***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)**
Conservation Advice for
Lowland Grassy Woodland in the South East Corner Bioregion

1. The Threatened Species Scientific Committee (the Committee) was established under the EPBC Act and has obligations to undertake assessments and present advice to the Minister for Sustainability, Environment, Water, Population and Communities (the Minister) in relation to the listing and conservation of threatened ecological communities, including under sections 189, 194N and 266B of the EPBC Act.
2. The Committee provided its advice on the *Lowland Grassy Woodland in the South East Corner Bioregion* ecological community to the Minister as a draft of this approved conservation advice. In 2013, the Minister accepted the Committee's advice, adopting it as the approved conservation advice.
3. The Minister amended the list of threatened ecological communities under section 184 of the EPBC Act to include the *Lowland Grassy Woodland in the South East Corner Bioregion* ecological community in the critically endangered category. It is noted that parts of the ecological community are also listed as the *Lowland Grassy Woodland in the South East Corner Bioregion* under the New South Wales (NSW) *Threatened Species Conservation Act 1995*.
4. The nomination and a draft description for this ecological community were made available for expert and public comment for a minimum of 30 business days. The Committee and Minister had regard to all public and expert comment that was relevant to the consideration of the ecological community.
5. This approved conservation advice has been developed based on the best available information at the time it was approved; this includes scientific literature, advice from consultations, existing plans, records or management prescriptions for this ecological community.

Table of Contents

Description

Name of the ecological community

Lowland Grassy Woodland in the South East Corner Bioregion

The Committee has determined the name of the ecological community to be Lowland Grassy Woodland in the South East Corner Bioregion.

The Lowland Grassy Woodland in the South East Corner Bioregion was listed in 2007 under the (NSW) *Threatened Species Conservation Act 1995* (NSW TSC Act) with the same name. The NSW listing was previously listed as two ecological communities: Candelo Dry Grass Forest and Bega Dry Grass Forest.

Location and Physical environment

The Lowland Grassy Woodland in the South East Corner Bioregion ecological community (hereafter referred to as the Lowland Grassy Woodland or the ecological community) originally occupied much of the lower parts of the landscape on rolling hills of the coastal river valleys in the NSW part of the South East Corner bioregion (south of, and including, the Clyde River catchment) (Interim Biogeographical Regionalisation of Australia (IBRA) version 7). Former strongholds include the Bega and Cobargo valleys and the Moruya area with smaller patches at Belowra, in the upper Towamba Valley and a few locations (with higher soil fertility) closer to the coast (e.g. Coila, Bingie Bingie, Tanja and Goalen Head) (Miles, 2006; NSW Scientific Committee, 2007; Tozer et al., 2010) including basalt derived clay loams in coastal areas of the Eurobodalla Shire (e.g. Congo) (NGH Environmental, 2007). Further inland and at higher elevation, the sandy granitoid soils of the Araluen Valley also support grassy woodlands that are part of the ecological community (Tindall et al., 2004; Tozer et al., 2010).

The ecological community is associated with rainshadow areas (mean annual rainfall 750 – 1100 mm/year) on undulating terrain at altitudes below 500 metres above sea level (asl). These areas usually occur on relatively fertile soils on granite substrates or other igneous rock (e.g. adamellites, granites, granodiorites, gabbros) or occasionally on soils derived from Ordovician metasediments and basalt, where they occur within granite areas (e.g. acid volcanic, alluvial and fine-grained sedimentary substrates).

The Lowland Grassy Woodland has been cleared or substantially modified by farming and development and no unmodified examples remain. Remnants are confined to private property or small public reserves such as Travelling Stock Reserves, cemeteries and roadsides.

A Distribution Map of the ecological community can be found at Appendix A.

Vegetation

The Lowland Grassy Woodland ecological community typically occurs as a grassy woodland but may also exhibit a more open forest structure. The species composition of a patch of Lowland Grassy Woodland is influenced by the size of the site, recent rainfall or drought conditions and disturbance history (including grazing, land clearing and fire). The number and relative abundance of species changes with time since fire, and may also change in response to changes in fire frequency or grazing regime (NSW Scientific Committee, 2007).

A large proportion of the species diversity in the ecological community is found in the grasses and forbs of the ground layer. Identification of indicator species is easier in spring (for forbs) and summer (for grasses) than in cooler parts of the year when species diversity can appear very low (Miles, 2006).

Canopy layer

The ecological community is composed of trees with a mature canopy height of up to about 20 metres. The community typically has a projected foliage cover[1] of 15-30 %; however, management may result in a temporary higher level of canopy cover.

The canopy is typically dominated by *Eucalyptus tereticornis* (forest red gum) and/or *Angophora floribunda* (rough barked apple). Associated tree species include *E. globoidea* (white stringybark) and *E. bosistoana* (coastal grey box). *Eucalyptus pauciflora* (snow gum) or *E. melliodora* (yellow box) may be dominant in some areas. Some areas have limited occurrences of forest red gum and rough barked apple. For example, Lowland Grassy Woodland in the Towamba Valley is more commonly dominated by yellow box and snow gum.

Hybrids of some eucalypt species may also be present in the canopy layer. Smaller trees such as *Acacia* may sometimes be present but are generally part of the mid-storey or shrub layer.

Mid Layer

A shrub layer is often present as an open to sparse layer, typically with *Acacia mearnsii* (black wattle) or *Ozothamnus diosmifolius* (sago flower). Some patches, or areas within a patch, have a dense shrub layer and consist mainly of *Bursaria spinosa* (sweet bursaria, blackthorn).

Ground layer

The ecological community typically has a near continuous groundcover dominated by grasses and forbs. Typical species present include grasses such as *Themeda triandra* (kangaroo grass), *Eragrostis leptostachya* (paddock lovegrass), *Microlaena stipoides* (weeping grass), *Poa labillardieri* (tussock grass), *Echinopogon caespitosus* (tufted hedgehog-grass), *E. ovatus* (forest hedgehog-grass), *Rytidosperma racemosum* var. *racemosum*[2] (formerly *Austrodanthonia racemosa* var. *racemosa*; clustered wallaby-grass), *Sorghum leiocladum* (wild sorghum) and *Dichelachne micrantha* (short-haired plume-grass); and forbs such as *Desmodium varians* (slender tick-trefoil), *Dichondra repens* (kidney weed), *Euchiton gymnocephalus* (creeping cudweed), *Geranium solanderi* (native geranium), *Glycine clandestina* (twining glycine), *G. tabacina* (variable glycine), *Hypericum gramineum* (small St John's wort), *Hydrocotyle laxiflora* (stinking pennywort); and the fern *Cheilanthes sieberi* (narrow rock-fern) (Keith and Bedward, 1999).

[1] Projected foliage cover is the proportion of the ground covered by the vertical projection of the vegetation.

[2] Following taxonomic revisions (Council of Heads of Australasian Herbaria (CHAH) (2011), Australian Plant Census)

Derived grassland

Some patches of the ecological community now occur in management-induced states that may vary from the typical vegetation description, above. In derived grassland, the canopy layer has been removed or thinned to very scattered trees but the ground layer with or without a shrub layer are intact and retain the native biodiversity components characteristic of these layers, as outlined above.

Derived grasslands are an important part of the broader ecosystem. They contain much of the native plant biodiversity of the ecological community and act as a seed bank and source of genetic material. Derived grasslands also act as buffer zones, that protect the woodland remnants from adjacent activities, and stepping stones that enable the movement of fauna between remnant woodlands. Derived grasslands are therefore important for the survival of the ecological community in an otherwise fragmented, rural landscape and are **included** as part of the ecological community.

There can be evidence from tree stumps, fallen logs, historical records, photographs, surrounding vegetation remnants, or reliable modelling of pre-European vegetation that a patch of derived grassland formerly contained the ecological community. For example, derived grassland patches found in cemeteries which are surrounded by woodland or that could be reasonably inferred from their location to have formerly been this vegetation type should be considered the ecological community as they are important remnants that contain a diverse ground layer.

Fauna

The Lowland Grassy Woodland ecological community supports a variety of fauna. These include larger mammalian herbivores (e.g. kangaroos), smaller ground-dwelling mammals (e.g. bandicoots and dasyurids), arboreal mammals (e.g. possums), bats, woodland birds and reptiles.

Many insectivorous bats are common in the ecological community such as *Vespadelus* sp. (vesper bats), *Chalinolobus* sp. (wattled bats) and *Nyctophilus* sp. (big-eared bats). Other mammal species such as *Macropus giganteus* (eastern grey kangaroo), *M. rufogriseus* (red-necked wallaby), *Tachyglossus aculeatus* (echidna), *Trichosurus vulpecula* (common brushtail possum), *Petaurus breviceps* (sugar glider), *Pseudocheirus peregrinus* (ringtail possum), *Vombatus ursinus* (wombat) and *Wallabia bicolor* (swamp wallaby) are found in the ecological community, particularly where there are connecting strips of native vegetation linking farming land to the surrounding forests (Whelan and Hibberd, 1992; Miles, 2006). *Acrobates pygmaeus* (feather tailed glider), *Cercartetus nanus* (eastern pygmy-possum), *Ornithorhynchus anatinus* (platypus), *Pteropus poliocephalus* (grey-headed flying fox) and *Rattus lutreolus* (swamp rat) have all been recorded in remnant vegetation where the ecological community occurs, and their populations are of local concern (Whelan and Hibberd, 1992). *Phascolarctos cinereus* (koala) (listed as vulnerable under TSC Act and EPBC Act) was once common in the forest red gum forests on fertile soils, such as this ecological community, but it is now mostly confined to small fragmented populations in surrounding forests (Miles, 2006).

Common open country bird species in the ecological community include *Cracticus tibicen* (magpie) and *Eolophus roseicapillus* (galah) (Miles, 2006). There are also many, less common, woodland species in the ecological community including *Acanthiza chrysorrhoa* (yellow-rumped thornbill), *A. reguloides* (buff-rumped thornbill) and *Microeca fascinans* (jacky winter), and migratory species such as *Artamus cyanopterus* (dusky woodswallow), *Cacomantis pallidus* (pallid cuckoo), *Chalcites basalis* (Horsfield's bronze cuckoo), *Eurystomus orientalis* (dollar bird), *Gerygone albogularis* (white throated gerygone) and *Petroica boodang* (scarlet robin). *Stagonopleura guttata* (diamond firetail), scarlet robin and *Ninox connivens* (barking owl) are listed as threatened in NSW because of loss of woodland habitat such as this ecological community.

Some characteristic reptiles of the ecological community include *Amphibolurus muricatus* (jacky lizard), *Pseudechis porphyriacus* (red-bellied black snake) and *Tiliqua scincoides* ssp. *scincoides* (blue tongued lizard).

Further details on flora and fauna species and other relevant biology and ecological interactions and processes can be found at Appendices B and C.

Key diagnostic characteristics and condition thresholds

Much of the Lowland Grassy Woodland has been cleared and what remains is often in a disturbed or degraded state. In many cases the loss and degradation is irreversible, or the potential for rehabilitation is impractical because natural characteristics and function have been removed (for instance, in areas permanently converted to improved pasture).

National listing focuses legal protection on the remaining patches of the ecological community that are functional, relatively natural and in relatively good condition. Key diagnostic characteristics and condition thresholds help identify a patch of the threatened ecological community and when the EPBC Act is likely to apply. They provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered a 'Matter of National Environmental Significance', as defined under the EPBC Act. This means that the referral, assessment and compliance provisions of the EPBC Act will be focussed on the more valuable elements of Australia's natural environment.

Although very degraded/modified patches will not be part of the ecological community listed under the EPBC Act, it is recognised that patches that do not meet the condition thresholds may retain important natural values and may be protected through State/Territory laws or schemes. Therefore, these patches should not be excluded from recovery and other management actions (see *Surrounding environment and national context* on page 11). Suitable recovery and management actions may improve a patch to the point that it can be regarded as part of the ecological community fully protected under the EPBC Act.

Condition thresholds were determined in consultation with experts on the particular ecological community.

The national ecological community is limited to patches that meet the following key diagnostic characteristics and condition thresholds:

Step 1 Key diagnostic characteristics

- The distribution is limited to New South Wales, south of (and including) the Clyde River catchment, and primarily within the South East Corner bioregion (IBRA 7) .
- It typically occurs in coastal or near coastal areas with some more inland outliers around Araluen.
- It typically occurs at elevations below 500m asl.
- The tree canopy is typically dominated by *Eucalyptus tereticornis* (forest red gum) and/or *Angophora floribunda* (rough barked apple). Associated tree species include *E. globoidea* (white stringybark) and *E. bosistoana* (coastal grey box). *Eucalyptus pauciflora* (snow gum) or *E. melliodora* (yellow box) may be dominant in some areas. The tree canopy usually has a maximum projected foliage cover of 30%. A sub-canopy or mid-layer may be present, typically with *Acacia mearnsii*.
- It typically includes a grassy understorey of *Themeda triandra* (kangaroo grass) as well as other grasses and forbs. Occasionally it also has a shrub layer of *Bursaria spinosa* (sweet bursaria, blackthorn).
- It can also occur as a derived grassland.

Step 2 Condition thresholds

The ecological community comprises those patches of native vegetation that meet the key diagnostic characteristics and the following condition thresholds for Type A, B, C, D or E:

Patch type	**A - Woodland** with very diverse understorey	**B - Derived Grassland** where the tree canopy and mid layers were formerly present but have been cleared	**C - Woodland** with a dense *Bursaria spinosa* mid-layer	**D - Woodland** that is less diverse but contiguous with other native vegetation	**E - Woodland** that is less diverse but contains large trees with hollows
Patch size	≥ 0.25 ha		≥ 2 ha		
AND					
Native vegetation cover	≥50% of total vegetation cover in the understorey* is comprised of native species				
AND					
Species richness	≥ 15 native understorey* species from Appendix B present in patch		≥ 10 native understorey* species from Appendix B present in patch		
AND					
Other patch characteristics and values	n/a			is contiguous with other native vegetation[#] that is ≥ 5 ha in area.	at least one tree with hollows per hectare or at least one large tree (>80 cm dbh) per hectare

Notes:
* mid and ground layers.
[#] any native vegetation where cover in each layer present is dominated by native species. In particular, this may include associated native grasslands that were previously the woodland.

Survey considerations

Land use history will influence the state in which a patch of the ecological community is currently found. The structural form (Type A, B, C, D or E) of the ecological community will influence the species diversity/richness. The surrounding vegetation will also influence how important a patch of the ecological community is in the broader landscape.

Defining a patch

A patch is defined as a discrete and continuous area of the ecological community. However, a patch may include small-scale disturbances, such as tracks or breaks, watercourses or small-scale variations in vegetation that do not significantly alter its overall functionality (functionality here refers to processes such as the movement of wildlife and pollinators, the dispersal of plant propagules, activities of seed and plant predators and many others).

Buffer zone

To assist in the preservation of the patch, it is recommended that a buffer zone of at least 50 metres be maintained from the outer edge of the patch. The purpose of the buffer zone is to protect and manage the patch and to help avoid potential significant impacts to the ecological community. The buffer zone will help protect the root zone of edge trees and the ecological

community from spraydrift (fertiliser, pesticide or herbicide sprayed in adjacent land) and other threats. If the use of an area (e.g. grazing land) that adjoins a patch of the ecological community is going to be intensified (e.g. intensified grazing or change to cropping) then approval under the EPBC Act may be required. Changes in land-use to the land that falls within the buffer zone must not have a significant impact on the ecological community, but there are exemptions for continuing use.

Sampling protocol

The recommended sampling protocol involves developing a quick/simple map of the vegetation, landscape qualities and management history (where possible) of the site. The area with the highest level of structural and species richness of native species (i.e. the number of different species in a given area) should be adequately sampled to determine estimates of native species richness in each patch.

The entire site should be representatively sampled for vegetation cover. Larger patches will require multiple sample plots (e.g. 50 x 20 m plot).

Seasonal variation

Timing of surveys is an important consideration because the ecological community can be variable in its appearance through the year and between years depending on drought-rain cycles. Assessment should occur at a time of year where the greatest number of species is likely to be detectable (i.e. spring and summer to early autumn). Timing of surveys should also consider the detectability of mid and ground layer species at different times of their life cycle, or their recovery after recent disturbances (natural or human-induced) to the ecological community.

Surrounding environment and national context

In the context of actions that may have 'significant impacts' and require approval under the EPBC Act, it is important to consider the environment surrounding patches that meet the condition thresholds.

The condition thresholds outlined on page 9 are the minimum level at which patches are to be considered under the EPBC Act for actions that may require approval. These thresholds do not represent the ideal state of the ecological community. Patches that are larger, more species rich and less disturbed are likely to provide greater biodiversity value. Additionally, patches that are spatially linked, whether ecologically or by proximity, are particularly important as wildlife habitat and to the viability of those patches of the ecological community into the future.

In contrast, other patches that meet the condition thresholds may occur in isolation and require protection and priority actions, to link them with other patches. In addition, patches that are interconnected to similar native vegetation associations may not, in their current state, meet the condition thresholds but may have additional conservation value. Therefore, the following indicators should be considered when assessing the impacts of actions or proposed actions under the EPBC Act, or when considering recovery, management and funding priorities for a particular patch:

- Large size and/or a large area to boundary ratio – larger area/boundary ratios are less exposed and more resilient to edge effect disturbances such as weed invasion and other anthropogenic impacts;
- Evidence of recruitment of key native plant species or the presence of a range of age cohorts (including through successful assisted regeneration). For example, tree canopy species are present as saplings through to large hollow-bearing trees;
- Good faunal habitat as indicated by patches containing mature trees (particularly those with hollows), logs, natural rock outcrops, diversity of landscape, contribution to movement corridors;
- High species richness, as shown by the variety of native species, particularly a high diversity of groundcover species or high number of native fauna species;
- Presence of listed threatened species;
- Areas of minimal weeds and feral animals, or where these threats can be managed;
- Presence of cryptogams, soil crust and leaf litter on the soil surface indicating low disturbance and potential for good functional attributes such as nutrient cycling;
- Connectivity to other native vegetation remnants or restoration works (e.g. native plantings) in particular, a patch in an important position between (or linking) other patches in the landscape;
- Derived grasslands, particularly those adjacent or near to woodland remnants, are important to the survival of the ecological community in an otherwise fragmented, rural landscape; and/or,
- Patches that occur in areas where the ecological community has been most heavily cleared and degraded, or that are at the natural edge of its range.

Additional information on ecological processes can be found in Appendix C.

Information on differences to similar or intergrading ecological communities can be found in Appendix D.

Area critical to the survival of the ecological community

Areas that meet the condition thresholds and the buffer zone (pages 9) are considered critical to the survival of Lowland Grassy Woodland. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community. It is also important to consider the surrounding environment and landscape context as outlined on page 11.

Geographic extent and distribution

Since European settlement, Lowland Grassy Woodland has undergone a reduction in extent (Table 1) having been cleared or substantially modified by farming and development to the point that no unmodified examples remain. Remnants are primarily confined to private property or small public reserves such as Travelling Stock Reserves, cemeteries and roadsides. As shown in Table 2, the majority of remnants of the ecological community are very small (< 10 ha).

Table 1. Estimates of decline and extent for Lowland Grassy Woodlands based on vegetation units that correspond with the ecological community.

	Pre 1750 ha	**Current ha**	**% remaining**	**In reserves ha**	**% of original extent in reserves**	**% of remaining extent in reserves**
Candelo and Bega Dry Grass Forest - combined (Keith and Bedward, 1999)	50 654	6 007	12%	368	0.7%	6%
e20p229: Southeast Lowland Grassy Woodland (Tozer et al. 2010)	56 000 – 140 000	14 000	10-25%	780	< 1.5%	5.6%

Table 2. Patch size analysis (Tozer et al., 2006)

Description of decline thresholds	**Threshold**	**Percent of remnants**
n/a	Patch size < 500ha	100%
Limited	n/a	n/a
Restricted	Patch size < 100ha	99.54%
Very restricted	Patch size <10ha	95.74%
n/a	Patch size < 0.5ha	53.38%

Other existing protection

Relationships to State-listed ecological communities

NSW *Threatened Species Conservation Act 1995*

> Lowland Grassy Woodland in the South East Corner Bioregion (NSW Scientific Committee, 2007) (previously listed as Candelo Dry Grass Forest and Bega Dry Grass Forest).

The state listed ecological community does not include condition thresholds.

Listed threatened flora species associated with the ecological community

Table 3. Listed Threatened Flora Species.

Species	Common name	NSW TSC Act 1995	EPBC Act 1999
Thesium australe	austral toadflax	V	V
Galium australe	tangled bedstraw	E	

Listed threatened fauna species associated with the ecological community

Table 4. Listed Threatened Fauna Species.

Species	Common name	NSW TSC Act 1995	EPBC Act 1999
Calyptorhynchus lathami	glossy black cockatoo	V	
Cercartetus nanus	eastern pygmy possum	V	
Dasyurus maculatus maculatus (SE mainland population)	spotted-tail quoll	V	E
Daphoenositta chrysoptera	varied sittella	V	
Hieraaetus morphnoides	little eagle	V	
Myotis adversus	large footed mouse eared bat	V	
Ninox connivens	barking owl	V	
Petroica boodang	scarlet robin	V	
Phascolarctos cinereus	koala	V	V
Pteropus poliocephalus	grey-headed flying-fox	V	V
Stagonopleura guttata	diamond firetail	V	

Further details on National Context can be found at Appendix D.

Summary of threats

Grassy woodlands such as this ecological community are amongst the most extensively depleted vegetation groups in Australia due to their suitability for agriculture and associated development (Keith, 2002; Fischer et al., 2008).

The main ongoing threats to the Lowland Grassy Woodland ecological community are:

- weed invasion;
- inappropriate fire regimes;
- inappropriate grazing regimes;
- dieback;
- land clearing, particularly for rural residential development; and
- other impacts associated with fragmentation of remnants.

Further details about the threats to the ecological community can be found at Appendix E.

Summary of eligibility for listing against EPBC Act criteria

Criterion 1 - Decline in geographic distribution

The Lowland Grassy Woodland ecological community has undergone a large reduction in extent since European settlement, largely due to clearing (Keith and Bedward, 1999; Tindall et al., 2004; Tozer et al., 2006; Tozer et al., 2010). The total area of Lowland Grassy Woodland remaining in the South East Corner bioregion is estimated to be 6 000–14 000 ha, representing approximately 10–25% of the extent before European settlement (Tozer et al., 2010) (see Table 1). It is likely that the extent of Lowland Grassy Woodland that remains in good condition, and meets the condition thresholds, is lower than indicated above.

The ecological community has undergone a substantial decline in geographic distribution. Therefore, the ecological community has been demonstrated to have met the relevant elements of Criterion 1 to make it **eligible** for listing as **vulnerable**.

Criterion 2 - Small geographic distribution coupled with demonstrable threat

Lowland Grassy Woodland occurs over a limited (approx. 800 000 ha) area of south eastern NSW (Keith and Bedward, 1999). Within these areas the ecological community occupies a limited area (maximum of 14 000 ha) (Tozer et al., 2010) making it potentially eligible for listing as endangered.

In addition, the majority (96%) of Lowland Grassy Woodland remnants are very small (<10 ha) in size (Tozer et al., 2006) (see Table 2) making it very restricted and potentially eligible for listing as critically endangered.

The impact of ongoing threats such as invasion of exotic species and inappropriate grazing or fire regimes are exacerbated by the very small distribution of the remaining extent of the Lowland Grassy Woodland ecological community. In addition, rural residential developments, such as in the Eurobodalla Local Government Area, pose a threat to remaining remnants (Eurobodalla Shire Council, pers. comm., 2012). Approximately half of the Lowland Grassy Woodland remnants in the Moruya and Bingie area are zoned for rural, rural residential or industrial development (Eurobodalla Shire Council, in prep.). These threats are unlikely to diminish in the foreseeable future.

The ecological community has a **very restricted** distribution. There is also clear evidence that the ecological community is subject to a range of ongoing threats that could cause it to be lost in the **immediate** future. Therefore, the ecological community has been demonstrated to have met the relevant elements of Criterion 2 to make it **eligible** for listing as **critically endangered**.

Criterion 3 - Loss or decline of functionally important species

Although studies specific to functional species in Lowland Grassy Woodland are not available, it is known that the relationship between species is important for maintaining ecosystem function.

It has been demonstrated that threats have impacted upon functionally important species within the Lowland Grassy Woodland ecological community, such as the impact of the decline in woodland bird populations on rural tree decline and death (Majer et al., 1999). However, data to support decline of these species in this ecological community is not available. Therefore, the ecological community is **not eligible** for listing in any category under this criterion.

Criterion 4 - Reduction in community integrity

The reduction in the integrity of the Lowland Grassy Woodland ecological community is evident from observations of fragmentation, rural tree dieback and weed invasion, and the decline of fauna within the ecological community.

The integrity of the ecological community and its ability to respond to natural and anthropogenic pressures has been severely reduced due to:

- loss or decline of numerous faunal species,

- decline of palatable flora species,

- loss of old trees and associated hollows,

- clearing,

- small size and isolation of most remnants,

- altered fire regimes, and

- impacts of weeds.

The change in integrity experienced by the ecological community is **very severe** and regeneration is unlikely in the immediate future. Therefore, the ecological community is **eligible** for listing as **critically endangered** under this criterion.

Criterion 5 - Rate of continuing detrimental change

The infestation of exotic fireweed demonstrates a rate of continuing detrimental change of 45% in some areas of the ecological community; this is despite weed management plans being in place in the Bega region. Additionally, inappropriate fire and grazing regimes that alter the species composition of the vegetation in the ecological community and rural residential development continue to be detrimental to the ecological community. Although there has been continuing detrimental change to the ecological community, data are insufficient, so it is **not eligible** for listing under his criterion.

Criterion 6 - Quantitative analysis showing probability of extinction

There is no quantitative data available to assess this ecological community under this criterion. Therefore, it is **not eligible** for listing under this criterion.

Further details about how the ecological community was judged against the criteria can be found at Appendix F.

PRIORITY CONSERVATION ACTIONS

Research priorities

Research priorities that would inform future regional and local priority actions in relation to the Lowland Grassy Woodland include:

- Determine optimal management regimes and best practice standards for remnants.
- Confirm the fire management regime generally used for grassy woodlands (below) is appropriate for this ecological community.
- Support and enhance development of regimes for managing regrowth across the ecological community and within different catchments.
- Support new and enhance existing surveys for the identification of sites of high conservation priority and better understanding of the variation across the ecological community.
- Support new and enhance existing programs for the production of mapping of pre-1750 extent and current remnants, including mapping of different patch types and condition.
- Assess the vulnerability of the ecological community to different threats such as weeds and climate change.

Priority recovery and threat abatement actions

Priority actions for national, regional and local land managers include:

Habitat Loss, Disturbance and Modification

- Avoid further clearance of remnants of the ecological community, and surrounding native vegetation, including derived grasslands.
- Monitor known sites to identify status and key threats.
- Manage any other known, potential or emerging threats such as rural tree dieback.
- Implement appropriate management regimes and best practice standards to maintain the biodiversity, including listed threatened species of the ecological community for remnants on private and public lands.
- Integrate fire and grazing regimes.
- Monitor the progress of recovery, through improved mapping, estimates of extent and condition assessments of the ecological community, and effective adaptive management actions.
- Create or restore wildlife corridors and linkages and ensure that remnants of particularly high quality or importance in a landscape context are considered for inclusion in reserve tenure, where possible.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible.
- Liaise with planning authorities to ensure that planning takes the protection of remnants into account, with due regard to principles for long-term conservation.
- Liaise with local councils and State authorities to ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where the Lowland Grassy Woodlands occur do not adversely impact the ecological community. This includes avoiding the introduction or spread of weeds.
- Retain hollows (including protection of existing mature trees) and plant native hollow producing species. Ensure that trees are always left to grow to maturity and if necessary place artificial hollows (e.g. nest boxes) in or near to the ecological community.

- Retain fallen logs as habitat for fauna, noting different log requirements for different species e.g. logs embedded in the soil are necessary for some species and hollow logs are required by other species.
- Retain paddock trees near patches of the ecological community.
- Revegetate gullies and stream banks where vegetation has been cleared and widen the strip of riparian vegetation (with appropriate local native species).
- Manage any changes to hydrology or disruptions to water flows that may result in changes to water table levels and/or increased run-off, salinity, sedimentation or pollution.

Invasive Weeds

- Promote knowledge about local weeds and keep woody weeds and noxious weeds controlled at all times.
- Control introduced pest animals, including domestic pets, to allow natural regeneration and to manage threats especially to threatened species.
- Keep vehicles and machinery out of remnants. If vehicles must be taken into remnants, ensure they are washed first to remove soil and weed seeds.
- Do not put newly bought stock into remnants in case they are carrying weed seeds.
- Do not plant potential environmental weeds in nearby gardens, from which they may spread into the remnant, nor dump garden waste beyond the confines of the garden, on private or public land.

Trampling, Browsing or Grazing

- Ensure that livestock grazing, if it occurs in the area, uses an appropriate management regime and density that does not detrimentally affect this ecological community.
    - Lowland Grassy Woodland remnants can be grazed occasionally and this may be beneficial for reducing grass cover, encouraging herb growth and keeping tree and shrub regeneration from becoming too thick. However, if stock could carry noxious weeds into the remnant, then it would be preferable to exclude stock altogether or admit them only at times when none of the weeds are producing seed.
    - Avoid grazing during native plant flowering and seeding times (spring and summer).
    - Short periods of intense grazing are preferable to leaving stock in for long periods.
- Where appropriate, manage total grazing pressure at important/significant sites through exclusion fencing or other barriers.

Fire

- Implement an appropriate fire management regime. This may include:
    - For large area remnants, burning different parts of a remnant in rotation rather than the whole area in any one season.
    - Monitoring the results for increases in native herbs, grasses and forbs or a decrease in weeds.
    - Raking fuel away from the base of old trees prior to burning and extinguishing tree bases during the fire so as not to undermine old trees and hasten their death.
    - Early spring burning is preferable for control of annual weeds.
    - Do not burn if soil moisture is very low, or dry conditions are predicted for the coming season, as grass recovery will be too slow and erosion may occur or weeds become established while the ground is bare.

Conservation Information

- Raise awareness of Lowland Grassy Woodland within the local community utilising a range of media/methods such as fact sheets/information brochures/field days in conjunction with known industry or community interest groups.
- Maintain engagement with private landholders and land managers where the ecological community occurs.

Existing plans/management prescriptions

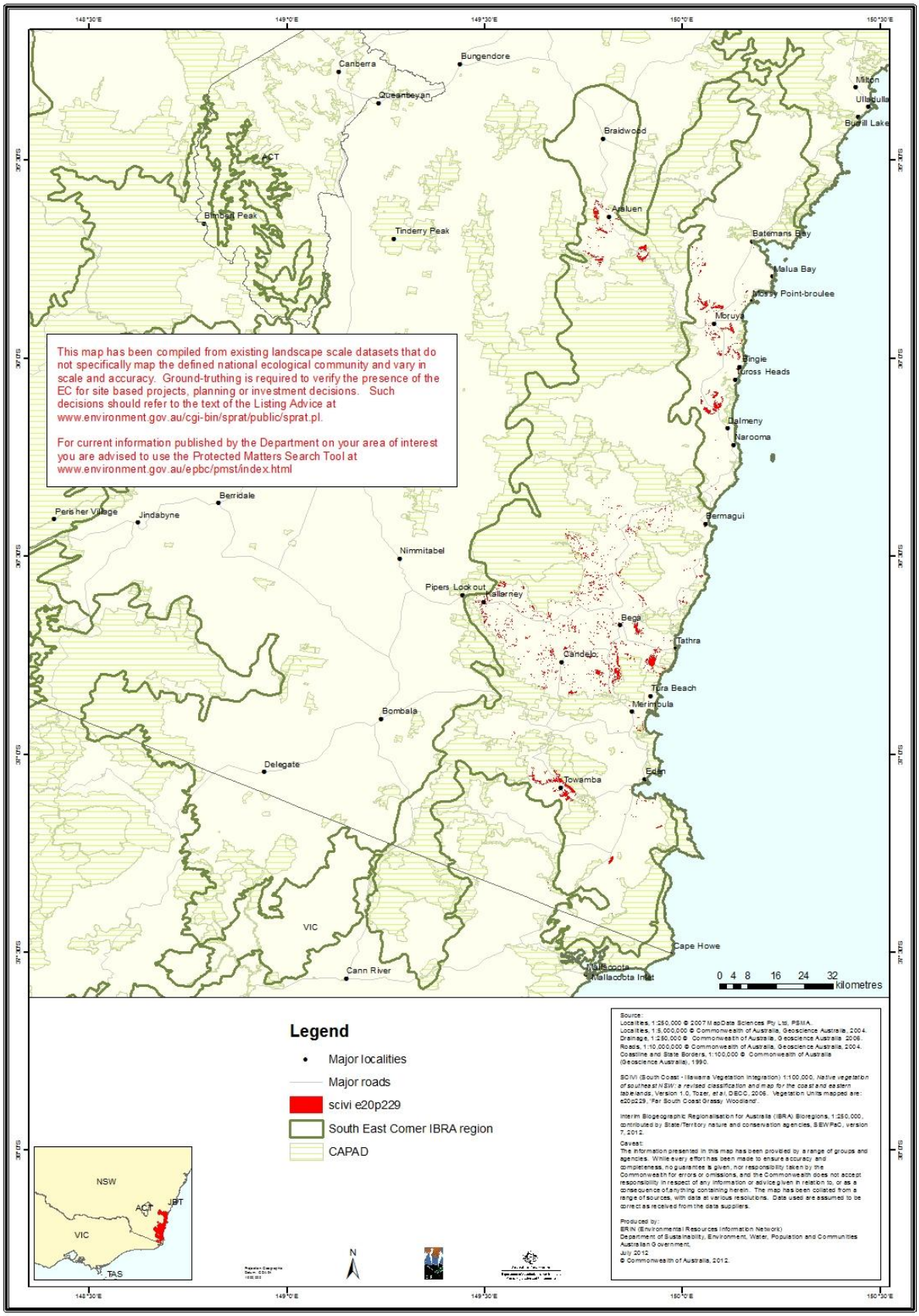
The following management prescription was current at the time of publishing; please refer to the relevant agency's website for any updated versions:

Miles J (2006). Recognition and management of endangered ecological communites in the south east corner of NSW. Southern Rivers Catchment Management Authority.

Recovery plan recommendation

Due to an existing management plan relevant to the ecological community, a recovery plan for the Lowland Grassy Woodland in the South East Corner Bioregion ecological community is not required. Management actions relevant to the ecological community can be found in "Recognition and management of endangered ecological communites in the south east corner of NSW" (Miles, 2006) and in Part B of this document.

Appendix A - Distribution map for the Lowland Grassy Woodland in the South East Corner Bioregion ecological community



Appendix B - Species lists

Table 1. Characteristic plant species

Table 1 lists vascular plant species **characteristic** of the Lowland Grassy Woodland in the South East Corner Bioregion. It is an indicative rather than comprehensive list of plant species present in the ecological community. Patches may not include all species on the list, or may include other species not listed. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. Scientific names are as at August 2012.

Tree Canopy	
Scientific Name	**Common Name**
Acacia implexa	hickory wattle
Acacia mearnsii	black wattle
Allocasuarina littoralis	black sheoak
Angophora floribunda	rough barked apple
Brachychiton populneus subsp. *populneus*	kurrajong
Eucalyptus baueriana	blue box
Eucalyptus bosistoana	coast grey box
Eucalyptus dives	broad-leaf peppermint
Eucalyptus globoidea	white stringybark
Eucalyptus maidenii	maidens gum
Eucalyptus melliodora	yellow box
Eucalyptus pauciflora	snow gum
Eucalyptus tereticornis	forest red gum
Eucalyptus viminalis	ribbon or manna gum
Exocarpos cupressiformis	native cherry
Pittosporum undulatum	sweet pittosporum, native daphne
Shrub Layer	
Scientific Name	**Common Name**
Bursaria spinosa	sweet bursaria, blackthorn
Cassinia longifolia	shiny cassinia
Cassinia trinerva	three veined cassinia
Discaria pubescens	anchor plant
Dodonaea viscosa subsp. *angustifolia*	narrow-leaf hop-bush
Jacksonia scoparia	broom, dogwood
Leucopogon juniperinus	prickly beard-heath
Melicytus dentatus	tree violet
Ozothamnus argophyllus	spicy everlasting
Ozothamnus diosmifolius	Sago bush

Climbing plants	
Scientific Name	**Common Name**
Clematis glycinoides var. *glycinoides*	headache vine
Hardenbergia violacea	false sarsparilla
Glycine clandestina	twining glycine
Glycine tabacina	variable glycine
Rubus parvifolius	native raspberry
Ground Cover Layer	
Scientific Name	**Common Name**
Acaena ovina	bidgee-widgee
Acaena echinata	sheep's burr
Ajuga australis	austral bugle
Aristida ramosa	purple wiregrass
Aristida vagans	three-awn spear-grass
Arthropodium milleflorum	pale vanilla-lily
Arthropodium spp.	vanilla-lily
Asperula conferta	common woodruff
Austrodanthonia pilosa (now known as *Rytidosperma pilosum*)	smooth-flowered wallaby-grass
Austrodanthonia racemosa var. *racemosa* (now known as *Rytidosperma racemosum* var. *racemosum*)	clustered wallaby-grass
Austrostipa rudis	veined spear-grass
Austrostipa scabra	rough spear-grass
Austrostipa verticillata	bamboo grass
Bossiaea buxifolia	matted bossiaea
Bossiaea prostrata	creeping bossiaea
Bothriochloa macra	red grass
Bulbine glauca	bulbine lily
Calotis lappulacea	yellow burr-daisy
Capillipedium parviflorum	scented-top grass
Carex breviculmis	short-stem sedge
Carex inversa	common sedge
Carex longebrachiata	drooping sedge
Cheilanthes distans	bristly cloak-fern
Cheilanthes sieberi	narrow rock-fern
Chloris truncata	windmill grass

Ground Cover Layer cont.	
Scientific Name	**Common Name**
Chloris ventricosa	tall windmill grass
Chrysocephalum apiculatum	yellow buttons, common everlasting
Chrysocephalum semipapposum	yellow buttons, clustered everlasting
Convolvulus angustissimus	Australian bindweed
Cullen microcephalum	mountain psoralea
Cyanthillium cinereum	
Cymbopogon refractus	barbed-wire grass
Cynoglossum australe	Australian forget-me-not,
Cynoglossum suaveolens	sweet hound's-tongue
Cyperus gracilis	slender sedge
Desmodium brachypodum	large tick trefoil
Desmodium varians	slender tick-trefoil
Dianella longifolia	blue flax lily
Dianella revoluta var. *revoluta*	blueberry lily
Dichelachne micrantha	short-hair plume-grass
Dichondra spp.	kidney weed
Digitaria brownii	cotton panic
Digitaria parviflora	small-flower finger grass
Digitaria ramularis	
Echinopogon caespitosus var. *caespitosus*	tufted hedgehog-grass
Echinopogon ovatus	forest hedgehog-grass
Einadia hastata	berry saltbush
Einadia nutans	nodding saltbush
Einadia trigonos	fishweed
Elymus scaber var. *scaber*	common wheat-grass
Enneapogon nigricans	nine-awn grass
Epilobium billardiereanum	stream willow-herb
Eragrostis leptostachya	paddock lovegrass
Euchiton japonicus	creeping cudweed
Fimbristylis dichotoma	common fringe-rush
Gahnia aspera	rough saw-sedge
Galium leiocarpum	maori bedstraw
Geranium solanderi var. *solanderi*	native geranium
Hovea heterophylla	common hovea
Hydrocotyle laxiflora	stinking pennywort
Hypericum gramineum	small St John's wort

Ground Cover Layer cont.	
Scientific Name	**Common Name**
Imperata cylindrica	blady grass
Laxmannia gracilis	slender wire lily
Lepidosperma laterale	sword sedge
Lespedeza juncea	
Lobelia purpurascens	whiteroot
Lomandra filiformis subsp. *filiformis*	wattle mat-rush
Lomandra longifolia	spiny-headed mat-rush
Lomandra multiflora subsp. *multiflora*	many-flowered mat-rush
Microlaena stipoides	weeping grass
Opercularia aspera	coarse stinkweed
Opercularia varia	variable stinkweed
Oplismenus imbecillis	creeping beard-grass
Oxalis perennans	grass wood-sorrel
Oxalis radicosa	dwarf wood-sorrel
Panicum effusum	hairy panic
Pellaea falcata	sickle fern
Pimelea curviflora var. *gracilis*	slender curved rice-flower
Pimelea curviflora var. *sericea*	curved rice-flower
Pimelea glauca	smooth rice-flower
Plantago varia	variable plantain
Poa labillardierei var. *labillardierei*	tussock grass
Poa meionectes	
Polygala japonica	dwarf milkwort
Ranunculus lappaceus	common buttercup
Rumex brownii	swamp dock
Rytidosperma longifolium (formerly *Notodanthonia longifolia*)	long-leaved wallaby grass
Rytidosperma pilosum (formerly *Austrodanthonia pilosa*)	smooth-flowered wallaby-grass
Rytidosperma racemosum var. *racemosum* (formerly *Austrodanthonia racemosa* var. *racemosa*)	clustered wallaby-grass
Scleranthus biflorus	spiny mat-plant
Scleranthus fasciculatus	
Senecio hispidulus	fireweed (native)
Senecio quadridentatus	cotton fireweed
Sigesbeckia orientalis	Indian weed

Ground Cover Layer cont.	
Scientific Name	**Common Name**
Solanum prinophyllum	forest nightshade
Solanum pungetium	eastern nightshade
Sorghum leiocladum	wild sorghum
Sporobolus creber	slender rat's-tail grass
Sporobolus elongatus	slender rat's-tail grass
Themeda triandra	kangaroo grass
Thesium australe	Austral toadflax
Tricoryne elatior	yellow rush-lily
Velleia paradoxa	spur velleia
Veronica calycina	hairy speedwell
Veronica plebeia	trailing speedwell
Wahlenbergia communis	tufted bluebell
Wahlenbergia gracilis	Australian bluebell
Wahlenbergia luteola	bronze bluebell
Wahlenbergia multicaulis	Tadgell's bluebell
Wahlenbergia stricta subsp. *stricta*	bluebell
Zornia dyctiocarpa var. *dyctiocarpa*	zornia

Table 2. Fauna

Table 2 lists fauna that may occur in the ecological community and where applicable, includes threatened status. This is not a comprehensive list of animal species in the ecological community. Scientific names are as at August 2012.

Species name	**Common name**	**NSW TSC Act**	**EPBC Act**
Mammals			
Acrobates pygmaeus	feather-tailed glider		
Antechinus stuartii	brown antechinus		
Cercartetus nanus	eastern pygmy possum	V	
Chalinolobus gouldii	Gould's wattled bat		
Chalinolobus morio	chocolate wattled bat		
Dasyurus maculatus maculatus (SE mainland population)	spotted-tail quoll	V	E
Macropus giganteus	eastern grey kangaroo		
Macropus rufogriseus	red-necked wallaby		
Myotis macropus	large footed mouse eared bat	V	
Nyctophilus geoffroyi	lesser long-eared bat		
Nyctophilus gouldi	Gould's long-eared bat		
Ornithorhynchus anatinus	platypus		
Perameles nasuta	long-nosed bandicoot		
Petaurus breviceps	sugar glider		
Phascolarctos cinereus	koala	V	V
Pseudocheirus peregrinus	ringtail possum		
Pteropus poliocephalus	grey-headed flying-fox	V	V
Rattus fuscipes	bush rat		
Rattus lutreolus	swamp rat		
Tachyglossus aculeatus	echidna		
Trichosurus vulpecula	common brushtail possum		
Vespadelus darlingtoni	large forest bat		
Vespadelus regulus	southern forest bat		
Vespadelus vulturnus	little forest bat		
Vombatus ursinus	wombat		
Wallabia bicolor	swamp wallaby		
Birds		**NSW TSC Act**	**EPBC Act**
Acanthiza chrysorrhoa	yellow-rumped thornbill		
Acanthiza lineata	striated thornbill		
Acanthiza nana	yellow thornbill		
Acanthiza reguloides	buff-rumped thornbill		
Acanthorhynchus tenuirostris	eastern spinebill		

Birds cont.		**NSW TSC Act**	**EPBC Act**
Anthochaera carunculata	red wattlebird		
Artamus cyanopterus	dusky woodswallow		
Callocephalon fimbriatum	gang-gang cockatoo		
Calyptorhynchus funereus	yellow-tailed black cockatoo		
Calyptorhynchus lathami	glossy black cockatoo	V	
Cacomantis pallidus	pallid bronze cuckoo		
Chalcites basalis	Horsfield's bronze cuckoos		
Colluricincla harmonica	grey shrike-thrush		
Coracina novaehollandiae	black-faced cuckoo-shrike		
Cormobates leucophaea	white-throated treecreeper		
Corvus coronoides	Australian raven		
Corvus mellori	little raven		
Cracticus tibicen	Australian magpie		
Cracticus torquatus	grey butcherbird		
Dacelo novaeguineae	laughing kookaburra		
Daphoenositta chrysoptera	varied sittella	V	
Eopsaltria australis	eastern yellow robin		
Eolophus roseicapillus	galah		
Eurystomus orientalis	dollar bird		
Gerygone olivacea	white throated gerygone		
Hieraaetus morphnoides	little eagle	V	
Lichenostomus chrysops	yellow-faced honeyeater		
Microeca fascinans	jacky winter		
Pachycephala rufiventris	rufous whistler		
Pardalotus striatus	striated pardalote		
Neochmia temporalis	red-browed finch		
Ninox connivens	barking owl	V	
Pachycephala pectoralis	golden whistler		
Petroica boodang	scarlet robin	V	
Platycercus eximius	eastern rosella		
Rhipidura albiscapa	grey fantail		
Rhipidura leucophrys	willie wagtail		
Stagonopleura guttata	diamond firetail	V	
Strepera graculina	pied currawong		

Table 3. Weed species

Table 3 lists weed species known to occur in the ecological community. Scientific names are as at August 2012.

Scientific Name	**Common Name**
Cenchrus clandestinus	kikuyu
Cirsium vulgare	thistle
Crataegus monogyna	hawthorn
Dactylis glomerata	cocksfoot
Eragrostis curvula	African lovegrass
Hypericum perforatum	St Johns wort
Lycium ferocissimum	African boxthorn
Nassella trichotoma	serrated tussock
Rosa rubiginosa	briar rose
Rubus spp.	blackberries
Senecio madagascariensis	fireweed
Solanum spp.	nightshades
Sporobolus africanus	Parramatta grass
Trifolium repens	clover

Appendix C - Detailed description of biology and ecological processes

Examples of faunal roles and interactions

The relationships between species within the ecological community is important for maintaining ecosystem function. The trees and plants of Lowland Grassy Woodlands are an essential resource for many animals. The plants provide food directly (blossom, seed, gum) and indirectly (attract insects which provide food for birds, reptiles and bats). They provide nesting and roosting sites among leaves, on branches and in hollows and create a sheltered microclimate under the canopy by reducing solar radiation and creating a litter layer (leaves, sticks, logs). Animals which graze the understorey selectively influence the floristic composition of the grassy ground layer.

The Lowland Grassy Woodland ecological community supports a variety of vertebrate fauna that have diminished but still have a broad range of functional roles within the ecological community. These include larger mammalian herbivores (e.g. kangaroos), smaller ground-dwelling mammals (e.g. bandicoots and dasyurids), arboreal mammals (e.g. possums), bats, woodland birds and reptiles.

Woodland birds across eastern Australia are declining due to loss, fragmentation and degradation of their habitat (Ford, 2011). *Stagonopleura guttata* (diamond firetail), *Petroica boodang* (scarlet robin) and *Ninox connivens* (barking owl) are listed as threatened in NSW because of loss of woodland habitat such as this ecological community. Scarlet robins for instance are negatively affected by the loss of native understorey in the Lowland Grassy Woodland ecological community.

The ecological community often has patches of *Allocasuarina littoralis* (black she-oak) in the sub-canopy and provides an important feed resource for *Calyptorhynchus lathami* (glossy black cockatoo) in an otherwise heavily cleared region.

Many species of insectivorous bats are common in the ecological community. They shelter in hollows or cracks in live or dead trees and sometimes in man made structures (Miles, 2006). *Myotis macropus* (large footed mouse eared bat) is listed under the NSW *Threatened Species Conservation Act 1995* as vulnerable.

Other mammal species such as *Macropus giganteus* (eastern grey kangaroo), *Macropus rufogriseus* (red-necked wallaby), *Tachyglossus aculeatus* (echidna), *Trichosurus vulpecula* (common brushtail), *Petaurus breviceps* (sugar glider), *Pseudocheirus peregrinus* (ringtail possums), *Vombatus ursinus* (wombat) and *Wallabia bicolor* (swamp wallaby) are found in the ecological community, particularly where there are connecting strips of native vegetation linking farming land to the surrounding forests (Whelan and Hibberd, 1992; Miles, 2006). *Acrobates pygmaeus* (feather tailed glider), *Cercartetus nanus* (eastern pygmy-possum) (listed in NSW), *Ornithorhynchus anatinus* (platypus), *Pteropus poliocephalus* (grey-headed flying fox) (listed NSW and nationally) also inhabit the ecological community. *Phascolarctos cinereus* (koala) (listed in NSW and nationally) was once common in red gum forests on fertile soils, such as this ecological community, but is now mostly confined to small fragmented populations in surrounding forests (Miles, 2006). Koala numbers were high in the Bega district in the early years of European settlement (Lunney and Leary, 1988). The koala population is dependent on species of nutrient-rich eucalypts, such as *Eucalyptus tereticornis* (forest red gum), which was almost entirely eliminated in the conversion of the Bega Valley to farmland (Lunney and Leary, 1988). Forest red gum is also identified as an important food tree for flying-foxes (Lunney and Leary, 1988).

Ecosystem functions

Consumption of insects that potentially damage vegetation within the ecological community is an obvious case where birds, bats and some mammals such as *Tachyglossus aculeatus* (echidna) and *Petaurus breviceps* (sugar glider) perform a vital service (Miles, 2006). Fauna also perform important ecosystem functions to keep remnant native vegetation viable such as pollination and seed dispersal.

A diversity of small woodland birds is important for regulating insect populations, notably the suite of phytophagous insects associated with rural tree dieback (Landsberg, 1990). Therefore, displacement of these woodland birds in this ecological community has implications for the future ability of affected remnants to abate and recover from dieback.

Bursaria spinosa (blackthorn), which is often dominant in the understorey of the ecological community, is functionally important as it is the host of a parasitic wasp that controls *Anoplognathus* spp. (Christmas beetle) larvae and in turn reduces the impact that the Christmas beetle has on tree dieback. Blackthorn also provides important habitat for small birds.

Soil disturbances are created by small ground-dwelling native marsupials such as common wombat and echidna (Miles, pers. comm., 2012). This has beneficial impacts in temperate grassy systems on soil aeration, nutrient cycling and water infiltration. They also facilitate the spread and establishment of seedlings, but these mammals are often lost from temperate grassy woodlands (McIntyre, 2011). The disruption of ecological processes associated with the loss of digging fauna in this ecological community contributes to a large reduction in ecological function. In addition, given modification and ongoing threats to the ecological community, when soil disturbance now occurs, rather than assisting recruitment of native flora, it often encourages weed invasion.

Due to the highly fragmented nature of Lowland Grassy Woodland and the fact that it is mostly surrounded by cleared land, the ecological community no longer provides suitable habitat for many native fauna species (Miles, 2006). The fragmentation of Lowland Grassy Woodland, and consequently the habitat for local flora and fauna, has impacted on the ecological processes and the species composition in the fragmented landscape.

Many remnants no longer support a range of fauna due to a loss of large old hollow bearing trees, modifications to the understorey, and isolation and fragmentation of remaining stands (Lindenmayer and Fischer, 2006). However, such remnants may still be of value to disturbance-tolerant or highly mobile species, particularly as stepping-stone habitat in otherwise cleared or developed landscapes (Doerr et al., 2010).

Vegetation dynamics

The composition of temperate woodland understoreys varies across Australia. These differences can be related to, in part, evapo-transpiration and soil nutrient levels but patterns are complicated by land use and in particular by the frequency and intensity of fire and grazing. Temperate woodlands are naturally more shrubby in areas of low nutrient, sandy, poor soils but on finer textured, deeper soils, shrubs are replaced by a well developed herbaceous grassy flora. The Lowland Grassy Woodland has an understorey typically dominated by herbaceous species and an overstorey consisting of eucalypts.

Grassy woodland communities are dynamic and inherently variable systems. Their expression is subject to the influences of seasonality, weather and land management practices (Barlow, 1998; Ross, 1999; Carter et al., 2003). The appearance of the ecological community during peak flowering time in spring can markedly differ to that in later summer or autumn. Several

grassland and grassy woodland species are geophytes[3] that die down during unfavourable seasons and only emerge above ground when flowering. Most geophytes[4] in temperate grassy systems are only evident above-ground during spring to early summer. Similarly, the appearance of the grassy woodlands during prolonged drought can differ significantly from that of a good season. The suite of typical spring-flowering herbs may be largely absent or less conspicuous during very dry seasons.

The severity and frequency of fire, grazing or fertiliser regimes also markedly affects appearance, species composition and functionality in the ground layer. These regimes influence the density of the native tussock sward, the diversity of the native herbs and wildflowers that occur amongst the tussocks and the capacity of the tree canopy layer to regenerate. Practices such as grazing or burning can alter floristic composition, by eliminating those species which are most sensitive to a particular regime, especially if the grazing is heavy and continuous or burning occurs at frequent intervals. Therefore, regimes that maintain or restore diversity in the understorey are best for the persistence of the ecological community, and regimes that decrease diversity should be avoided.

Indigenous use

Indigenous use of fire, prior to European settlement of the region, is likely to have altered parts of the vegetation in the region of the ecological community. Fire was used in grassy woodlands for purposes such as flushing out of possums and kangaroos, to encourage new growth (Lunney and Leary, 1988) and to limit tree and shrub densities (McIntyre, 2011). As a result, fires also restricted the growth of rainforest into the more open forest and woodland areas such as this ecological community (Lunney and Leary, 1988).

[3] A geophyte is a perennial plant with an underground food storage organ, such as a bulb, tuber, corm or rhizome. The above ground part of the plant dies away during adverse conditions, such as a dry season, and grows again from buds that are on or within the underground portion of the plant when conditions improve.

[4] A geophyte is a perennial plant with an underground food storage organ, such as a bulb, tuber, corm or rhizome. The above ground part of the plant dies away during adverse conditions, such as a dry season, and grows again from buds that are on or within the underground portion of the plant when conditions improve.

Appendix D - Detailed description of national context

Distribution

Temperate grassy woodlands are extensive in range and were once almost continuous in extent across large areas of eastern Australia. The component plant species of this ecological community have a very wide latitudinal distribution with low specificity to environmental factors such as lithology and altitude.

The Lowland Grassy Woodland ecological community originally occupied much of the lower parts of the landscape on rolling hills of the coastal river valleys in the NSW part of the South East Corner bioregion. Within the bioregion, vegetation types such as Lowland Grassy Woodlands are found in low relief, fertile terrain and are among the most species-rich in the region, the most depleted by past clearing and the most threatened by continuing processes (Keith and Bedward, 1999). Former strongholds include the Bega and Cobargo valleys and the Moruya area with smaller patches at Belowra, in the upper Towamba Valley and a few locations (with higher soil fertility) closer to the coast (e.g. Coila, Bingie Bingie, Tanja and Goalen Head) (Miles, 2006; NSW Scientific Committee, 2007; Tozer et al., 2010), including where basalt derived clay loams occur in coastal areas of Eurobodalla Shire (e.g. Congo) (NGH Environmental, 2007). Further inland and at higher elevation, the sandy granitoid soils of the Araluen Valley also support grassy woodlands that are part of the ecological community (Tindall et al., 2004; Tozer et al., 2010).

Lowland Grassy Woodlands have been cleared or substantially modified by farming and development and no unmodified examples remain. Most remnants are confined to private property or small public reserves such as Travelling Stock Reserves, cemeteries and roadsides.

Land use history

The Bega district was first explored in 1829, soon after which, beef cattle was brought to the Bega Valley (Bayley 1942 in Lunney and Leary, 1988). The most productive and accessible land along the river flats in the valley were the first areas settled. As land was cleared for cattle grazing *Acacia* spp. (wattles) came up as secondary growth following the removal of the *Eucalyptus* tree canopy. The cultivation and cutting of wattlebark, mainly *A. mearnsii* (black wattle), for tanning became a source of income for farmers preparing their land for agriculture (Lunney and Leary, 1988). In the latter half of the 19th century, sawn timber production prized the valley species such as forest red gum over dry sclerophyll species from the surrounding ranges (Lunney and Leary, 1988).

Relationships to State-listed ecological communities

NSW *Threatened Species Conservation Act 1995*

> Lowland Grassy Woodland in the South East Corner Bioregion (NSW Scientific Committee, 2007) (previously listed as Candelo Dry Grass Forest and Bega Dry Grass Forest).

The state listed ecological community does not include condition thresholds.

Relationships to other vegetation classifications

Caveat

Ecological communities are complex to classify. Each State/Territory jurisdiction applies its own system to classify ecological communities which can cause challenges when cross-referring amongst systems. They may also vary in accuracy to the on-the-ground situation, particularly if based on maps and modelling. Any reference to vegetation and mapping units as equivalent to a national ecological community, at the time of listing, should be taken as indicative rather than definitive. A unit that is generally equivalent may include elements that do not meet the description. Conversely, areas mapped or described as units other than those referred to may sometimes meet the description. Judgement of whether an EPBC-protected ecological community is present at a particular site should focus on how an area meets the description, key diagnostic characteristics and condition thresholds of the national ecological community.

The ecological community corresponds, entirely or in part, to the following vegetation classifications:

Keith and Bedward (1999)

20 - Bega Dry Grass Forest

21 - Candelo Dry Grass Forest

Keith (2002)

72 - Coastal Rainshadow Grassy Woodlands

Keith (2004)

Coastal Valley Grassy Woodlands

Gellie (2005) and Thomas et al. (2000)

52 - Bega Valley Shrub/Grass Forest

54 - Far South Coast Forest Red Gum Grass/Herb Dry Forest/Woodland

Tozer et al. (2006)

Far South Coast Grassy Woodland

Tozer et al. (2010)

GWe20p229 - Southeast Lowland Grassy Woodland

Differences to similar or intergrading ecological communities

Other dry grass forest (or woodland) vegetation associations are identified for the south east forests region of NSW (Keith and Bedward, 1999). Although these associations are structurally similar, and contain *Eucalyptus tereticornis*, the combination of dominant species (forest red gum and rough-barked apple) and the continuous groundcover distinguishes Lowland Grassy Woodland from other ecological communities. The listed ecological community is only known from the NSW portion of the South East Corner bioregion and is distinct from other similar or intergrading ecological communities such as:

Bega Wet Shrub Forest (Southern Comprehensive Regional Assessment (CRA) - FE48 and FE49) replaces Lowland Grassy Woodlands in some gullies and on river banks and is dominated by *Eucalyptus elata* (river peppermint).

Brogo Wet Vine Forest of the South East Corner Bioregion (NSW TSC Act) is found on steeper, often north facing slopes and includes rainforest elements such as *Ficus rubiginosa* (Port Jackson Fig) and *Alectryon subcinereus* (native quince, wild quince). A diverse array of vines and twiners is interspersed amongst the groundcover and shrub stratum.

Escarpment Dry Grass Forest occurs around the edges of the Towamba and Bega valleys but is uncommon in the Eurobodalla Local Government Area. It is distinguished by (apart from location) the dominance of *E. maidenii* (Maiden's or blue gum) and the absence of *E. tereticornis* (forest red gum). Additional indicator species for this community are *Acacia falciformis* (broad leaved hickory), *Indigofera australis* (austral indigo), *Senecio linearifolius* (fireweed groundsel) and *Xerochrysum bracteatum* (yellow everlasting) (Miles, 2006).

Southern Escarpment Herb/Grass Dry Forest (Southern CRA - FE50) contains many of the same species as the Lowland Grassy Woodland. However it differs by having little or no *Themeda triandra* (kangaroo grass) and often has a high cover of the small shrub *Leucopogon juniperinus* (prickly beard heath). The groundcover is frequently sparse rather than the near-continuous grass cover typical of high quality Lowland Grassy Woodland (Miles, 2006).

Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (NSW TSC Act) occurs to the north of the Lowland Grassy Woodlands ecological community. It includes vegetation communities on floodplains that therefore include a greater number of species of wet areas such as *Eucalyptus amplifolia, Melaleuca* spp. and *Boronia polygalifolia*. The community is characterised by *E. tereticornis, E. eugenioides*, (thin-leaved stringybark), *E. longifolia* (woollybutt), *E. bosistoana* (coastal grey box) and *Melaleuca decora* (honey-myrtle). *Angophora floribunda* does occur in this community but is not a characteristic species (as it often is in the Lowland Grassy Woodland ecological community). The understorey is not typically grassy (unlike the grassy understorey of most patches of the Lowland Grassy Woodland ecological community). It also includes drier communities on ridges and slopes and moist communities on the lower escarpment (NSW Scientific Committee, 1999).

River flat Eucalypt forest on coastal floodplains (NSW TSC Act) also occurs in the Bega and Towamba valleys and can be dominated by *Eucalyptus tereticornis* and *Angophora floribunda* (amongst other dominant species). This community differs from the Lowland Grassy Woodland ecological community as it has a greater component of wet area species such as *Melaleuca ericifolia, Parsonsia straminea* and *Leptospermum polygalifolium*. It occurs on flat alluvial sites. The grassy component of River Flat Eucalypt Forest is not dominated by *Themeda triandra* (kangaroo grass).

Araluen Scarp Grassy Forest in the South East Corner Bioregion (NSW TSC Act) is a drier community that typically occurs on the escarpment and associated ridges on the northern and western sides of the Araluen Valley. It occurs on steep slopes and sandy loams. This community is usually dominated by *Eucalyptus melliodora* (yellow box), *E. maidenii* (Maidens' gum) and *Acacia mearnsii* (black wattle) but may also contain *E. tereticornis* and *Angophora floribunda*. It also has an open, grassy understorey. Araluen Scarp Grassy Forest has a much sparser and much less diverse coverage of grass species than Araluen Valley Grassy Woodland (included in Lowland Grassy Woodland) and may be further distinguished by a representation of species characteristic of moister, more sheltered habitats including *Ficus rubiginosa, Marsdenia rostrata, Melicytus dentatus, Pandorea pandorana, Pellaea falcata, Pittosporum undulatum* and *Plectranthus parviflorus*.

Gippsland Red Gum Grassy Woodland and Associated Native Grassland (EPBC Act) ecological community occurs in Victoria. The Lowland Grassy Woodland ecological community differs from vegetation classifications in Victoria (Woodgate et al., 2007). Keith and Bedward (1999) also state that rainshadow valleys are limited further south (i.e. in Victoria) with Gippsland Lakes district being the most physiographically similar valley. Neville Walsh (pers. comm., 2005) also stated that *E. tereticornis* and *Angophora floribunda* do not occur together in Victoria. Importantly, the subspecies of *E. tereticornis* present in the Lowland Grassy Woodland ecological community differs to that in Gippsland. The Gippsland ecological community is dominated by *E. tereticornis* subsp. *mediana* (Gippsland red gum). The shrub and ground layers also differ in their floristic compositions with a number of species present in the ecological community (in NSW) being absent or uncommon in Victoria.

Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory There are no known natural temperate grasslands in the coastal rainshadow valleys (including the Bega valley) but there are areas of grassland derived from Lowland Grassy Woodland that may have a high species diversity and may be included in the Lowland Grassy Woodland listing (see condition thresholds page 9).

White Box - Yellow Box - Blakely's Red Gum grassy woodlands and derived native grasslands (EPBC Act) is a grassy woodland dominated by *Eucalyptus albens* (white box), *E. melliodora* (yellow box) and/or *E. blakelyi* (Blakely's red gum). The grassy component of this ecological community has many species in common with the Lowland Grassy Woodlands ecological community. This community occurs over a large range from southern Queensland, through NSW and the ACT and into Victoria, on the tablelands and western slopes. However, *E. tereticornis* and *A. floribunda* are not characteristic and it does not occur near the coast of the South East Corner Bioregion (IBRA 7).

Level of protection in reserves

Vegetation types such as Lowland Grassy Woodland in the South East Corner Bioregion have a very low proportion of their extent in reservation (Keith and Bedward, 1999), particularly in comparison to vegetation assemblages inhabiting steep, infertile terrain which have more than two-thirds of their original extent represented in conservation reserves (Keith and Bedward, 1999). It is estimated that 75–90% of this vegetation has been cleared for agriculture, forestry and development and almost all of the remainder is highly fragmented on private land where it is potentially threatened by further clearing, grazing and weed invasion. Approximately 5% of the current extent of this ecological community is protected in reserves such as Eurobodalla and Mimosa National Parks.

Appendix E - Description of threats

Clearing, fragmentation and land management practices

Historically, land in the Bega valley was cleared for cattle grazing and sawn timber production resulted in the removal of tree species such as *E. tereticornis.* This has resulted in 10-25% of the Lowland Grassy Woodlands in the region remaining. The areas that are remaining have been so fragmented that over 95% of patches are less than 10 ha in size. A large proportion (>90%) of the remaining Lowland Grassy Woodland is found on private land (Miles, 2000) and susceptible to continued clearing.

The expansion of rural residential zones into remnants of Lowland Grassy Woodland, such as is occurring in the Moruya region, threatens the survival of the ecological community. A large proportion (approximately half) of the Lowland Grassy Woodland remnants near Moruya and Bingie are zoned as rural, rural residential or industrial (Eurobodalla Shire Council, in prep.).

Nutrient enrichment, through application of inorganic fertilisers to promote non-native pastures or accumulation of manure from livestock, is highly detrimental to many native plant species that are adapted to the poor nutrient status of most Australian soils. In particular, native perennial geophytes decline with an increase in soil nutrient phosphorus content. Increased availability of soil nutrients following soil disturbance also contributes to the establishment of weeds into grassy systems. Pasture improvement in the understorey of woodlands significantly impacts the ecological community. As a result of these agricultural practices, good quality patches of grassy vegetation have become increasingly restricted to small remnants in areas marginal for agriculture. Smaller woodlands are then further prone to increased soil nutrient load as a consequence of livestock sheltering as well as drift from surrounding agricultural land. Re-establishing natural soil nutrient status is identified as a major inhibitor to restoring grassy ecosystems (Prober et al., 2005) and areas where exotic pasture species have been sown are difficult to restore.

Potential impacts exist around resumption or intensification of mining activities particularly in the northern distribution of the ecological community (Eurobodalla Shire Council, pers. comm., 2012). For example, renewed activity at the Donkey Hill mine may pose a threat to Lowland Grassy Woodland remnants in the vicinity of the original shaft area and an extensive exploration licence has recently been sought over much of the historic Moruya goldfields.

The net result of widespread loss of native vegetation in the region has left a highly fragmented landscape with remnants that are typically small with limited connectivity. Offsets to clearing of the ecological community may reduce the impacts of loss of vegetation in the region but can threaten the current extent and integrity of the ecological community.

Weeds and pest animals

Weed invasion poses a major ongoing threat to the Lowland Grassy Woodland ecological community, with introduced perennial grasses having a particularly serious impact (Miles, 2002; NSW Scientific Committee, 2007). Significant environmental weeds known to occur in the region include: African Lovegrass (*Eragrostis curvula*), Fireweed (*Senecio madagascariensis*), Cocksfoot (*Dactylis glomerata*), Thistle (*Cirsium vulgare*), Hawthorn (*Crataegus monogyna*), St John's Wort (*Hypericum perfoliatum*), African Boxthorn (*Lycium ferocissimum*), Serrated Tussock (*Nassella trichotoma*), Kikuyu (*Cenchrus clandestinus*), Blackberries (*Rubus* spp.), Nightshades (*Solanum* spp.), Parramatta Grass (*Sporobolus africanus*), Briar rose (*Rosa rubiginosa*) and Clover (*Trifolium repens*).

Eragrostis curvula (African lovegrass) and *Senecio madagascariensis* (fireweed) are two weeds that have significantly increased their range and density in the region (Office of the Commissioner for Sustainability and the Environment, 2009; Miles, 2010). Between 2004 and 2009 the area of infestation for African lovegrass and fireweed in the Bega Shire have

increased by approximately 11% and 45%, respectively (Office of the Commissioner for Sustainability and the Environment, 2009).

Each of these weeds presents a serious management issue for the ecological community. Weeds compete with native species in the ecological community for space, light, water and nutrients. They contribute to loss of biodiversity and conservation value and loss of agricultural productivity if weeds replace fodder species. Further, areas of high weed occurrence may act as a seed source from which weeds can spread to other areas.

Many weed species establish within a native vegetation remnant through some form of soil disturbance (e.g. maintenance works, stock movement, feral animals) and proximity to weedy sites from which propagules spread. The net result of unmitigated weed invasion is a loss of native species diversity from the competitive and smothering effects of weeds.

A number of exotic animal species have been recorded in the Bega Valley (hares, rabbits, foxes, pigs, camels, deer, rats, goats, mice and feral cats) although, only a few exotic animals continue to threaten the ecological community (Lunney and Leary, 1988). Rabbits may selectively remove the most palatable herbs and grasses and suppress tree and shrub regeneration. Goats and deer damage trees and shrubs and can cause erosion. Pigs do considerable damage to grassy vegetation by digging and turning over the sod. They may selectively target native lilies and orchids which have palatable tubers. They may also consume eggs and young of ground-nesting birds. Introduced carnivores such as foxes, cats and feral dogs are a threat to a wide range of native mammal species that are part of the ecological community (Lunney and Leary, 1988; Miles, 2006; DEWHA, 2008a,b).

Manorina melanocephala (noisy miner) is an aggressive territorial native species which drives most other birds out of its territory. The result is reduced biodiversity as well as reduced consumption of damaging insects on the eucalypts, which can aggravate dieback in already stressed trees in fragmented landscapes. The noisy miner prefers open park-like woodland with grassy understorey and also appears to prefer to live along edges of woodland patches. Fragmentation and understorey removal have probably contributed to its present-day impact on remnant trees in the ecological community (Miles, 2006).

Inappropriate fire regimes

Fire regimes can affect the structure and species composition of the understorey of Lowland Grassy Woodland. Fire and fire-related cues are important factors in breaking the dormancy of soil seed banks in fire prone woodlands but they can also have a lethal effect on seed banks (Clarke, 2000). Altered fire frequencies within some patches may reduce the viability of some native plant populations. The dominance of the understorey by grasses or shrubs is likely to be related to fire history (Watson and Morris, 2006). *Themeda triandra* declines in the absence of fire and *Bursaria spinosa* is found in high abundance in low fire frequency sites to the point where the species can dominate much of the landscape (Watson and Morris, 2006).

Inappropriate grazing regimes

Moderate to heavy, or frequent, grazing by domestic stock and rabbits can change the structure, composition and ecological function of the ecological community. Grazing impacts such as browsing, compaction of topsoil and erosion, result in the decline and disappearance of palatable plant species and make restoration of a diverse native understorey problematic (NSW Scientific Committee, 2008). Grazing may also reduce recruitment of canopy species due to browsing on seedlings. Habitat degradation associated with overgrazing and erosion contributes to a large reduction in ecological function of the ecological community (NSW Scientific Committee, 2008).

The extent to which native plant species are affected by grazing depends on their palatability, growth form and regeneration capacity (Keith and Bedward, 1999). Kangaroo grass is highly palatable and proliferates when grazing is excluded, particularly in response to summer rain,

but may be eliminated under continued heavy grazing regimes. Forbs with erect growth forms are also more prone to declines under grazing than those with rosette or prostrate growth forms. However, grazing is also a mechanism that creates gaps in grass canopies which are important for seedling establishment in many species (Fischer et al., 2008). Nevertheless, in some cases this may provide opportunities for the establishment of exotic plant species. Nutrient enrichment (from animals or direct pasture improvement) may also further advantage exotic plant species.

Heavy grazing may also exacerbate rates of soil erosion by increasing exposure of soils. Such effects may be particularly evident after prolonged drought when regrowth capacity is diminished (Keith and Bedward, 1999).

Rural tree dieback

Dieback is the premature, relatively rapid decline and death of native trees (Reid and Landsberg, 1999). It can be caused by brush-tailed possum browsing, changed hydrology, or a variety of factors, such as large numbers of *Manorina melanocephala* (noisy miners) and *M. melanophrys* (bell miners), leading to damage by insects. In the Bega region, dieback has been recorded by Jurskis and Turner (2002) as expanding.

In the agricultural landscape in which the ecological community occurs, large trees often remain as isolated individuals (paddock trees or small stands). These trees suffer increased mortality related to drought and recurring insect attack as well as occasional lightning strike. The loss of large trees that provide habitat resources for a range of fauna contributes to a large reduction in ecological function within the ecological community.

Climate Change

Climate change is now understood to pose a serious long-term threat to our terrestrial, coastal and aquatic ecosystems and to have the potential to change the ecology of these environments. Climate change models are predicting increased temperatures and changed rainfall patterns (Department of Environment Climate Change and Water NSW 2010, Dunlop et al. 2012). Ecological consequences are likely to include an increase in fire events, changes in seasonal moisture and reduction in productivity.

Not only does climate change directly threaten species that cannot adapt, it could exacerbate existing threats, including loss of habitat, altered hydrological regimes, altered fire regimes and invasive species which, themselves, are not adequately managed at present. The potential large scale impacts of climate change could influence the species composition of this ecological community through their responses to disturbance and the very nature of those disturbances. Biotic responses in temperate grassy woodlands like this ecological community could include declines of temperature-sensitive, fire-sensitive and moisture-dependent species, as shifts in dominance occur according to seasonal growth characteristics and temperature tolerance (McIntyre, 2011). Climate change could also possibly influence the future distribution and extent of the ecological community.

Key threatening processes

Key Threatening Processes are listed under the NSW *Threatened Species Conservation Act* 1995 (NSW TSC Act 1995) and the EPBC Act. A threatening process is defined as a key threatening process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

Key Threatening Processes that operate in the Lowland Grassy Woodland ecological community include:

- Land clearance (EPBC Act); Clearing of native vegetation (NSW TSC Act)
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (EPBC Act); Invasion of native plant communities by exotic perennial grasses (NSW TSC Act)
- Competition and land degradation by rabbits (EPBC Act); Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (NSW TSC Act)
- Loss of Hollow-bearing Trees (NSW TSC Act)
- Removal of dead wood and dead trees (NSW TSC Act)
- Herbivory and environmental degradation caused by feral deer (NSW TSC Act)
- Competition from feral honeybees (NSW TSC Act)
- Predation by European Red Fox (EPBC Act); Predation by the European red fox (*Vulpes vulpes*) (NSW TSC Act)
- Predation by feral cats (EPBC Act); Predation by the feral cat (*Felis catus*) (NSW TSC Act)
- Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases (EPBC Act); Anthropogenic Climate Change (NSW TSC Act)

Appendix F - Eligibility for listing against the EPBC Act criteria

Criterion 1 - Decline in geographic distribution

The Lowland Grassy Woodland ecological community has undergone a large reduction in extent since European settlement, largely due to clearing (Keith and Bedward, 1999; Tindall et al., 2004; Tozer et al., 2006; Tozer et al., 2010). The loss of woodlands has not been uniform throughout the landscape; the Lowland Grassy Woodland is among the woodland communities that occur on the most fertile soils and are the most amenable to agriculture. Therefore, the ecological community has been preferentially cleared. The total area of Lowland Grassy Woodland remaining in the South East Corner bioregion is estimated to be 6 000–14 000 ha, representing approximately 10–25% of the extent before European settlement (Tozer et al., 2010).

Although no hard data is available, it is known that only limited occurrences of derived grasslands occur. This is supported by local expert opinion and the NSW Scientific Committee listing determination (NSW Scientific Committee, 2007), which found that the ecological community, including derived grasslands, was endangered. Therefore, the inclusion of derived grassland in the ecological community has negligible effect on the above figures.

Clearing of the community has not been evenly distributed across its range (NSW Scientific Committee, 2007). For example, Keith and Bedward (1999) estimated that less than 10% of the ecological community remains in the western parts of the Bega and Towamba valleys.

The estimates of decline in Table 1 do not take into consideration the condition of remnants. It is likely that the extent of Lowland Grassy Woodland that remains in good condition, and meets the condition thresholds, is lower than indicated above and may meet criterion 1 as endangered.

Based on the figures in Table 1, the ecological community has undergone a substantial decline in geographic distribution. Therefore, the ecological community has been demonstrated to have met the relevant elements of Criterion 1 to make it **eligible** for listing as **vulnerable**.

Table 1. Estimates of decline and extent for Lowland Grassy Woodlands based on vegetation units that correspond with the ecological community.

	Pre 1750 ha	**Current (ha)**	**% remaining**	**In reserves (ha)**	**% of original extent in reserves**	**% of remaining extent in reserves**
Candelo and Bega Dry Grass Forest - combined (Keith and Bedward 1999)	50 654	6 007	12%	368	0.7%	6%
e20p229: South east Lowland Grassy Woodland (Tozer et al., 2010)	56 000 - 140 000	14 000	10-25%	780	< 1.5%	5.6%

Criterion 2 - Small geographic distribution coupled with demonstrable threat

The purpose of this criterion is to recognise that an ecological community with a distribution that is currently small has an inherently higher risk of extinction if it is subject to a threatening process. Thresholds to identify terrestrial vegetation communities with small distributions are typically based on three indicative measures; area of occupancy, total extent of occurrence and patch size (indicative of fragmentation). If any of the three measures is demonstrated to apply to the ecological community it is considered to have a small geographic distribution.

Lowland Grassy Woodland occurs over a limited (approx. 800 000 ha) area of south eastern NSW in the Bega, Moruya, Towamba and Belowra valleys and small areas at Tanja and Araluen (Keith and Bedward, 1999). Within these areas the ecological community occupies a limited area (maximum 14 000 ha) (Tozer et al., 2010) making it potentially eligible for listing as endangered.

In addition, the majority of Lowland Grassy Woodland remnants are very small (<10 ha) in size (Tozer et al., 2006) making it very restricted and potentially eligible for listing as critically endangered. The fragmented nature of this ecological community means it is vulnerable to edge effects as well as other threats. The inclusion of limited occurrences of derived grasslands in the ecological community will not significantly change these figures.

As detailed in Part A and Appendix E – 'Description of Threats', the Lowland Grassy Woodland ecological community is subject to several ongoing demonstrable threats. Key threats include the impacts associated with fragmentation of remnants and weed invasion. The impact of ongoing threats such as invasion of exotic species and inappropriate grazing or fire regimes are exacerbated by the small distribution of the remaining extent of the Lowland Grassy Woodland ecological community. In addition, rural residential developments, such as in the Eurobodalla Local Government Area, pose a threat to remaining remnants of the ecological community (Eurobodalla Shire Council, pers. comm., 2012). These threats are unlikely to diminish in the foreseeable future.

The ecological community has a **very restricted** distribution, as evidenced by highly fragmented remnants (Table 2) with the majority (approx. 95%) of patches being a very small size, typically less than 10 ha (Tozer et al., 2006). There is also clear evidence that the ecological community is subject to a range of ongoing threats that could cause it to be lost in the immediate future. Therefore, the ecological community has been demonstrated to have met the relevant elements of Criterion 2 to make it **eligible** for listing as **critically endangered**.

Table 2. Patch size distribution (based on Tozer et al., 2006)

Description of decline thresholds/category	**Threshold**	**Percent of remnants**
n/a	Patch size < 500ha	100%
Limited = Vulnerable	n/a	n/a
Restricted = Endangered	Patch size < 100ha	99.54%
Very restricted = Critically Endangered	Patch size <10ha	95.74%
n/a	Patch size < 0.5ha	53.38%

Criterion 3 - Loss or decline of functionally important species

Although studies specific to functional species in Lowland Grassy Woodland are not available, it is known that the relationship between species is important for maintaining ecosystem function.

Vegetative components of the ecological community are important as they provide food and habitat for faunal components of the community. A large proportion of the ecological community is regrowth (Miles, 2006). Regrowth trees lack the hollows that are found in older trees and therefore reduce the ecological complexity and functionality of the ecological community.

Land use intensification may be a major threat to small species because it homogenises the landscape. Fischer et al. (2008) demonstrated the important relationship between the structure of vegetation and species distribution (body size) of birds in south eastern Australia. Therefore, the structure of the vegetation of the Lowland Grassy Woodland ecological community influences the bird (and other animal) populations and/or species diversity that the ecological community can support. The species diversity will differ between the different structural forms of the ecological community (grassy understorey or shrubby understorey).

Loss of grassy understorey due to overgrazing by livestock (cattle, sheep and goats), rabbits and native fauna (kangaroo) has been related to marked changes in community structure and composition. Short lived grass species appear to be less affected by grazing than species of intermediate longevity. The unpalatability of some shrub species has also led to increased survival of shrub seedlings. The reduction in floral diversity of the remnants is directly related to the reduction in diversity of fauna thus causing many changes and an over-simplification of the system, which can not then sustain itself (Windsor, 1999).

Lowland Grassy Woodland has undergone a very substantial loss of native mammal fauna since European settlement (NSW Scientific Committee, 2007). At least six native mammal species have become locally extinct (Lunney and Leary, 1988). Many of these extinctions have been attributed to loss of habitat, invasion of feral predators and hunting activities (Lunney and Leary, 1988; NSW Scientific Committee, 2007). Based on the extent of the decline of vertebrate fauna, it is not unreasonable to predict that the invertebrate fauna of woodlands has also been adversely affected by clearing and habitat loss (Majer et al., 1999). Soil and litter invertebrates in woodlands are affected by grazing, loss of ground vegetation and the removal of litter and wood debris. Fundamental changes in nutrient inputs and hydrology associated with land clearing and agriculture have caused physical, chemical and biological changes to woodland soils, driving reductions in the abundance of soil and litter dwelling invertebrates, which are a major food source for many woodland birds (Watson, 2011). Changes in invertebrate abundance coupled with declines in the woodland bird populations are among the explanations proposed for rural tree decline and death (Majer et al., 1999).

Tall trees that approximate the original stature of the ecological community prior to European settlement often only remain as isolated paddock trees. These and other remnant and regrowth trees suffer episodes of elevated mortality related to drought and recurring insect attack (exacerbated by *Manorina melanocephala* (noisy miner) and *M. melanophrys* (bell miner) population increase) consistent with rural tree dieback. The loss of these large trees which provide habitat resources for a range of fauna, contribute to a large reduction in the ecological function of the community. The loss of large proportions of the dominant tree species, forest red gum, to clearing, is one of the causes of the severe decline in koala numbers in the Bega region (Lunney and Leary, 1988).

Although it has been demonstrated that threats have impacted upon functionally important species within the Lowland Grassy Woodland ecological community, data to support decline of particular functionally important species is not available. Therefore, the community is **not eligible** for listing in any category under this criterion.

Criterion 4 - Reduction in community integrity

The reduction in the integrity of the Lowland Grassy Woodland ecological community is evident from observations of fragmentation, rural tree dieback and weed invasion, and the decline of fauna within the ecological community.

Reduction in integrity through fragmentation

The Lowland Grassy Woodland ecological community has been extensively cleared across its range. Those remnants which remain are generally small and isolated – i.e. 95% of patches are less than 10 ha in size (Tozer et al., 2006). Fragmentation results in the isolation of, and loss of connectivity between remnants that can be critical to the survival and dispersal of native species, and to the maintenance of ecological processes that sustain the ecological community. Fragmentation also places the ecological community under additional pressures particularly if remnants are surrounded by agricultural land. These include edge effects, degradation of habitat for many species, altered fire regimes and reduced opportunities for pollination and dispersal of plant propagules.

Reduction in integrity through rural tree dieback

Dieback has been recorded in the Bega region and the ecological community (Eurobodalla Shire Council, 2012; Miles, 2000; Jurskis and Turner, 2002). In this ecological community it can be caused by increased impact of brush-tailed possum browsing in rural areas where tree cover is minimal, changed hydrology, or a variety of factors, such as large numbers of noisy miners and bell miners, leading to damage by insects.

Noisy miners are an aggressive species which drive most other bird species out of its territory. The result is a reduced consumption of damaging insects on the eucalypts, which aggravates dieback in already stressed trees. The noisy miner prefers open park-like woodland with grassy understorey and also appears to prefer to live along edges. Fragmentation and understorey removal have probably contributed to the current impact of this species on remnant trees in the Lowland Grassy Woodland ecological community (Miles, 2000).

Reduction in integrity through weed invasion

Weeds are a serious threat to the Lowland Grassy Woodland ecological community. The fertile soil, the widespread disturbance and fragmentation of native vegetation remnants and the surrounding matrix of agricultural and developed lands are conducive to the invasion and establishment of weeds. Fireweed (*Senecio madagascariensis*) is one weed, amongst others, that is continuing to increase in the ecological community. Exotic fireweed has recently increased by up to 45% in some parts of the ecological community's distribution (Office of the Commissioner for Sustainability and the Environment, 2009).

Reduction in integrity through decline of faunal components

Important functional roles are played by insectivorous woodland birds and arboreal mammals, both of which feed on herbivorous insects frequenting the tree canopy. The woodland bird fauna is highly modified and woodlands are amongst the areas in Australia with the highest decline in bird species (National Land and Water Resource Audit, 2007). Bird species are likely to have declined in many small remnants of Lowland Grassy Woodland. Fragmentation of vegetation correlates with the distribution of bird species of different sizes (Reid and Landsberg, 1999). The decline in woodland fauna may be another factor contributing to tree dieback associated with outbreaks of herbivorous insects. Whilst the causes of insect outbreaks are undoubtedly complex, a sharp decline in the abundance of predators that normally feed on herbivorous insects would preclude any possibility of regulating insect outbreaks.

Restorability of the ecological community

A key issue is the extent to which the present degraded state of the ecological community can be reversed towards its original state. This is problematic because the response of the ecological community to disturbance involves multiple facets – not only loss of native biodiversity but also promotion of weed invasion. Changes in condition and states of grassy ecosystems become increasingly difficult to reverse as the impacts of persistent disturbance accumulate (Prober et al., 2005).

Some management strategies are available to help maintain or increase the native plant cover of grassy woodland and grassland remnants based on appropriate regimes for grazing, fire and weed control (e.g. Prober and Thiele, 1995, Lunt, 1991; Barlow, 1998). However, knowledge gaps remain for how best to halt the degradation and restore the ecological community.

Another key challenge to restoration of the ecological community is that it is currently not possible to access sufficient seed supplies for broadscale revegetation programs and there are certain species which cannot be re-introduced in this way because their germination strategies are poorly known or not applicable to broadcast seeding. Furthermore, it remains difficult to increase native plant biodiversity in remnants degraded by highly invasive weeds without first enforcing a weed management strategy.

Artificial grassy woodlands are unlikely to ever approximate the ecological integrity of the pre-European state of the ecological community (Lunt, 1991).

Summary

The loss or decline of numerous faunal species, palatable flora species, old trees and associated hollows, combined with the effects of substantial clearing, severe fragmentation, altered fire regimes and the impacts of weeds have seriously reduced the community's integrity and consequently its ability to respond to natural and anthropogenic pressures.

The change in integrity experienced by the ecological community through fragmentation, weed invasion and the inferred loss of key faunal components is **very severe** and regeneration is unlikely in the immediate future. Therefore, the ecological community is **eligible** for listing as **critically endangered** under this criterion.

Criterion 5 - Rate of continuing detrimental change

Despite plans in place to manage weeds in the Bega region, the area of infestation for African lovegrass in the Bega Shire has continued to increase by approximately 11% between 2004 and 2009 and the infestation of fireweed in the shire has increased 45% over the same period (Office of the Commissioner for Sustainability and the Environment, 2009).

All remnants have visibly declined (tree health and weed invasion) in the last 10 years (Miles, pers. comm., 2010). Noisy miners are contributing to tree decline in many areas and bell miners are moving from adjacent wetter forests down the rivers and into riparian remnants of the community. The recent long term drought has advantaged African lovegrass and fireweed which have extended their range and density in the region (Miles, pers. comm., 2010). The rate of decline has accelerated in the last decade due to the effects of drought on tree decline and the expansion of weeds able to capitalise on the decline of native species cover.

In addition, inappropriate fire and grazing regimes that alter the species composition of the vegetation in the ecological community and rural residential development continue to be detrimental to the ecological community.

Although there has been continuing detrimental change to the ecological community, data are insufficient to determine an overall rate, so it is **not eligible** for listing under his criterion.

Criterion 6 - Quantitative analysis showing probability of extinction

There is no quantitative data available to assess this ecological community under this criterion. Therefore, it is **not eligible** for listing under this criterion.

Bibliography

Barlow T (1998). Grassy Guidelines. How to Manage Native Grasslands and Grassy Woodlands on your Property. Trust for Nature, Melbourne, Victoria.

Carter O, Murphy A and Cheal D (2003). Natural Temperate Grassland (web page). Available on the Internet at: http://www.environment.gov.au/biodiversity/publications/grasslands/index.html.

Clarke PJ (2000). Plant population processes in temperate woodlands of eastern Australia - premises for management. In 'Temperate eucalypt woodlands in Australia: biology, conservation, management and restoration.' (eds) R.J. Hobbs & C.J. Yates. Surrey Beatty & Sons.

Department of Environment, Climate change and Water NSW (2010). NSW Climate Impact Profile: The impacts of climate change on the biophysical environment of New South Wales.

DEWHA (2008a). Threat abatement plan for competition and land degradation by rabbits.

DEWHA (2008b). Threat abatement plan for predation by the European red fox.

Doerr VAJ, Doerr ED and Davies MJ (2010). Does structural connectivity facilitate dispersal of native species in Australia's fragmented terrestrial landscapes? Systematic review No. 44. Collaboration for environmental evidence.

Dunlop M, Hilbert DW, Ferrier S, House A, Liedloff A, Prober SM, Smyth A, Martin TG, Harwood T, Williams KJ, Fletcher C and Murphy A (2012). The Implications of Climate Change for Biodiversity Conservation and the National Reserve System: Final Synthesis. A report prepared for the Department of Sustainability, Environment, Water, Population and Communities and the Department of Climate Change and Energy Efficiency. CSIRO Climate Adaptation Flagship, Canberra.

Eurobodalla Shire Council (2012). Bega and Candelo Dry Grass Forest/Lowland Grassy Woodland Management Issues. Fact Sheet 2. (web page). Viewed: January 2012. Available on the Internet at: http://www.esc.nsw.gov.au/media/340433/FactSheet2.pdf.

Eurobodalla Shire Council (2012). Personal Communication by email June 2012, Paula Pollock, Natural Environment Planning Coordinator, Eurobodalla Shire Council.

Eurobodalla Shire Council (in preparation). Biodiversity Certification Project Report: South Moruya and Broulee.

Fischer J, Lindenmayer DB and Montague-Drake R (2008). The role of landscape texture in conservation biogeography: a case study on birds in south-eastern Australia. Diversity and Distributions, 14, p 38-46.

Ford HA (2011). The cause of decline of birds of eucalypt woodlands: advances in our knowledge over the last 10 years. Emu, 111, p 1-9.

Gellie N (2005). Native vegetation of the southern forests: South-east Highlands, Australian Alps, South-west Slopes and South-east Corner bioregions. Cunninghamia, 9, p 219-254.

Jurskis V and Turner J (2002). Eucalypt dieback in eastern Australia: a simple model. Australian Forestry, 65, p 87-98.

Keith DA (2002). A Compilation Map of Native Vegetation for New South Wales - NSW Biodiversity Strategy - Draft Report.

Keith DA (2004). Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Sydney.

Keith DA and Bedward M (1999). Native vegetation of the South East Forests region, Eden, New South Wales. Cunninghamia, 6.

Landsberg J (1990). Dieback of rural eucalypts: does insect herbivory relate to dietary quality of tree foliage? Austral Ecology, 15, p 73-87.

Lindenmayer DB and Fischer J (2006). Habitat Fragmentation and Landscape Change - An Ecological and Conservation Synthesis. CSIRO Publishing.

Lunney D and Leary T (1988). The impact on native mammals of land-use changes and exotic species in the Bega district, New South Wales, since settlement. Australian Journal of Ecology, 13, p 67-92.

Lunt ID (1991). Management of remnant lowland grasslands and grassy woodlands for nature conservation: a review. Victorian Naturalist, 108, p 56-66.

Majer JD, Recher H and Keals N (1999). Canopy arthropod faunas in fragmented agricultural landscapes. In 'Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration.' (eds) R.J. Hobbs & C.J. Yates. Surrey Beatty and Sons, Chipping Norton.

McIntyre S (2011). Ecological and anthropomorphic factors permitting low-risk assisted colonisation in temperate grassy woodlands. Biological Conservation, 144, p 1781-1789.

Miles J (2000). State of the Vegetation Report for Bega Valley Shire. Prepared for Bega Valley Shire Council and the Far South Coast Catchment Management Committee.

Miles J (2002). Weeds of the NSW south coast. A guide to identification and control. Report to the Bega Valley and Eurobodalla Shire Councils, Shoalhaven City Council and Illawarra District Noxious Weeds Authority.

Miles J (2006). Recognition and management of endangered ecological communities in the south east corner of NSW. Southern Rivers Catchment Management Authority.

Miles J (2010). Personal Communication in Threatened Ecological Community Nomination Form - for listing or changing the status of an ecological community under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Lowland Grassy Woodland and Forest of the NSW Southeast Corner Bioregion.

Miles J (2012). Personal communication by email January 2012, botanical consultant and expert, Bega NSW.

National Land and Water Resource Audit (2007). Australian Natural Resources Atlas. Biodiversity Assessment. (web page). Viewed: September 2011. Available on the Internet at: http://www.anra.gov.au/topics/vegetation/index.html.

NGH Environmental (2007). Endangered Ecological Communities Survey and Mapping in Eurobodalla Shire. Eurobodalla Shire Council.

NSW Scientific Committee (1999). Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion - Final Determination (web page). Available on the Internet at: http://www.environment.nsw.gov.au/determinations/illawarralowlandsgrassy36a.htm

NSW Scientific Committee (2007). Lowland Grassy Woodland in the South East Corner Bioregion - endangered ecological community listing. (web page). Viewed: 23 May 2011. Available on the Internet at: http://www.environment.nsw.gov.au/determinations/LowlandGrassyWoodlandEndSpListing.htm.

NSW Scientific Committee (2009). Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing. Final Determination (web page). Available on the Internet at: http://www.environment.nsw.gov.au/determinations/cumberlandplainpd.htm.

Office of the Commissioner for Sustainability and the Environment (2009). Regional State of the Environment Report (web page). Available on the Internet at: http://www.envcomm.act.gov.au/soe/rsoe2009/begavalley/indicators/pestplants.shtml

Prober SM, Thiele KR, Lunt ID and Koen TB (2005). Restoring ecological function in temperate grassy woodlands: manipulating soil nutrients, exotic annuals and native perennial grasses through carbon supplements and spring burns. Journal of Applied Ecology, 42, p 1073-1085.

Reid N and Landsberg J (1999). Tree decline in agricultural landscapes: what we stand to lose. In 'Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration' (eds) R.J. Hobbs & C.J. Yates. Surrey Beatty and Sons, Chipping Norton.

Ross J (1999). Guide to Best Practice Conservation of Temperate Native Grassland. World Wildlife Fund for Nature (Australia), Sydney, NSW

Thomas V, Gellie N and Harrison T (2000). Forest Ecosystem Classification and Mapping for the Southern CRA Region. NSW National Parks and Wildlife Service, Queanbeyan.

Tindall D, Pennay C, Tozer MG, Turner K and Keith DA (2004). Native vegetation map report series. No. 4. Araluen, Batemans Bay, Braidwood, Burragorang, Goulburn, Jervis Bay, Katoomba, Kiama, Moss Vale, Penrith, Port Hacking, Sydney, Taralga, Ulladulla, Wollongong. NSW Department of Environment and Conservation and NSW Department of Infrastructure, Planning and Natural Resources, Sydney.

Tozer MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, MacKenzie B, Beukers P and Cox S (2010). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Cunninghamia, 11.

Tozer MG, Turner K, Simpson C, Keith DA, Beukers P, MacKenzie B, Tindall D and Pennay C (2006). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. NSW Department of Environment and Conservation and NSW Department of Natural Resources.

Walsh N (2005). Personal Communication by email May 2005, Senior Conservation Botanist, Royal Botanic Gardens, Victoria.

Watson DM (2011). A productivity-based explanation for woodland bird declines: poorer soils yield less food. Emu, 111, p 10-18.

Watson P and Morris EC (2006). Effects of fire frequency on vegetation in western Sydney's Grassy Cumberland Plain Woodland and implications for management. In 'Bushfire Conference 2006'. Brisbane, 6-9 June 2006.

Whelan R and Hibberd J (1992). Mammals and Habitat in the Bega valley: the importance of remnant forest on private property. NSW Department of Planning, Sydney.

Windsor DM (1999). A review of factors affecting regeneration of box woodlands in the Central Tablelands of New South Wales. In 'Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration.' (eds) R.J. Hobbs & C.J. Yates. Surrey Beatty and Sons, Chipping Norton.