

Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on Amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

1. Name

A nomination was received for the Yellow Box – Red Gum Grassy Woodland. Experts identified numerous similarities and intergradations between the nominated ecological community and the Grassy White Box Woodlands ecological community, which was previously listed as endangered under the EPBC Act. The Committee considers these two ecological communities to be sufficiently similar and intermixed to merit listing as a single entity.

In addition, the Committee considers that, in order to highlight the important contribution of the understorey to the biodiversity and function of this ecological community, emphasis should be placed upon it in naming the ecological community, including areas in which no overstorey remains.

Therefore, to reflect the broader definition of the ecological community and the role of its understorey, it is recommended that the name of the ecological community be changed to the White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland, to be known informally as Box – Gum Grassy Woodland and Derived Grassland.

2. General Description

Box – Gum Grassy Woodlands and Derived Grasslands are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely’s Red Gum trees. In the Nandewar Bioregion, Grey Box (*Eucalyptus microcarpa* or *E. moluccana*) may also be dominant or co-dominant. The tree-cover is generally discontinuous and consists of widely-spaced trees of medium height in which the canopies are clearly separated (Yates & Hobbs 1997).

In its pre-1750 state, this ecological community was characterised by:

- a ground layer dominated by tussock grasses;
- an overstorey dominated or co-dominated by White Box, Yellow Box or Blakely’s Red Gum, or Grey Box in the Nandewar bioregion; and,
- a sparse or patchy shrub layer.

Associated, and occasionally co-dominant, trees include, but are not restricted to: Grey Box (*Eucalyptus microcarpa*), Fuzzy Box (*E. conica*), Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Red Stringybark (*E. macrorhyncha*), White Cypress Pine (*Callitris glaucophylla*), Black Cypress Pine (*C. enderlicheri*), Long-leaved Box (*E. gonicalyx*), New England Stringybark (*E. calignosa*), Brittle Gum (*E. mannifera*), Candlebark (*E. rubida*), Argyle Apple (*E. cinerea*), Kurrajong (*Brachychiton populneus*) and Drooping She-oak (*Allocasuarina verticillata*) (Austin *et al.* 2002; Beadle 1981; Fischer *et al.* 2004; NSW National Parks & Wildlife Service 2002; Prober & Thiele in press).

This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres (NSW Scientific Committee 2002).

In general, White Box is more prevalent in the west, and Yellow Box – Red Gum in the east. A distinct exception is the outlying White Box woodlands in the upper Snowy River region in Victoria and adjacent southern New South Wales. Yellow Box and Blakely's Red Gum are generally dominant on the Tablelands and form mosaics with White Box on the Eastern Slopes (Beadle 1981; Prober & Thiele in press). The understorey shows a more consistent pattern than the overstorey, with understorey species composition on the Tablelands differing from that on the Slopes (Prober & Thiele in press).

The Box – Gum Grassy Woodland and Derived Grassland ecological community intergrades with Western Grey Box (*Eucalyptus microcarpa*) woodlands in the west (Prober and Thiele in press). Sites dominated by Western Grey Box (*E. microcarpa*) or Coastal Grey Box (*E. moluccana*) without Yellow Box, White Box or Blakely's Red Gum as co-dominants are not considered to be part of the ecological community, except in the Nandewar Bioregion.

Thiele and Prober (2000) estimated that less than 0.1% of Grassy White Box Woodlands (a component of the Box – Gum Grassy Woodland and Derived Grassland ecological community) remains in a near-intact condition. Much of the original extent of the Box – Gum Grassy Woodland and Derived Grassland ecological community has been cleared for agriculture. In most of the areas that remain, grazing and pasture-improvement have effectively removed the characteristic understorey, leaving only the overstorey trees with an understorey dominated by exotic species (McIntyre *et al.* 2002; Prober & Thiele in press). In these areas, grazing has also largely prevented the regeneration of the overstorey species (Sivertsen 1993). Due to the high levels of clearing that have taken place, and continued grazing, large areas of healthy, regenerating overstorey are rare. Areas containing a number of mature trees or regenerating trees are important as they provide current and future breeding and foraging habitat for woodland animals, such as Regent Honeyeaters (*Xanthomyza phrygia*), Squirrel Gliders (*Petaurus norfolcensis*) and Superb Parrots (*Polytelis swainsonii*) (NSW Scientific Committee 2002).

Kangaroo Grass (*Themeda triandra*, also known as *Themeda australis*) and Snow Grass (*Poa sieberiana*) were originally the dominant grasses across a large part of the ecological community's range, and are particularly sensitive to grazing pressure (Cole *et al.* 2004). Grazing tends to cause the loss of these grasses, along with other grazing-intolerant forbs, grasses, sedges and shrubs. These grazing-intolerant forbs include tall perennial herbs such as daisies (e.g. Yam Daisy (*Microseris lanceolata*)), lilies (e.g. Milkmaids (*Burchardia umbellata*)), pea plants (e.g. Australian Trefoil (*Lotus australis*)) and orchids (e.g. Purple Diuris (*Diuris punctata*)). Grazing can also have indirect effects upon other ground layer species through soil disturbance and physical changes to the soil such as compaction, nutrient enrichment, reduced water infiltration and erosion. These changes to the soil can facilitate and maintain weed invasions and make soil conditions unsuitable for native species regeneration (Prober *et al.* 2002a & 2002b; Yates & Hobbs 1997).

As a consequence of these pressures, there are only a small number of areas remaining that retain a highly diverse understorey dominated by native, perennial tussock grasses. These areas are extremely rare, and usually quite small in size (Prober & Thiele 1995). They have often been cleared of trees and may no longer possess an overstorey. However, these remnants can be relatively intact despite the absence of trees. Generally an intact native understorey can resist large-scale weed invasion. For example, when established at high densities, Kangaroo Grass can suppress invasive exotic perennial grass species (Cole *et al.* 2004). This type of understorey can also provide important habitat for fauna, such as small mammals, reptiles and insects, and foraging habitat for larger mammals (Sivertsen 1993).

Areas of high understorey biodiversity tend to occur on public land that has not been utilised for domestic stock grazing or cropping. Examples include cemeteries and road verges, some town commons, or travelling stock routes or reserves (Prober & Thiele in press).

Given the occurrence of Box – Gum Grassy Woodlands and Derived Grasslands on the best soils, and therefore the most sought-after agricultural land, very little of the ecological community is reserved. The reserved areas tend to be shrubbier and occur on less arable soils. Remnants on the most fertile soils are the least commonly reserved (Thiele & Prober 2000). Prober (1996) noted that remnants in the existing reserves did not represent the natural variation in Grassy White Box Woodland, but favoured communities on poorer soils, i.e. soils classed as unsuitable for agriculture, generally associated with steeper slopes, or shallower soils and/or areas with high shrub abundance. While the ecological community does occur in a number of reserves, most reserves contain only small occurrences, and these remnants have usually been modified by historical land use (NSW Scientific Committee 2002; Prober & Thiele 1993).

Shrubs can occur naturally in grassy woodlands, and can form an important part of the Box – Gum Grassy Woodland and Derived Grassland ecological community, however, on poorer soils throughout its range, this ecological community grades into shrubby woodlands (Prober & Thiele 1993). This can lead to confusion in recognising the listed ecological community, and the following can be used to determine if a remnant is included in the listed ecological community or if it is a shrubby woodland. Shrub cover in this ecological community is naturally patchy, and shrubs may be dominant only over a very localised area. Shrub cover should therefore be assessed over the entire remnant, not just in a localised area. A remnant with a significant ground layer of tussock grasses, and where the distribution of shrubs is scattered or patchy, is part of the ecological community. In shrubby woodlands, the dominance of native tussock grasses in the ground layer of vegetation is lost. Therefore, a remnant with a continuous shrub layer, in which the shrub cover is greater than 30%, is considered to be a shrubby woodland and so is not part of the listed ecological community. Remnant attributes, such as shrubbiness, should be measured on a scale of 0.1 hectares or greater.

3. National Extent

The Box – Gum Grassy Woodland and Derived Grassland ecological community occurs in an arc along the western slopes and tablelands of the Great Dividing Range from Southern Queensland through NSW to central Victoria (Beadle 1981). It occurs in the Brigalow Belt South, Nandewar, New England Tableland, South Eastern Queensland, Sydney Basin, NSW North Coast, South Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina Bioregions (Environment Australia 2000).

This ecological community is listed under New South Wales (NSW) legislation as an endangered ecological community, White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland).

In the Australian Capital Territory (ACT), Yellow Box – Red Gum Grassy Woodland, a component of the ecological community, is listed as endangered.

In Queensland the ecological community is a primary component of the following Regional Ecosystems: 11.8.2a, 11.8.8, 11.9.9a, 13.3.1, 13.11.8, 13.12.8 and 13.12.9. It can also be a smaller component of the following regional ecosystems: 11.3.23, 12.8.16 (only at the far western edge of the bioregion), 13.3.4, 13.11.3 and 13.11.4. These regional ecosystems range in conservation status from 'not of concern at present' to 'endangered'.

In Victoria, the ecological community can be a component of the following Ecological Vegetation Classes in the Highlands – Northern Fall, Northern Inland Slopes, Riverina and Goldfields Bioregions: 47 – Valley Grassy Forest, 55 – Plains Grassy Woodland, 175 – Grassy Woodland.

This national listing excludes many areas that are included within these State-recognised communities. The excluded areas are heavily degraded and do not retain sufficient values to be considered part of the ecological community. However, such areas, especially those in which the vegetation could respond to assisted regeneration, may be important areas of partial native vegetation recovery and could be targeted for rehabilitation under NRM regimes to maintain and improve those values.

4. Condition Class

The White Box – Yellow Box – Blakely’s Red Gum grassy woodlands that existed prior to European settlement now exists as remnants in three different states.

The three states are:

- An overstorey of eucalypt trees exists, but there is no substantial native understorey.
- A native understorey exists, but the trees have been cleared.
- Both a native understorey and an overstorey of eucalypts exist in conjunction.

The Committee considers that areas in which an overstorey exists without a substantially native understorey are degraded and are no longer a viable part of the ecological community. Although some native species may remain, in most of these areas the native understorey is effectively irretrievable.

In order for an area to be included in the listed ecological community, a patch must have a predominantly native understorey.

The size and life-form of understorey species are such that viable populations can exist in very small areas (Prober & Thiele 1993). Therefore, in order to be the listed ecological community, an understorey patch, in the absence of overstorey trees, must have a high level of native floral species diversity, but only needs to be 0.1 hectares or greater in size. A patch in which the perennial vegetation of the ground layer is dominated by native species, and which contains at least 12 native, non-grass understorey species (such as forbs, shrubs, ferns, grasses and sedges) is considered to have a sufficiently high level of native diversity to be the listed ecological community. At least one of the understorey species should be an important species (e.g. grazing-sensitive, regionally significant or uncommon species; such as Kangaroo Grass or orchids) in order to indicate a reasonable condition.

Areas with both an overstorey and understorey present are also considered of sufficiently good condition to be part of the listed ecological community if the understorey meets any of the conditions above, or if they have a predominantly native understorey, are two hectares or above in size, and have either natural regeneration of the overstorey species or 20 or more mature trees per hectare.

The condition criteria outlined above are the minimum level at which patches are to be included in the listed ecological community. Such minimum conditions do not represent the ideal state of the ecological community. The larger and more diverse a patch is, the more important it is. Additionally, patches that link remnants in the landscape, that occur in depauperate areas, that contain rare, declining or threatened species and, that encompass the

entire range of the ecological community, are important to the viability of the ecological community into the future. Such areas should accordingly be given priority in Australian Government NRM investments.

5. How judged by TSSC in relation to the EPBC Act criteria

The TSSC judges the ecological community to be eligible for listing as **critically endangered** under the EPBC Act. The justification against the criteria is as follows:

Criterion 1 - Decline in geographic distribution

There are significant gaps in the knowledge about both the historic and current extent of this ecological community, particularly in the north west of its distribution in NSW. The ecological community occurs over a very large range across four jurisdictions, and there is no mapping that encompasses the entirety of its distribution. The existing broad scale mapping has generally been based on tree cover and did not consider remnant condition. Using this work to estimate remaining extent will therefore overestimate the extent of this ecological community.

Studies that have considered condition have been restricted geographically to the NSW Southern Tablelands and South-West Slopes.

The ecological community has been most severely reduced on the Western Slopes of NSW and across Central Victoria. The level of clearance has been least in Northern NSW and Southern Queensland, particularly in the rugged gorge country, and in the ACT. This is largely related to past management history, which is in turn influenced by soil types and topography.

A summary of the known extent of Box – Gum Woodlands and Derived Grasslands in each jurisdiction is below. Tables 1-5 show estimates of extant and pre-clearing extent of Box – Gum Grassy Woodland and Derived Grassland communities based on a number of different studies. Please note that there is some overlap between mapping studies, and figures are not available for the full extent of this ecological community. Figures in these tables should therefore only be used in a generalised manner.

Australian Capital Territory

The Australian Capital Territory (ACT) contains the largest remaining remnants in good condition, reflecting significantly lower levels of stock grazing than the rest of the range of the ecological community. In terms of size, connectivity, diversity and condition, the ACT remnants are exceptional, especially the presence of larger patches (over 100 ha) in good condition (ACT Government 2004). It is likely that the woodland of the ACT is in better condition overall than in adjacent regions due to the system of leasehold title in the ACT, which meant that short-lease rural lands were unlikely to have been subject to intensive pasture improvement (ACT Government 2004).

Table 1. Extant and pre-clearing extent of Box – Gum Grassy Woodland and Derived Grassland communities in the ACT

Vegetation type	Current Area (ha)	Pre-1750 Area (ha)	% cleared
Australian Capital Territory from ACT Government			
2004 Yellow Box- Red Gum Grassy Woodland	10,865	32,000	66

New South Wales

Austin *et al.* (2000) found that this ecological community had been reduced to less than 1% of its pre-1750 extent in the Central Lachlan region. Thomas *et al.* (2000) estimated <4% remaining in the NSW South Western Slopes and Southern Tablelands. Gibbons and Boak (2002) estimated 7.4% of Yellow Box/Blakely's Red Gum woodland remaining in 30,000 hectares on the NSW South West Slopes, which is reduced to 3.4% when isolated trees, remnants of less than one hectare and small, modified patches were excluded.

The ecological community has been less severely impacted in parts of the western fall of northern NSW due to the use of native pastures rather than improved pastures, and less cropping. However, the extensive grazing in the north has still resulted in an overall decline in the condition of the ecological community, particularly the understorey. As a result, the ecological community generally occurs as small patches of woodland in good condition, surrounded by modified woodlands that are degraded. Given that the ecological community occurs on the most fertile soils, it has been preferentially cleared and grazed. The New England Tablelands Bioregion Draft Regional Vegetation Management Plan classifies this ecological community as endangered (less than 10% of pre-1750 extent remaining or 10-30% of pre-1750 extent remaining and <10,000 ha extent remaining) (Voller *et al.* 2003). This assessment was not based on condition, but on the clearance of overstorey trees, so it is likely that the ecological community as defined has an even smaller extent.

Table 2. Extant and pre-clearing extent of Box – Gum Grassy Woodland and Derived Grassland communities in NSW

Vegetation type	Current Area (ha)	Pre-1750 Area (ha)	% cleared
Upper North East NSW CRA Region (CRA Unit 1999)			
99. New England Stringybark – Blakleys Red Gum	10,786	14,496	26
163. Yellow Box - Blakely's Red Gum	7,245	39,525	82
179. Yellow Box - Broad-leaved Stringybark	3,859	11,549	67
190. Yellow Box - Grey Box - Red Gum	21,273	60,630	65
SUB-TOTAL	43,163	126,200	66
Lower North East NSW CRA Region (CRA Unit 1999)			
99. New England Stringybark – Blakleys Red Gum	28,245	116,133	76
163. Yellow Box - Blakely's Red Gum	2,696	28,088	90
179. Yellow Box - Broad-leaved Stringybark	273	1,026	73
190. Yellow Box - Grey Box - Red Gum	7,724	35,934	79
SUB-TOTAL	38,938	181,181	79
Nandewar Bioregion from NPWS 2000			
Yellow Box / Blakleys Red Gum / Rough-barked Apple	9,044	151,121	94
Yellow Box /Blakleys Red Gum / Grey Box	1	77	99
SUB-TOTAL	9,045	151,198	94

Little River Catchment from Seddon et al. 2002			
Yellow Box - Blakely's Red Gum	5,154	87,246	94
White Box	1,082	37,297	97
SUB-TOTAL	6,236	124,543	95
Central Lachlan from Austin et al 2000			
1. E. melliodora / E. microcarpa	4,600	155,200	97
2. E. melliodora	200	2,200	91
6. E. goniocalyx / E. blakelyi / E. melliodora	6,800	75,500	91
7. E. bridgesiana / E. blakelyi / E. melliodora	1,300	17,200	92
15. Callitris glaucophylla/E. albens	100	6,700	99
28. E. blakelyi/Callitris endlicheri	2,000	38,100	95
75. E. albens/E. microcarpa	5,900	102,700	94
SUB-TOTAL	20,900	397,600	95
Boroowa Shire from Friday et al. 2002			
Blakely's Red Gum Grassy Woodland	1,570	29,577	95
Blakely's Red Gum-Yellow Box Poa-Themeda woodland	2,176	11,371	81
Northern Tablelands and Slopes Blakely's Red Gum - Yellow Box - Long Leaved Box Woodland	105	3,095	97
Blakely's Red Gum - Yellow Box - Apple Box - Bothriochloa Grassy Woodland	248	6,028	96
Kangaroo Grass - Red Leg grassland/open woodland	418	24,269	98
NW White Box grassy woodland	1,974	30,556	94
White Box - Blakely's Red Gum - Bothriochloa grassy woodland	230	9,144	97
SUB-TOTAL	6,721	114,040	94
Wagga Wagga Shire from Friday & Mulvaney 2004			
White Box Woodland	1,495	68,156	98
Yellow Box Woodland	2,806	93,683	97
White Cypress Pine - Yellow Box - Grey Box Woodland	6,054	138,034	96
White Box - White Cypress Pine - Grey Box Woodland	105	6,174	98
SUB-TOTAL	10,460	306,047	97
South-Eastern NSW from Thomas et al. 2000			
92. Tablelands Acacia/Grass/Herb Dry Forest - E. bridgesiana / E. melliodora / Acacia mearnsii / Microlaena stipoides	7,417	42,726	83
116. Western Slopes Herb/Grass Woodland - E. blakelyi / Microlaena stipoides / Hydrocotyle laxiflora	4,670	82,110	94
117. Western Slopes Dry Grass Woodland - E. albens / Microleana stipoides / Bothriochloa macra	7,053	86,724	92
118. Western Slopes Dry Grass Forest - E. sideroxylon/ E. blakelyi/ E. goniocalyx/ Elymus scaber	486	4,673	90
120. Western Slopes Shrub/Herb/Grass Dry Forest - E. macrorhyncha / E. albens / Hydrocotyle laxiflora / Microlaena stipoides	11,139	82,545	87
154. Tableland Dry Grassy Woodland - E. bridgesiana / Themeda australis	12,713	262,205	95
159. Northern Slopes Dry Grass Woodland - E. blakelyi/ E. bridgesiana/ E. melliodora/ Aristida ramosa	591	17,183	97
160. Northern Slopes Dry Grass Woodland - E. blakelyi/ E. melliodora/ Danthonia racemosa/ Austrostipa scabra subsp. falcata	12,902	335,030	96

161. Tablelands and Slopes Dry Herb/Grass Woodland - E. melliodora/ Austrodanthonia racemosa	1,918	88,499	98
162. Western Slopes Moist Herb/Sedge/Grass Woodland - E. blakelyi/ Carex appressa	173	2,929	94
163. Central North Slopes Dry Grass Woodland - E. blakelyi/ Danthonia racemosa/ Cheilanthes sieberi	406	7,428	95
SUB-TOTAL	59,468	1,012,052	94
South West Slopes (Upper Slopes Province) from Friday (in prep.)			
10. South West Slopes Box Gum Woodland (Woody vegetation)	39,413	902,173	96
11. Alluvial Flats Grassy Woodland (Woody vegetation)	16,385	402,332	96
SUB-TOTAL	55,798	1,304,505	96
TOTAL	250,729	3,717,366	93

Victoria

Data from Victoria show that Ecological Vegetation Classes containing this ecological community have been heavily depleted, with only 6% of the original, pre-1750 distribution remaining. As this ecological community tends to occur on fertile soils, it has been preferentially cleared, and is highly modified through grazing where it remains., The extant ecological community in Victoria is likely to be considerably less than 6%.

Table 3. Extant and pre-clearing extent of Box – Gum Grassy Woodland and Derived Grassland communities in Victoria

Vegetation type	Current Area (ha)	Pre-1750 Area (ha)	% cleared
Dataset provided by Vic. Department of Sustainability and Environment			
Victorian Riverina - Valley Grassy Forest	70	2,144	97
Victorian Riverina - Plains Grassy Woodland	2,926	207,516	99
Victorian Riverina - Grassy Woodland	1,276	41,937	97
Goldfield - Valley Grassy Forest	5,147	21,428	76
Goldfield - Plains Grassy Woodland	1,140	33,445	97
Goldfield - Grassy Woodland	27,427	411,427	93
Northern Inland Slopes - Valley Grassy Forest	10,310	132,961	92
Northern Inland Slopes - Plains Grassy Woodland	92	8,166	99
Northern Inland Slopes - Grassy Woodland	7,152	104,315	93
Highlands - Northern Fall - Valley Grassy Forest	1,896	7,676	75
Highlands - Northern Fall - Plains Grassy Woodland	24	222	89
Highlands - Northern Fall - Grassy Woodland	3,900	5,390	28
TOTAL	61,360	976,627	94

Queensland

Data from Queensland show that Regional Ecosystems containing this ecological community have been cleared by almost 70%, with a proportion of these regional ecosystems likely to be shrubby woodlands, rather than grassy woodlands. As grassy areas are likely to exist on more fertile soils and have been cleared preferentially, it is likely that the degree of clearing is greater than 70%. As the areas remaining have been modified through grazing, it is likely that only a small proportion of these areas would be in sufficient condition to be the ecological community as defined.

Table 4. Extant and pre-clearing extent of Box – Gum Grassy Woodland and Derived Grassland communities in Queensland

Vegetation type	Current Area (ha)	Pre-1750 Area (ha)	% cleared
Queensland Regional Ecosystems (Environment Protection Agency 2003)			
<i>11.3.23. Eucalyptus conica, E. tereticornis, Angophora floribunda ± E. melliodora ± E. nobilis grassy woodland.</i>	980	2,181	55
11.8.2a. Eucalyptus tereticornis and E. melliodora occurring on low hills	10,267	25,932	60
11.8.8. Eucalyptus albens ± E. crebra ± E. tereticornis ± Callitris baileyi grassy woodland	37,015	79,337	53
11.9.9a Eucalyptus albens ± E. crebra ± E. tereticornis ± Callitris baileyi woodland	19,312	34,392	44
<i>12.8.16 (only at the far western edge of the bioregion). Eucalyptus crebra, generally with E. tereticornis and E. melliodora ± E. albens grassy woodland.</i>	25,660	78,130	67
<i>13.3.4. Eucalyptus conica, E. microcarpa or E. moluccana, E. melliodora grassy woodland.</i>	1,993	37,623	95
13.3.1. Eucalyptus blakelyi grassy woodland or open forest +/- E. bridgesiana +/- E. melliodora on Cainozoic alluvial plains	2,269	7,299	69
<i>13.11.3. Eucalyptus crebra, E. dealbata, E. albens grassy woodland.</i>	85,490	310,702	72
<i>13.11.4. Eucalyptus melanophloia, E. dealbata, E. albens ± Callitris glaucophylla grassy woodland.</i>	48,997	117,387	58
13.11.8. Woodland of E. melliodora and/or E. microcarpa/moluccana on rolling hills, depressions and lower slopes around drainage lines.	17,754	91,043	80
13.12.8. Woodland of E. melliodora and/or E. microcarpa/moluccana +/- conica, on undulating plains and lower slopes in granite basins.	776	14,963	95
13.12.9. Woodland to open forest of E. blakelyi and/or E. calignosa or E. mckieana on plains and rolling hills in granite basins.	5,978	32,696	82
NB: The ecological community is likely to make up less than 20% of those regional ecosystems that are in italics. These have been excluded from the calculations.			
TOTAL	93,371	285,662	67

Overall

This ecological community has been heavily cleared across most of its range. The remaining extent of the ecological community is highly fragmented, occurring in small isolated patches within a cleared environment, or within a landscape of other disturbed woodlands.

The available data show that over 90% of the original extent of this ecological community has been cleared (Table 5). Of the remaining area, a large proportion of it has been modified and occurs as trees over a predominantly exotic understorey. The Committee judge that less than 5% of the original extent of the ecological remains of sufficient condition and size to be included in the listed ecological community, having undergone a decline of 95% or more.

The ecological community is therefore **eligible for listing as critically endangered** under this criterion.

Table 5 – Overall Extant and Pre-Clearing extents of Box - Gum Grassy Woodland and Derived Grassland Communities

State	Current Area (ha)	Pre-1750 Area (ha)	% cleared
Queensland	93,371	285,662	67
New South Wales	250,729	3,717,366	93
Australian Capital Territory	10,865	32,000	66
Victoria	61,360	976,627	94
TOTAL	416,325²	5,011,655	92³

2 Note this estimate includes areas in poor condition and therefore covers a much larger area than the listed ecological community.

3 Due to the estimate of current extent being greater than the listed ecological community this figure is an under-estimate of decline.

Criterion 2 - Small geographic distribution coupled with demonstrable threat

The extent of occurrence of this ecological community is very large, notwithstanding that it has undergone a severe decline in area of occupancy due to both clearing and degradation. It is difficult to ascertain the current area of the ecological community as defined. The figures used to address Criterion 1 are indicative of relative decline and cannot be used to determine actual extent.

There is no doubt that this ecological community is subject to ongoing threats across its range. These include further clearing, deterioration of remnant condition and degradation of the landscape in which remnants occur (NSW Scientific Committee 2002).

Of particular concern is the threat to posed to some of the highest quality remnants, on Travelling Stock Routes and Reserves, through the increasing trend of converting intermittent grazing regimes to more intensive or set stocking regimes (Prober & Thiele 1995).

While this ecological community is subject to demonstrable, ongoing threats, there are insufficient data to determine the current degree of these threats across the dispersed remnants of this ecological community. There are also insufficient data to accurately determine its current area. Therefore it is **not eligible** for listing under this criterion.

Criterion 3 - Loss or decline of functionally important species

Degradation and fragmentation of this ecological community involves, amongst other things, the loss of suites of species, such as woodland birds, understorey plant species and soil crusts. These can sometimes be replaced, functionally, by more common or exotic species, but more often the species, and their function within the ecological community, simply disappear. For example the loss of shrubs from the understorey may result in the loss of insectivorous woodland bird species (Barrett *et al.* 1994) and invasion by the aggressive native bird species, Noisy Miner (*Manorina melanocephala*). It has been observed that eucalypt dieback can be more severe in patches with a degraded understorey that are occupied by Noisy Miners than in areas with an intact understorey (Clarke *et al.* 1995). Another example of the decline of - functional species is the loss of perennial ground cover species, which, in combination with invasion by exotic annual species, alters nutrient cycling patterns in remnants (Prober *et al.* 2002b).

This criterion refers to native species that are functionally important in the processes that sustain or play a major role in the ecological community. It is clear that their removal has the potential to precipitate change in structure or function sufficient to lead to the eventual extinction of the ecological community.

It is known that these woodlands and grasslands are losing suites of functionally important species, and that these losses are detrimentally impacting upon the ecological community. However, there are insufficient quantitative data available on the timing and severity of these impacts at this time. The ecological community is therefore **not eligible** for listing under this criterion.

Criterion 4 - Reduction in community integrity

There has been an overall reduction in the integrity of this ecological community compared with its pre-1750 state. There are essentially no areas remaining that could be considered fully intact, as most patches have at least some degree of weed invasion. The majority of the remaining extent has lost its native understorey, lost whole suites of species, been invaded by exotic species or lost structural integrity in terms of the loss of shrub, tree or ground layers. Further invasion by exotic species and landscape-scale effects such as salinity, nutrient enrichment, soil structural decline and altered fire regimes are likely to detrimentally effect the integrity of the remaining ecological community in the future.

Understorey diversity

In general, the diversity of understorey flora species has decreased across the range of the ecological community, primarily as a result of grazing and pasture improvement. Clearing the understorey for cropping and cultivated pasture eliminates the native species, including any soil-stored seed, preventing the re-establishment of a native understorey without assistance. As a result of this, very few patches with a predominantly native understorey remain, particularly in the central and southern part of the range, where cultivation for crops and pasture improvement has been more prevalent.

Grazing has further reduced the diversity of the understorey across most remaining sites. Grazing-sensitive species such as Kangaroo Grass and Snow Grass, and a large number of grazing-sensitive forbs, have been largely removed. As many grasses and forbs do not form persistent soil seed banks, once plants have been eliminated from the standing vegetation, they are unable to re-establish naturally, even if grazing pressure is removed (Cole *et al.* 2004). Grazing also compacts the soil, which often prevents seeds from germinating (Cole *et al.* 2004).

The degree of degradation of a patch varies with the grazing regime history. Constant grazing pressure throughout the year is more likely to eliminate grazing-sensitive species than intermittent or seasonal stocking. This is why travelling stock routes and reserves, which generally have only had intermittent grazing, often contain some of the best remnants. An ongoing threat to the integrity of this ecological community is the change of grazing regimes on travelling stock routes and reserves from intermittent grazing to set stocking.

Understorey species diversity has also been lost, and continues to be lost, through the effects of the severe fragmentation. If population sizes are too small, the local extinction of species from a patch can occur at random. Small areas are also more susceptible to weed invasion. In addition, many of the remaining areas in best condition occur on linear reserves such as travelling stock routes and road reserves. While these linear remnants are important for conservation, they are particularly prone to invasion by weeds, such as Coolatai Grass

(*Hyparrhenia hirta*)(McArdle *et al.* 2004).

With the combination of these factors, the integrity of the understorey has generally been reduced to the extent that regeneration is unlikely, even with immediate intervention. For example, Spooner *et al.* (2002) found that stock exclusion can lead to rapid improvements in native plant composition, particularly perennial grass cover. However it is highly unlikely that fencing alone would restore the composition of the original ground layer, as grazing-sensitive species are often absent or very rare in most sites, and vulnerable to weed invasion (Spooner *et al.* 2002).

Overstorey health and regeneration

The health of the overstorey trees is in decline in many areas across the range of the ecological community.

Dieback is affecting many overstorey trees. In some cases this may be due to insect attack, exacerbated by a decline in insectivorous birds or increased soil nutrients which make leaves more attractive to insects. Salinity may also affect trees, particularly Blakely's Red Gum, which occurs in lower topographical areas.

In addition to dieback, many overstorey trees are simply very old. As there is a general lack of regeneration of overstorey trees, dying trees are not being adequately replaced across the range of the ecological community (Reid & Landsberg 2000).

Regeneration is being impeded by a number of factors, including: compacted soils preventing seed germination; seedling competition with understorey weeds for resources; grazing of seedlings by stock; genetic inbreeding arising from small tree populations and isolation; and the reduced fertility of old and ailing trees.

Excluding stock may improve regeneration, but successfully addressing the other issues affecting regeneration and tree retention is not likely to be possible even with immediate human intervention.

Salinity

Rising saline water tables are threatening the persistence of remnant woodland patches (Yates & Hobbs 1997). The natural range of this ecological community contains some of the most extensive areas of dry land salinity in the country. For example, the mapping of Littleboy *et al.* (2001) showed a total of 93,000 ha of land in the south west slopes of NSW affected by salinity. Impacts are particularly severe on the Yellow Box – Red Gum component of the ecological community as it occupies lower topographical positions where the water table intersects the ground surface and salinisation occurs.

Salinity affects both the understorey and overstorey in remnant woodland. It causes dieback in the overstorey eucalypts, resulting in feedback, in which the death of these trees further disrupts groundwater hydrology, causing further salinity, which in turn contributes to more tree deaths (Briggs & Taws 2003). In a study of remnant woodland in the wider Yass region, Briggs and Taws (2003) found that salinised remnants had 50% more exotic species and over twice the cover of exotic plants than non-salinised sites of the same vegetation type. Most (90%) salinised patches of woodland surveyed in this study were dominated by Yellow Box and/or Blakely's Red Gum (Briggs & Taws 2003; Taws 2003). Salinity and rising groundwater threaten many of the remaining patches of this ecological community, particularly those dominated by Yellow Box and Blakely's Red Gum, even those currently in good condition. While efforts are underway to control salinity, altering these processes at the landscape level is unlikely to be possible within the immediate future.

Weed invasion

Weed invasion is, and continues to be one of the key mechanisms and indicators of degradation of this ecological community. Direct threats such as grazing, soil disturbance and nutrient enrichment also facilitate weed invasion. Environmental weeds impacting upon this ecological community include both agricultural weeds, such as Coolatai Grass and introduced exotic pasture grasses, such as *Phalaris*.

Weeds have invaded most of the remaining areas of the original pre-1750 extent of this ecological community. Austin et al (2000) found that only 8% of Yellow Box – Red Gum Woodland sites had greater than 50% cover of native species.

Increased nutrient content of soils, due to inputs such as fertiliser, manure and decomposing annual weeds, increases the competitive advantage of weeds over native grass species. Prober et al (2004b) have had some success in re-establishing native grasses and reducing annual weeds by reducing the nitrogen content of the soil through hot spring burns or adding sugar to the soil. These processes, while successful, are resource intensive and unlikely to be applicable on a broad scale.

Patches that have been heavily invaded by annual weeds may still have a substantially native understorey outside of spring and annual weeds can be controlled to a certain extent through appropriate grazing techniques or fire regimes (Prober *et al.* 2004a). Perennial weeds are a more intractable problem.

Coolatai Grass is a weed that has been recognised as having a direct impact on rare or threatened native plant species (Groves *et al.* 2003). This weed now dominates the ground layer of many of the White Box and Grey Box woodlands on roadside reserves between Manilla and the Queensland border (Nadolny undated). It is found extensively on the north west slopes and northern tablelands of NSW, and also occurs on the central and southern slopes and central and north coast areas (McArdle *et al.* 2004). Coolatai Grass spreads rapidly and has invaded many areas of previously high quality woodland (Nadolny undated). It forms dense swards that smother most native plants (Nadolny undated). It is able to gain a foothold by rapidly colonising disturbed sites, but it can also invade adjacent undisturbed native vegetation (Nadolny undated). This perennial grass is a serious threat to the future of the ecological community.

Fire regime

A further threat to the integrity of the ecological community is altered fire regimes. While the pre 1750 fire regime is largely unknown, there can be little doubt that the pattern and frequency of fire has changed considerably.

The general exclusion of fire from small fragments increases the likelihood that species which existed under a more frequent fire regime may be lost. Kangaroo Grass is known to benefit from a frequent fire regime, and weeds seem to be less prevalent in frequently burnt patches. Whereas fires most likely burnt in a mosaic in the past, as a result of fragmentation, unmanaged fires now tend to burn an entire patch at once, leaving no refuge for fire sensitive plants and animals to survive and subsequently recolonise.

The processes outlined above that have degraded, and continue to degrade this ecological community are difficult to reverse, and successful restoration techniques are only beginning to be developed (Yates & Hobbs 1997).

The ecological community continues to be degraded at both the patch and landscape scale. This ongoing modification, while not necessarily leading to the total destruction of all elements of the ecological community, threatens it with extinction. The reduction in the

integrity of this ecological community across most of its range has been very severe. The changes have been such that re-establishment of the ecological processes, species composition and community structure of the original ecological community is not likely to be possible, even with immediate positive human intervention. The ecological community is therefore **eligible for listing as critically endangered** under this criterion.

Criterion 5 - Rate of continuing detrimental change

This ecological community is undergoing continuing detrimental change due to weed invasion, ongoing grazing and clearing, conversion to set stocking, and the effects of fragmentation. However, there are no quantitative data indicating the rate at which these threats are causing change, therefore, this ecological community is **not eligible** for listing under this criterion.

Criterion 6 - Quantitative analysis showing probability of extinction

There is no quantitative information addressing this criterion for the Box Gum Grassy Woodland and Derived Grassland ecological community. Therefore, this ecological community is **not eligible** for listing under this criterion.

6. Conclusion

The Threatened Species Scientific Committee has framed this recommendation after considerable preliminary work on ecological communities in general. The ecological community that is the subject of this recommendation was chosen as one of the most difficult ecological communities to deal with and the framing of this recommendation represents a significant development in ecological community listing.

For reasons given under Criterion 1 and further discussed under Criteria 2, 3 and 4 the Committee concludes that the more extensive ecological community, White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland, is eligible for listing as critically endangered. It meets Criterion 1 as critically endangered due to its very severe decline in geographic distribution; and Criterion 4 as critically endangered as its integrity is being very severely reduced across most of its geographic range.

7. Recommendation

In light of the conclusion above the TSSC recommends that:

- the list referred to in section 181 of the EPBC Act be amended by deleting from the list in the endangered category: “Grassy White Box Woodlands”.
- the list referred to in section 181 of the EPBC Act be amended by including in the list in the critically endangered category: “White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland”.

Associate Professor Robert J.S. Beeton
Chair
Threatened Species Scientific Committee

Conservation Advice

The White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Grassland ecological community occurs in the Condamine, Border Rivers/Gwydir, Northern Rivers, Namoi, Central West, Hunter/Central Rivers, Lachlan, Hawkesbury Nepean, Murrumbidgee, Australian Capital Territory, Southern Rivers, Murray, Goulburn Broken, North East (Vic) East Gippsland and Port Phillip and Westernport NHT regions. It has suffered a severe decline in extent and condition, and remaining areas are generally small and highly fragmented.

The key threats to the survival of the ecological community include clearing, grazing and weed invasion. Other threats include salinity, nutrient enrichment, altered fire regimes and the effects of fragmentation.

The priority recovery and threat abatement actions required for the listed ecological community include:

- protection of remnants of the listed ecological community through the development of conservation agreements and covenants;
- protection of remnants from weeds, particularly Coolatai Grass, by preventing soil disturbance in and around remnants, and the speedy eradication of any new invasion;
- avoid the use of fertilisers in or near remnants
- avoid soil disturbance in or near remnants, such as ripping planting lines and road grading;
- in very small derived grassland sites, avoid planting trees as they may reduce the floral diversity through competition for light, nutrients and water;
- planting and other rehabilitation-focussed disturbance should focus on the edges of patches, expanding them, rather than within the patches;
- expansion and connection of existing remnants;
- exclusion of continuous grazing from remnants is important, coupled with weed management and control;
- use strategic grazing (incorporating rest at appropriate times) in areas still containing a diverse native understorey;
- burning or slashing if native tussock grasses have built up to a high level, to open inter-tussock spaces for tree seedlings, forbs and shrubs to establish; and,
- for assistance and advice in implementing any of these suggested actions, land managers can contact the Grassy Woodlands Conservation Management Network.

This list does not encompass all actions that may be of benefit to this ecological community, but highlights those that are considered to be of the highest priority at the time of listing.

A draft recovery plan for Grassy White Box Woodland, a component of this ecological community, has been released for public comment.

Priority for the development of recovery plan: high.

Associate Professor Robert J.S. Beeton
Chair
Threatened Species Scientific Committee

Table 2. Species recorded in Box – Gum Grassy Woodlands and Derived Grasslands listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*.

Species	Conservation Status
Plants	
Austral Toadflax (<i>Thesium australe</i>)	Vulnerable
Button Wrinklewort (<i>Rutidosis leptorrhynchoides</i>)	Endangered
<i>Dichanthium setosum</i>	Vulnerable
Euroa Guinea-flower (<i>Hibbertia humifusa</i> spp. <i>erigens</i>)	Vulnerable
Hoary Sunray (<i>Leucochrysum albicans</i> var. <i>tricolor</i>)	Endangered
Lobed Blue-grass (<i>Bothriochloa biloba</i>)	Vulnerable
Narrow Goodenia (<i>Goodenia macbarronii</i>)	Vulnerable
Small Purple-pea (<i>Swainsona recta</i>)	Endangered
Tarengo Leek Orchid (<i>Prasophyllum petilum</i>)	Endangered
Yass Daisy (<i>Ammobium craspedioides</i>)	Vulnerable
Invertebrates	
Bathurst Copper Butterfly (<i>Paralucia spinifera</i>)	Vulnerable
Golden Sun Moth (<i>Synemon plana</i>)	Critically Endangered
Reptiles	
Pink-tailed Worm-lizard (<i>Aprasia parapulchella</i>)	Vulnerable
Striped Legless Lizard (<i>Delma impar</i>)	Vulnerable
Birds	
Plains-wanderer (<i>Pedionomus torquatus</i>)	Vulnerable
Regent Honeyeater (<i>Xanthomyza phrygia</i>)	Endangered
Superb Parrot (<i>Polytelis swainsonii</i>)	Vulnerable
Swift Parrot (<i>Lathamus discolor</i>)	Endangered
Mammals	
Spotted-tail Quoll (<i>Dasyurus maculatus maculatus</i>) SE mainland population	Endangered

References

ACT Government (2004). Woodlands for Wildlife: ACT Lowland Woodland Conservation Strategy. Action Plan No. 27. Environment ACT, Canberra.

Austin, M.P., Cawsey, E.M., Baker, B.L., Yialeloglou, M.M., Grice, D.J. & S.V. Briggs (2002). Predicted Vegetation Cover in Central Lachlan Region. Final Report of the Natural Heritage Trust Project AA 1368.97. CSIRO Wildlife and Ecology, Canberra.

- Barrett, G.W., Ford, H.A. & H.F. Recher (1994). Conservation of woodland birds in a fragmented rural landscape *in* *Pacific Conservation Biology* 1:245-256.
- Beadle, N.C.W. (1981). *The Vegetation of Australia*. Cambridge University Press, Cambridge.
- Briggs, S.V. & N. Taws (2003). Impacts of salinity on biodiversity - clear understanding or muddy confusion? *in* *Australian Journal of Botany* 51: 609-617.
- Clarke, M.F., Grey, M.J., Britton, D.R. & R.H. Loyn (1995) The Noisy Miner *Manorina melanocephala* and rural dieback in remnant eucalypt woodlands. RAOU Report No. 98, November 1995.
- Cole, I., Lunt, I.D. & T. Koen (2004). Effects of soil disturbance, weed control and mulch treatments on establishment of *Themeda triandra* (Poaceae) in a degraded White Box (*Eucalyptus albens*) woodland in central western New South Wales *in* *Australian Journal of Botany* 52:629-637.
- CRA Unit, Northern Zone NPWS (1999). Forest Ecosystem Classification and Mapping for Upper and Lower North East CRA Regions. A project undertaken for the Joint Commonwealth NSW Regional Forest Agreement Steering Committee as part of the NSW Comprehensive Regional Assessments project number NA35/EH. Accessed on 8/11/04 at http://www.affa.gov.au/corporate_docs/publications/word/forestry/rfa/nsw/northeast/nsw_ne_na35eh.doc.
- Environment Australia (2000). Interim Biogeographic Regionalisation of Australia. Version 5.1. Accessed on 8/11/04 at <http://www.deh.gov.au/parks/nrs/ibra/index.html>.
- Environment Protection Agency (2003). Regional Ecosystem Description Database (REDD) Version 3.2. Accessed on 8/11/04 at http://www.epa.qld.gov.au/nature_conservation/biodiversity/regional_ecosystems/introduction_and_status/.
- Fischer, J., Lindenmayer, D.B. & A. Cowling (2004). The challenge of managing multiple species at multiple scales: reptiles in an Australian grazing landscape *in* *Journal of Applied Ecology* 41: 32-44.
- Gibbons, P. & M. Boak (2002). The value of paddock trees for regional conservation in an agricultural landscape *in* *Ecological Management and Restoration* 3: 205-210.
- Groves, R.H., Hosking, J.R., Batianoff, G.N., Cooke, D.A., Cowie, I.D., Johnson, R.W., Keighery, G.J., Lepschi, B.J., Mitchell, A.A., Moerkerk, M., Randall, R.P., Rozefelds, A.C., Walsh, N.G. & B.M. Waterhouse (2003). Weed categories for natural and agricultural ecosystem management. Bureau of Rural Sciences, Canberra.
- Littleboy, M., Piscopo, G., Beecham, R., Barnett, P., Newman, L. & N. Alwood (2001). Dryland Salinity Extent and Impacts, New South Wales: Technical Report for the National Land and Water Resources Audit. Prepared by the Department of Land and Water Conservation for the National Land and Water Resources Audit, Canberra.
- McArdle, S.L., Nadolny, C. & B.M. Sindel (2004). Invasion of native vegetation by Coolatai Grass *Hyparrhenia hirta*: impacts on native vegetation and management implications *in* *Pacific Conservation Biology* 10: 49-56.
- McIntyre, S., McIvor, J.G. & K.M. Heard (Eds) (2002). *Managing & Conserving Grassy Woodlands*. CSIRO, Collingwood.

Nadolny, C. (undated). Woodlands – What’s so special about them? Accessed on 16/11/04 at <http://www.dipnr.nsw.gov.au/nativeveg/pdf/woodlands.pdf>.

NSW Scientific Committee (2002). White Box Yellow Box Blakely’s Red Gum Woodland – endangered ecological community listing. Final Determination. Accessed on 16/11/04 at <http://www.nationalparks.nsw.gov.au/npws.nsf/content/box-gum+woodland+endangered+ecological+community+listing>.

NSW National Parks and Wildlife Service (2000) *Nandewar Draft Bioregional Scoping Study*.

NSW National Parks and Wildlife Service (2002). White Box Yellow Box Blakely's Red Gum Woodland Fact Sheet. Accessed on 16/11/04 at http://www.nationalparks.nsw.gov.au/pdfs/box-gum_factsheet.pdf.

Friday, S.D. (in prep.). The Native Vegetation of the NSW South Western Slopes Bioregion (within the Lachlan, Murrumbidgee and Murray Catchments).

Friday, S.D. & Mulvaney, M. (2004). DRAFT REPORT The Native Vegetation and Threatened Species of the City of Wagga Wagga. Department of Environment and Conservation, NSW.

Friday, S., Mulvaney, M., Gellie, N. & K. Hudson (2002). The Native Vegetation of the Boorowa Shire. NSW National Parks and Wildlife Service.

Prober, S.M. (1996). Conservation of Grassy White Box Woodlands: rangewide floristic variation and implementations for reserve design *in* Australian Journal of Botany 44: 57-77.

Prober, S.M. & K.R. Thiele (1993). The ecology and genetics of remnant Grassy White Box Woodlands in relation to their conservation *in* Victorian Naturalist 110: 30-36.

Prober, S.M. & K.R. Thiele (1995). Conservation of the Grassy White Box Woodlands: Relative Contributions of Size and Disturbance to Floristic Composition and Diversity of Remnants *in* Australian Journal of Botany 43: 349-366.

Prober, S.M. & K.R. Thiele (in press). Floristic Patterns Along an East-West Gradient in Grassy Box Woodlands of Central New South Wales.

Prober, S.M., Thiele, K.R. & T.B. Koen (2004a). Spring burns control exotic annual grasses in a temperate grassy woodland *in* Ecological Management and Restoration 3: 131-136.

Prober, S.M., Thiele, K.R. & I.D. Lunt (2002a). Determining reference conditions for management and restoration of temperate grassy woodlands: relationships among trees, topsoils and understorey flora in little-grazed remnants *in* Australian Journal of Botany 50: 687-697.

Prober, S.M., Thiele, K.R. & I.D. Lunt (2002b). Identifying barriers to restoration in temperate grassy woodlands: soil changes associated with different degradation states *in* Australian Journal of Botany 50: 699-712.

Prober, S., Thiele, K. & I. Lunt (2004b) Add Sugar and Kangaroo Grass and Burn in Spring - A Recipe for Success in Woodland Understorey Restoration? *in* Woodland Wanderings 4(Autumn).

Reid, N. & Landsberg, J. (2000). Tree decline in agricultural landscapes: what we stand to lose *in* Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration (Eds Hobbs, R. J. & C. J. Yates). Surrey Beatty and Sons, Chipping Norton, pp. 127-166.

Seddon J., Briggs S. & S. Doyle (2002). Little River Catchment Biodiversity Assessment. A report for the TARGET project. Accessed on 16/11/04 at http://www.nationalparks.nsw.gov.au/PDFs/little_river_catchment_bio_ass.pdf.

Sivertsen, D. (1993). Conservation of Remnant Vegetation in Box and Ironbark Lands of New South Wales *in* Victorian Naturalist 110: 24-29.

Spooner, P., Lunt, I. & W. Robinson (2002). Is fencing enough? The short-term effects of stock exclusion in remnant grassy woodlands in southern NSW *in* Ecological Management and Restoration 3: 117-126.

Taws, N. (2003). Woodland Remnants and Dryland Salinity. Final report to the NSW National Parks and Wildlife Service. Greening Australia ACT & SE NSW, Canberra.

Thiele, K.R. & S.M. Prober (2000). Reserve concepts and conceptual reserves: options for the protection of fragmented ecosystems *in* Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration (Eds Hobbs, R. J. & C. J. Yates). Surrey Beatty and Sons, Chipping Norton, pp. 351-358.

Thomas, V., Gellie, N. & T. Harrison (2000). Forest ecosystem classification and mapping for the Southern CRA region, Volume II Appendices. NSW National Parks & Wildlife Service, Southern Directorate. A report undertaken for the NSW CRA/RFA Steering Committee.

Voller, P., Moye, R., Stickler, R., Gray, J., Dowling, M., Brown, H. & R. Kerr (2003). DRAFT New England Tablelands Bioregion Regional Vegetation Management Plan.

Yates, C.J. & R.J. Hobbs (1997) Temperate Eucalypt Woodlands: a review of their status, processes threatening their persistence and techniques for restoration *in* Australian Journal of Botany 45: 949-973

Glossary

Derived Grassland (also known as secondary grassland) – an expression of the ecological community that develops when the tree canopy cover of the grassy woodland is removed or suffers dieback and natural regeneration is prevented, and in which the understorey remains relatively intact.

Ground layer – the structural layer closest to the ground containing grasses, forbs and sub-shrubs.

Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:

- an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
- the area over which the understorey is predominantly native.

Patches must be assessed at a scale of 0.1 ha (1000m²) or greater.

Regeneration of dominant overstorey species – the patch contains eucalyptus saplings of 5 cm diameter at breast height or greater.

Predominantly native understorey – 50% of the perennial vegetation cover in the ground layer is made up of native species.