmland nests. Artificial nest experiments suggested that overall predation rates of nests 1km or more from a farmland edge in *E. arenacea/ E. baxteri* woodland were markedly lower than in farmland. Overall nesting success did not improve significantly as a result of collaring trees to exclude possums because egg hatching rate was lower than in previous years. This was most likely attributed to shortages of food in the nesting areas in that breeding season. Disturbance caused by collaring of nest trees was thought to be very unlikely. Nevertheless the possibility that collaring of nest trees somehow affects nest survival negatively should not be completely discounted. The Recovery Team has accepted that management of nest sites should

included collaring of nests and almost 60 nest trees have been collared. Because predation rates in woodland are assumed to be lower, and the difficulty in isolating these trees from neighbouring trees, woodland nests will not be collared routinely.

Population modelling was used to investigate the impact of collaring various numbers of nests on the total population size of a hypothetical population of 1000 birds or 770 adults. The effect of collaring 100, 120 and 150 nests was investigated. After 40 years total population size had increased by between 120 (100 nests) and 230 (150 nests) individuals. By the start of the breeding season 2001/02, 60 nests will be collared and between 5-10 nests are found each year through reports from the public. If the annual loss of dead trees is assumed to be 5%, then 2-3 collared nests will be lost each year. Thus it will take up to 8 years to reach 100 nests collared and 15 years to reach 150 collared nests.

4 Roosting Habitat

Roosts of South-eastern Red-tailed Black-Cockatoos were found by radio-tracking and following birds from drinking sites in the evening. Red-tailed Black-Cockatoos utilise clumps of usually tall eucalypts for roosting, and sometimes used the same site each night for many months (unpublished data). Of 19 roost sites located in this study, 15 (79%) were in copses of Red Gum, 3 (16%) in *E. leucoxylon* and one (5%) in Manna Gum (*E. viminalis cygnatensis).* Thirteen of these sites (68%) were on private land. Red Gum trees chosen for roosting were 80±13 cm DBH (diameter at breast height) and 26±3 m in height (n=9). The distance from the roosting tree to the nearest neighbouring tree was 6.2 ± 3.9 m (range 1-11 m; n=9). Manna Gums chosen for roosting were 64±32 cm DBH and 20+2 m in height and 3.9±3.2 m from the nearest neighbouring tree (n = 4).

Red-tailed Black-Cockatoos will fly substantial distances to use a traditional roost. Two groups of cockatoos were observed regularly flying up to 5 km from feeding sites to roosting sites.

5 Identifying priority Red-tailed Black-Cockatoo Habitats

To identify existing and potential Red-tailed Black-Cockatoo habitat, all floristic vegetation units with stringybark or Buloke were included if they fell within the range of the cockatoo. Each vegetation unit was classified as feeding, roosting, or nesting according to the habitat species present. Many vegetation units are potentially suitable for all three habitat uses. In South Australia 13 mapped vegetation units provide potential habitat for Red-tailed Black-Cockatoos; in Victoria 70 Ecological Vegetation Classes provide potential habitat (Appendix 2).

Vegetation mapping in South Australia has been done at 1:40,000 scale and maps blocks of native vegetation as small as one ha in size. In Victoria Ecological Vegetation Class mapping was carried out at 1:50,000 and maps remnants down to 100 m in the narrowest dimension and 4 ha in size. Both nest sites and general sightings of Red-tailed Black-Cockatoos tend to be close to mapped native vegetation. Red-tailed Black-Cockatoos frequently use scattered trees for both nesting and feeding, but these small remnants tend not to be mapped. Therefore, an opportunity existed to use mapped vegetation and buffers to identify unmapped Red-tailed Black-Cockatoo habitats and to identify where re-establishment of Red-tailed Black-Cockatoo habitat should be attempted if possible.

Identification of feeding habitat

All vegetation units potentially containing feed tree species were combined into an existing feeding habitat layer. Then all sightings of Red-tailed Black-Cockatoos recorded since 1990 were overlain and the position of sightings in relation to mapped Red-tailed

Black-Cockatoo habitat was examined. A number of combinations of patch size and distance from patch was investigated to determine the best dimensions for a buffer out from mapped habitat to include all non-mapped potential feeding habitat. As with nesting sites, Red-tailed Black-Cockatoo sightings tend to be closely associated with mapped Red-tailed Black-Cockatoo habitat. Again a 5 km buffer was used and applied to mapped patches of various sizes containing Red-tailed Black-Cockatoo habitats. From several scenarios of block size, blocks of native vegetation greater than 20 ha in size were selected and buffered by 5 km. This patch size included the large majority of all sightings. Pre-European mapping was then used to select areas within the buffer which were mapped as having comprised vegetation units suitable for Red-tailed Black-Cockatoo feeding. These areas were selected and called 'Potential Feeding Habitat'. The results are presented in 1:500,000 summary maps and a series of 1:50,000 maps in South Australia and 1:100,000 in Victoria.

Identification of nesting habitat

All vegetation units containing potential nest tree species were combined into an existing nesting habitat layer. The position of 78 precisely located nest sites was then overlaid and the position of each nest site in relation to the mapped nesting habitat was examined. A number of combinations of patch size and distance from patch were investigated to determine the best dimensions for a buffer out from mapped habitat to include all non-mapped potential nesting habitat. The most isolated Red-tailed Black-Cockatoo nest known is 5 km from an existing block of native vegetation containing Red-tailed Black-Cockatoo habitats, this value was used to buffer blocks of native vegetation. From several scenarios of block size, blocks of native vegetation greater than 30 ha were selected and buffered by 5 km. This patch size included all known nest sites. Pre-European mapping was then used to select areas within the buffer zone which formerly comprised vegetation units suitable for Red-tailed Black-Cockatoo nesting. These areas were selected and called 'Potential Nesting Habitat'. The results are presented in 1:500,000 summary maps and a series of 1:50,000 maps for the entire range.

Identification and protection of dead potential nest trees

Protection of dead potential nest trees presents a challenge throughout the range of the Red-tailed Black-Cockatoo. This is because although standing dead trees are protected on public land, standing dead trees on private land are not protected in either State by existing native vegetation controls. Extension and education material has been produced and is promoted throughout the Red-tailed Black-Cockatoo's range. In addition to this, in the West Wimmera and Glenelg Shires potential nest trees for Red-tailed Black-Cockatoos are protected by Environmental Significance Overlays that are part of the Shire planning schemes. These overlays apply to potential nesting habitat within the Shire (all potential nesting habitat in West Wimmera Shire and currently only the northern part of the Red-tailed Black-Cockatoo's range in the Glenelg Shire). Importantly the overlay aims only to protect those trees potentially suitable for Red-tailed Black-Cockatoos to nest in, and guidelines and training have been provided to Shire planners and Natural Resources and Environment staff to enable them to identify these trees. Implementation of the overlay has revealed that dead trees suitable as nest sites for Red-tailed Black-Cockatoos are rare, and that on average, in the two Shires, only 13% of all standing dead trees are protected. Thus the overlay is considered to have only a marginal impact on farming operations, and the new measures have been generally well received by landholders.

The Red-tailed Black-Cockatoo Recovery Team seeks to implement similar legislative protection of potential dead nest trees throughout the Red-tailed Black-Cockatoo's potential nesting distribution. The following guidelines have been provided to both

Shires and to Natural Resources and Environment staff to assist in implementing the overlays:

Implementing ESO3 Glenelg Planning Scheme and ESO2 West Wimmera Planning Scheme.

Environmental Objective to be Achieved

"To protect areas of critical breeding habitat of the endangered Red-tailed Black-Cockatoo by ensuring the retention of suitable nesting trees with the bird's known nesting area" (the same wording is used in both planning schemes).

Definition

Glenelg Planning Scheme ESO3

A permit is not required to remove, destroy or lop any vegetation except that a permit is required for the removal of *hollow dead River Red Gum trees* having a diameter greater than 60cm at 1 metre above ground level.

West Wimmera planning Scheme ESO2

A permit is not required to remove, destroy or lop any vegetation except that a permit is required for the removal of hollow dead eucalypt trees having a diameter greater than 60cm at 1 metre above ground level. This permit requirement does not apply to solid trees.

Decision guidelines

Before deciding on an application, the responsible authority may obtain comments from the Department of Natural Resources and Environment (wording same for both schemes)

Interpretation

The planning notes state that the objective of this overlay is to protect suitable nesting trees for Red-tailed Black-Cockatoos within their known nesting area (same wording for both schemes).

"Known nesting area":

West Wimmera Shire: this is anywhere within the known range of the Red-tailed Black-Cockatoo.

Glenelg Shire: When this overlay was introduced Red-tailed Black-Cockatoos were thought not to nest much south of Casterton. We now understand that the birds nest throughout their range. Currently the overlay only applies to the area north of Kilmoc Rd., which is approximately 1.5 km south of Glenelg River at Killara Bridge, Bahgallah. We will encourage the Glenelg Shire to expand the overlay area to include the entire range of the Red-tailed Black-Cockatoo.

"Suitable nesting trees"

Red-tailed Black-Cockatoos nest only in large hollows in both live and dead eucalypts; they show a marked preference for dead trees with over 80% of known nests recorded in dead trees. Red-tailed Black-Cockatoos have specific nest hollow requirements which are only found in relatively few dead trees. They require large hollows with an entrance which is preferably facing upwards but which can be vertical, but cannot face towards the ground. The hollow itself must be less than 45' off vertical. This is because the birds enter the hollow tail first and descend tail first to the floor of the hollow where they make their nest. Nest hollows tend to be in vertical or near vertical 'spouts', but can also be in the trunk. The attached 'decision tree' should assist you in deciding on the suitability of a particular dead tree.

Proportion of trees protected by overlay

From five inspections the percentage of dead trees that were suitable using this definition ranged from 2-25% of all dead trees at the site; the average was 13%. These results indicate that dead trees which are suitable for Red-tailed Black-Cockatoos to nest in form only a small proportion of all dead trees and thus the decision to protect them has relatively little impact on farming operations.

Impact on firewood harvesting

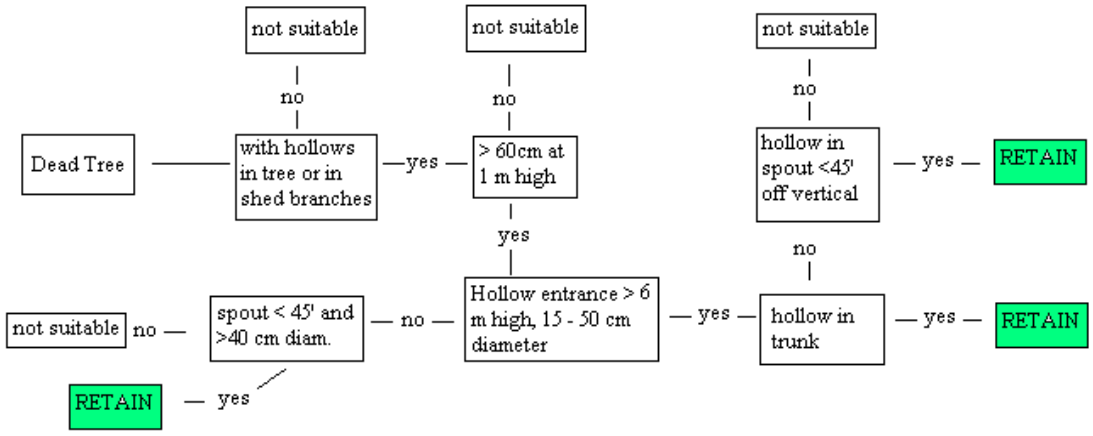
Hollows are formed in eucalypts primarily by termites, which enter the tree through its trunk. Consequently trees with hollows are rotten in the butt and tend to be unsuitable for commercial firewood cutters. Firewood cutters prefer solid trees that tend not to have hollows. At one site in the Glenelg Shire where a commercial woodcutter operates, 25% of the dead trees fit the criteria and were protected by the overlay, of which only 2 out of 17 would have been suitable for firewood.

Using the 'Nest tree identification guide'

Here are a few notes to assist in using the guide:

- The planning overlays only protect dead trees with hollows which are suitable for Red-tailed Black-Cockatoos, which tends to be only a small proportion of all dead trees with hollows. These other trees may have very significant value for other wildlife and *if the landowner is willing* should be protected as well.
- Dead trees with hollows tend to have dropped most smaller branches
- If shed branches on the ground have hollows then the standing tree probably does also.
- Red-tailed Black-Cockatoos need hollows which are steep-sided. They won't use hollows that are more than 45° off vertical.

Red-tailed Black-Cockatoo potential nest tree identification guide.



Notes for using habitat maps

The distribution boundary of the South-eastern Red-tailed Black-Cockatoo used for this mapping exercise is approximate and reflects our best knowledge of the range of the cockatoo. Red-tailed Black-Cockatoos are mobile and may occasionally range outside the areas identified. Our knowledge of its distribution may also be incomplete, and populations regularly utilising areas outside the identified range may still be discovered. Maps will be updated from time –to – time to reflect any new distributional information.

The maps provided are intended as a guide to identifying where Red-tailed Black-Cockatoo habitat or potential habitat is likely to be found within the range of the cockatoo and which areas are a priority for protection because their proximity to existing Red-tailed Black-Cockatoo habitat makes them more likely to be used by cockatoos. The accuracy of the maps depends on the accuracy of the vegetation mapping, both of extant and pre-European vegetation boundaries. The authors of the vegetation mapping in both states accept that there will be some errors in the floristic group boundaries and thus it is almost certain that some sites identified as potentially containing Red-tailed Black-Cockatoo remnant habitats will not contain or support Red-tailed Black-Cockatoo habitat species. As much as possible therefore, sites should be assessed on the ground to confirm or reject their suitability for supporting Red-tailed Black-Cockatoo habitat species.

In Victoria detailed floristic group mapping is not available at present for the area north of the Natimuk-Frances road. There Broad Vegetation Mapping data has been used and, as the maps show, it crudely identifies most of the range of the Red-tailed Black-Cockatoo in this area as potentially suitable. We will revise this area as better data comes to hand, possibly as early as late 2001. The Ecological Vegetation Class mapping data in Victoria is not as well suited to identifying Red-tailed Black-Cockatoo habitat because it uses understorey species characters primarily to identify related floristic groups. Thus in Victoria Plains Woodland (EVC 803) always contains Buloke and is mapped as potential feeding habitat, but because it also may contain Red Gum or Yellow/Blue Gum, is also mapped as potential nesting habitat. In South Australia this community is mapped as Buloke Woodland and is identified in this plan as only providing potential feeding habitat.

Implementing the Red-tailed Black-Cockatoo Habitat Management Plan

Recovery Plan objectives

Overall objective:

- *To shift the status of the Red-tailed Black-Cockatoo from endangered to vulnerable within 20 years*
- *To increase the population to 625-960 adults and maintain at least current levels of recruitment.*

Specific objectives:

- *To maintain current range and area of occupancy.*
- *To maintain area of existing feeding habitat.*
- *To increase seed production of existing habitat through improved fire and grazing management*
- *To establish new feeding habitat.*
- *To maintain current availability of nest habitat.*
- *To minimise impact of nest predators.*
- *Increase regional planning recognition and protection, and awareness and involvement by the regional community, and establish long-term support structures for the South-eastern Red-tailed Black-Cockatoo and its habitats.*
- *Operate the Recovery Plan through a Recovery Team.*

Performance criteria

Objective: *To shift status of the Red-tailed Black-Cockatoo from endangered to vulnerable within 20 years*

Performance criteria:

- Habitat loss stopped or reversed so that an ongoing population decline can no longer be inferred.

Objective*: To increase the population to 625-960 adults and maintain at least current levels of recruitment.*

Performance criteria:

- Population size at least 625 adults.
- Average percentage of juveniles and sub-adults in flocks not less than 23%.

Objective: *To maintain current range and area of occupancy*

Performance criteria:

- Current range (over previous 10 years) and area of occupancy maintained.

Objective: *To maintain area of existing feeding habitat*

Performance criteria:

- No loss of existing feeding habitat.

Objective: *To increase seed production of existing habitat through improved fire and grazing management*

Performance criteria:

- A 25% increase in seed production in stringybark woodland achieved through be management.
- Increased area of feeding habitat with appropriate grazing regimes

Objective: *To establish new feeding habitat*

Performance criteria:

- A minimum of 500 ha of stringybark woodland and 500 ha of Buloke woodland p or revegetated each year.

Objective: *To maintain current availability of nest habitat*

Performance criteria:

- Legislated protection of dead trees with hollows across the Red-tailed Black-Cockatoo range
- Any areas with limited nest sites identified
- Number of nest sites enhanced in areas where a shortage of nests is indicated

Objective: *To minimise impact of nest predators*

Performance criteria:

- ***Protect all known nest trees from predators***

Objective: *Increase regional planning recognition and, protection, and awareness and involvement by the community, and establish long-term support structures for the South-eastern Red-tailed Black-Cockatoo and its habitats*

Performance criteria:

- Recognition of the significance of the species and its habitats by the planning sections of relevant state agencies, regional catchment management authorities, local government and Landcare groups, particularly fire management, within two years.
- Measured increased awareness and involvement of land owners and other members of the community in the recovery of the South-eastern Red-tailed Black-Cockatoo; and identified structures in place to ensure the ongoing support of these activities in the region beyond the life of the Recovery Plan.

Objective: *Operate the Recovery Plan through a Recovery Team*

Performance criteria:

- Demonstrated successful operation of the Recovery Team over five years.

Actions

❖ **Objective:** *To maintain current availability of nest habitat*

Performance criteria:

- Legislated protection of dead trees with hollows across the Red-tailed Black-Cockatoo range**.**

Actions

- **Increase range of Glenelg Shire Environmental Significance Overlay**
- **Expand Environmental Significance Overlay protection to include Horsham and Southern Grampians Shires**.
- **Make submission to West Wimmera Shire on planning review**
- **Pursue legislative protection of hollow dead trees in South Australia**
- **Publicise the importance of nest trees**
- **Make available information on what trees to protect and how**

The recovery team will continue its efforts to have suitable nest trees protected throughout the range of the Red-tailed Black-Cockatoo. Local government and other relevant agencies will be addressed and supplied with the information required to make decisions that will protect nesting habitat.

When additional protection is given to nesting habitat, the recovery team will work w agencies to publicise the changes. This will include road signs and pamphlet distributi relevant ratepayers and media coverage.

❖ **Objective**: *To maintain current availability of nest habitat*

Performance criteria:

- Any areas with limited nest sites identified
- Number of nest sites enhanced in areas where a shortage of nests is indicated

Actions

- **Map existing and potential nesting habitat**
- **Map critical nesting habitat**
- **Investigate areas where nesting has not been recorded**

Existing and potential nesting habitat will be mapped producing a predicted breeding distribution for the Red-tailed Black-Cockatoo. Potential nesting areas where nesting has not been recorded will be examined to see whether, if nesting does not occur, there appears to be a local shortage of nest sites. This process will also identify critical nesting habitat.

❖ **Objective:** *To maintain current availability of nest habitat*

Performance criteria

- Increase the number of nest sites to allow for natural decline

Actions

- **Erect artificial nests where shortage of nests is indicated**
- **Maintain artificial nests, monitor artificial nest use and adapt as necessary**
- **Encourage nest tree planting in priority areas**

The Recovery Team will investigate and document the effects of loss of dead trees in nesting areas. Depending on the results of this work, they will then, using habitat m and site inspections, attempt to identify areas where nesting habitat appears to be supply. Artificial nest sites will be erected at any such areas.

❖ **Objective:** *To minimise impact of nest predators*

Performance criteria:

- Protect all known nest trees from predators

Actions

- **Conduct volunteer nest searches**
- **Collar known nest trees – utilise volunteer assistance where possible**
- **Study effects of collaring**
- **Publicity – how to protect nest trees from predation**

The Recovery Team will collar all known nests to protect them from ground predators. New nests will be found by maintaining the Red Tail observer network and encouraging volunteer nest searchers. Publicity will be generated each September, requesting sightings of nests to be reported to the 1800 freecall number. Volunteers will be used where possible to confirm sites.

When identified, nest trees will be protected from possum predation by placing collars around the base of the tree. The recovery team will encourage volunteers to assist in this task.

Landholders who do not wish to identify specific sites on their own land will be encouraged to undertake their own protection of nest trees and supplied with information on how to undertake this. Sponsorship for the supply of collaring materials will be sought.

Management of existing habitat

Ungrazed blocks

Fire management of stringybark dominated woodlands is a key issue in increasing food availability for Red-tailed Black-Cockatoos. Throughout the range of the Red-tailed Black-Cockatoo fire management in stringybark woodlands over recent decades has suppressed food availability. As a general principle deliberately-planned fire in stringybark woodlands should be carried out so that there is no canopy scorch, and thus no reduction in current or future seed crops. More detailed prescriptions for ideal fire management will be forthcoming when current studies by the University of Adelaide are completed. Consistent with current policy, wildfire should be excluded from stringybark woodlands as much as possible.

Stringybark blocks are also an important nesting habitat. Nest trees are only found in the largest and oldest of *E. arenacea/ E. baxteri* trees. Thus removal of large trees is undesirable in areas of Red-tailed Black-Cockatoo habitat. Nests are often in dead stringybark trees and so removal of large, standing dead trees is also undesirable.

Ungrazed gum woodlands (*E. camuldulensis, E. leucoxylon)* mapped as existing Red-tailed Black-Cockatoo habitat may provide nesting and roosting habitat. Activities that reduce the availability of live or dead hollow-bearing gums or the future availability of these trees is undesirable.

Scattered trees and grazed woodland remnants

Small blocks of native vegetation and paddock trees that are grazed continuously or heavily tend to suffer from several problems. High on the list is that stock tend to suppress regeneration so that young trees are rare on land which is heavily or continually grazed. Stock grazing tends to increase the weediness of blocks of native vegetation. Reducing grazing pressure is one of the most effective ways of improving the health and viability of remnant blocks of bush on private land. As trees become more isolated in paddocks, these problems are exacerbated. For paddock Buloke and stringybark trees ringbarking by cattle rubbing can be a serious threat.

Stringybark tree health was described in four paddocks in the Naracoorte range in which Red-tailed Black-Cockatoos regularly fed. Of 89 trees 26% had signs of feeding. Three of the four paddocks had a recent history of both cattle and sheep grazing, one paddock was being used for sheep grazing. In the four paddocks, 24% of stringybarks had no sign of ringbarking caused by stock rubbing, 37% had outer layers of bark removed by rubbing, and 38% had some bark completely removed by rubbing. Most trees had some dieback (loss of foliage in the crown): 37% had mild signs of crown dieback, 21% had moderate to severe loss of foliage, 15% of these trees were dead, and only 26% had no sign of dieback. There was much more ringbarking of trees in paddocks grazed by cattle and sheep than in paddocks grazed by sheep alone ($\chi^2 = 64.1$, $df = 1$, $P < 0.01$). There was a significant relationship between the degree of ringbarking and the degree of crown dieback ($r^2 = 0.10$, $P = 0.023$) and no relationship between the degree of crown dieback and the number of mistletoe plants. Thus ringbarking was associated with poor tree health, whereas the number of mistletoe plants per tree, often accused of affecting tree health, was not.

Reducing the intensity and frequency of grazing is the most effective way to protect remnant bush and trees on farms. For remnants the most cost-effective and practicable of doing that is through fencing and funding is available in both States for this purpose. Details of grants and contact addresses are given in table 2. Protection of scattered individual trees is more problematic due to the cost of fencing individual trees, however, the biodiversity benefits can be very great. Old farm trees provide resources such as

hollows and large seed crops that young trees cannot. Fenced off areas around old farm trees areas can be made large enough to allow regeneration of new seedlings. Wrapping the trunk in wire netting can also successfully protect individual trees, as can piling up fallen branches around the trunk. In South Australia grants are available for fencing off copses of scattered trees as small as one ha.

Table 2: Grants available within the range of Red-tailed Black-Cockatoos for protection of remnant vegetation.

State	Region	Grant name	Administering body	Contact
Victoria	West Wimmera	"Healthy Waterways Incentive Scheme"	Wimmera Catchment Management Authority	53821544
Victoria	West Wimmera	"Land Protection Incentive Scheme"	Wimmera Catchment Management Authority	53821544
Victoria	West Wimmera	"Wimmera Bushcare Remnant Fencing"	Greening Australia	53811010
Victoria	Glenelg	"Waterways Partnership Grants"	Glenelg-Hopkins Catchment Management Authority	55712526
Victoria	Glenelg	"Tree Victoria"	Glenelg-Hopkins Catchment Management Authority	55712526
Victoria	Glenelg	"Fencing the Future"	Trust for Nature	55235840
South Australia	Upper south-east	"Salt to Success"	Primary Industry South Australia	87553166
South Australia	Lower south-east	"Sustaining the South"	Primary Industry South Australia	87629100

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Appendix 1: Annotated description of vegetation classifications with known nesting records (descriptions from Anon 2000, Yugovic 2000, Croft et al. 1999).

Victoria

EVC 55 Plains Grassy Woodland. Dominated by *Eucalyptus camuldulensis. 17 known nests since 1990.*

EVC 882 Shallow Sands Woodland. Dominated by *E. leucoxylon* and *E. ovata. 5 nests since 1990.*

EVC 650. Heathy Woodland/Damp Heathy Woodland/Damp Heathland Mosaic. I nest since 1990.

EVC 68 Creekline Grassy Woodland. Dominated by *E. camuldulensis.* 1 nest since 1990.

EVC 629 Shrubby Woodland/Riparian Scrub Mosaic 9 nests since 1990.

EVC 803 Plains Woodland. Dominated by *E. microcarpa* and *Allocasuarina luehmannii* ± *E. camuldulensis.* 4 nests since 1990.

EVC 885 Damp Sands Herb-rich woodland/Plains Grassy Woodland Complex. Dominated by *E. camuldulensis* and *E. viminalis* ± *E. ovata* and *A. luehmanni.* 14 nests recorded since 1990.

EVC 48 Glenelg Plain Heathy Woodland. Dominated by *E. baxteri* and/or *E. willisii.* 2 nests since 1990.

EVC 736 Limestone Rise Grassland, Limestone Rise Woodland. 1 nest since 1990.

EVC 779 Damp Sands Herb-rich Woodland/ Shallow sands Woodland: One nest since 1990.

EVC 179 Wimmera Heathy Herb-Rich Woodland. Dominated by *E. arenacea* or *E. viminalis.* 3 nest since 1990.

EVC 3. Wimmera Damp Sands Herb-rich Woodland. Dominated by *E. viminalis* ± *E. camuldulensis.* 3 nests since 1990.

South Australia

6 *E. leucoxylon* open woodland: 2 nests

0 (cleared land) 5 nests

12 *E. arenacea/baxteri* woodland

Appendix 2: Vegetation communities with potential Red-tailed Black-Cockatoo habitat in Victoria and South Australia

Number		NESTING	FEEDING	ROOSTING
Victoria				
3	Damp Sands Herb-rich Woodland	N	F	R
16	Lowland Forest	N	F	R
48	Heathy Woodland	N	F	
55	Plains Grassy Woodland	N		R
56	Floodplain Riparian Woodland	N		R
175	Grassy Woodland	N		R
179	Heathy Herb-Rich Woodland	N	F	R
292	Red Gum Wetland	N		R
295	Riverine Grassy Woodland	N		R
298	Riverine Sedgy Forest	N		R
641	Riparian Woodland	N		R
645		N	F	
646		N	F	R
650		N	F	
652	Lunette Woodland	N		R
659	Plains Riparian Shrubby Woodland	N		R
660			F	R
662		N		R
670	Limestone Woodland	N	F	
672		N	F	R
675		N	F	R
679	Drainage Line Woodland	N		R
698		N	F	
704		N		R
707	Sedgy Swamp Woodland	N		R
711		N		R
713		N	F	R
714		N		R
716		N		R
719		N	F	R
724			F	
725		N	F	R
726		N	F	
727		N	F	R
729		N	F	R
730		N		R
731		N	F	R
732		N	F	R
735		N	F	
736		N		
737		N	F	
738		N		R
739		N		R
740		N	F	R
745		N		R
748		N	F	R
749		N		R
750		N	F	R
756		N	F	
757		N	F	R
764		N	F	
765		N		R
770		N	F	R
774		N	F	R
778		N		R
779		N	F	R

Number		NESTING	FEEDING	ROOSTING
780		N	F	R
781		N	F	R
785		N	F	R
786		N	F	R
787		N	F	R
788		N	F	R
790		N	F	R
791		N	F	R
794		N		R
802		N	F	
803	Plains Woodland	N	F	
881		N	F	R
882	Shallow Sands Woodland	N	F	R
885	Damp Sands Herb-rich Woodland / Plains Grassy Woodland Complex	N	F	R
892		N	F	
South Australia				
5	*E. fasciulosa, E. leucoxylon* Low Woodland	N		R
6	*E. leucoxylon* Woodland	N		R
8	*E. leucoxylon Low Open woodland*	N		R
9	*Allocasuarina verticillata, E. leucoxylon Low*	N		R
11	*E. arenacea/ E. baxteri Low Woodland*	N	F	R
12	*E. arenacea/ E. baxteri Woodland*	N	F	R
18	*E. camuldulensis* woodland	N		R
77	*E. leucoxylon* woodland	N		R
80	*Callitris pressii, E. E. arenacea/ E. baxteri*	N	F	R
81	*E. ovata, E. viminalis ssp.* Woodland			R
96	*E. odorata, E. leucoxylon spp.* Woodland	N		R
97	Degraded *E. camuldulensis or E. leucoxylon, or E. baxteri or E. arenacea or E. fasciculosa.* Woodland	N	F	R
	E. viminalis woodland			R
	E. arenacea/E. baxteri ± *E. obliqua, E. fasciculosa, E. viminalis* open forest to woodland	N	F	R
	A. luehmannii Woodland		F	