# National Recovery Plan

## White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland

A critically endangered ecological community

**May 2011**

Department of Environment, Climate Change and Water NSW. 2010. National Recovery Plan for White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Department of Environment, Climate Change and Water NSW, Sydney.

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**Disclaimer:**
This recovery plan sets out the actions necessary to stop the decline of, and support the recovery of, the listed critically endangered ecological community. The Australian Government is committed to action in accordance with the plan and to implementing the plan as it applies to Commonwealth areas.

The plan has been developed with the involvement and cooperation of a broad range of stakeholders, including in partnership with the Department of Environment and Resource Management (Qld), the Department of Environment, Climate Change and Water (NSW), Department of Sustainability and Environment (Vic) and the Territory and Municipal Services (ACT). The making or adoption of this plan does not necessarily indicate the commitment of individual stakeholders to undertaking any specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge and changes in conservation status.

ISBN 978 1 74232 311 4
DECC 2009/407

Australian Government

NSW GOVERNMENT Environment, Climate Change & Water

State Government Victoria Department of Sustainability and Environment

Queensland Government

ACT Parks Conservation and Lands

*Front cover photograph: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland in Barayamal National Park (W. Hawes)*

## Acknowledgments

The initial draft of this recovery plan was prepared by *The Envirofactor Pty Ltd* from an original draft prepared by NSW Department of Environment, Climate Change and Water. Many thanks to the then National Recovery Team who provided valuable input into the development of the original draft. In addition, this plan has benefited greatly from the generous contributions of Dr Suzanne Prober and Dr Kevin Thiele. Special thanks to them for their continued commitment to, and passion for, the conservation of *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*, for sharing their expertise with land managers, and for their vision in developing the Conservation Management Network model.

The Australian Government provided funding to the NSW Department of Environment, Climate Change and Water to assist with the preparation of this recovery plan.

The maps for the recovery plan were prepared by the Environmental Resources Information Network of the Department of Sustainability, Environment, Water, Population and Communities with assistance from the relevant State and Territory agencies.


## Abbreviations

| | |
|---|---|
| ARG | Aboriginal Reference Group |
| ANU | Australian National University |
| BGGW | Box-Gum Grassy Woodland; *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* |
| CA | Conservation Agreement |
| CAP | Catchment Action Plan |
| CEN | Community Environment Network |
| CMA | Catchment Management Authority |
| CMN | Conservation Management Network |
| DECCW | Department of Environment, Climate Change and Water (NSW) |
| DERM | Department of Environment and Resource Management (Qld) |
| DEWHA | Department of the Environment, Water, Heritage and the Arts (Cwlth, former) |
| DSE | Department of Sustainability and Environment (Vic) |
| DSEWPaC | Department of Sustainability, Environment, Water, Population and Communities (Cwlth) |
| EPA | Environmental Protection Agency (Qld) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) |
| ESP | Environmental Stewardship Program (Cwlth) |
| EVC | Ecological Vegetation Class (Vic) |
| FFG Act | *Flora and Fauna Guarantee Act 1988* (Vic) |
| GA | Greening Australia |
| GBW | Grassy Box Woodlands |
| IBRA | Interim Biogeographic Regionalisation for Australia |
| IUCN | International Union for Conservation of Nature and Natural Resources |
| LHPA | Livestock Health and Pest Authorities |
| NC Act | *Nature Conservation Act 1980* (ACT) |
| NC Act(Q) | *Nature Conservation Act 1992* (Qld) |
| NCT | Nature Conservation Trust |
| NCT Act | *Nature Conservation Trust Act 2001* (NSW) |
| NGO | Non-government Organisation |
| NPWS | National Parks and Wildlife Service (NSW) |
| NRM | Natural Resource Management |
| NV Act | *Native Vegetation Act 2003* (NSW) |
| PVP | Property Vegetation Plan (NSW) |
| RLPB | Rural Lands Protection Board (NSW) |

| | |
|---|---|
| RTA | Roads and Traffic Authority (NSW) |
| TFN (Vic) | Trust for Nature (Vic) |
| TSC Act | *Threatened Species Conservation Act 1995* (NSW) |
| TSR | Travelling Stock Route/Reserve |
| TSSC | Threatened Species Scientific Committee (Cwlth) |
| VM Act | *Vegetation Management Act 1999* (Qld) |
| WWF | World Wide Fund for Nature |

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# Executive Summary

This document constitutes the formal National Recovery Plan for *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (referred to throughout this recovery plan as Box-Gum Grassy Woodland) and as such considers the conservation requirements of the ecological community across its known range. It identifies actions to be undertaken to ensure the long-term viability of the ecological community.

*White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* is listed as a critically endangered ecological community under the *Environment Protection and Biodiversity Conservation Act 1999*. The ecological community can occur either as woodland or derived native grassland (i.e. grassy woodland where the tree overstorey has been removed). It is characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs (where shrub cover comprises less than 30% cover), and a dominance or prior dominance of White Box (*Eucalyptus albens*) and/or Yellow Box (*E. melliodora*) and/or Blakely's Red Gum (*E. blakelyi*) trees. In the Nandewar bioregion, Grey Box (*E. microcarpa* or *E moluccana*) may also be dominant or co-dominant. In the woodland state, tree cover is generally discontinuous and of medium height with canopies that are clearly separated.

To be considered part of the listed ecological community remnant areas must also:

- have a predominantly native understorey (i.e. more than 50% of the perennial vegetative groundlayer must comprise native species), and
- be 0.1 hectare (ha) or greater in size and contain 12 or more native understorey species (excluding grasses), including one or more identified important species (see Appendix 1);

  or

  be 2 ha or greater in size and have either natural regeneration of the overstorey species or an average of 20 or more mature trees per ha.

Box-Gum Grassy Woodland occurs along the western slopes and tablelands of the Great Dividing Range from southern Queensland through New South Wales and the Australian Capital Territory to Victoria. The ecological community once covered several million hectares in the eastern part of the wheat-sheep belt and tablelands and some coastal regions (e.g. Bega Valley of NSW). Due to the ecological community's occurrence on fertile soils it has been extensively cleared for agriculture and intact remnants, including both trees and unmodified understorey, are now extremely rare. Very few high quality remnants remain anywhere across its former range. Current estimates indicate that only 405,000 ha of the ecological community in various condition states remain (Australian Government 2007). Clearing and fragmentation for urban, rural residential, agricultural and infrastructure development remain on-going threats to this ecological community, while degradation resulting from inappropriate management and weed invasion by introduced perennial grasses continues to erode the conservation value of remnant areas.

The objective of this recovery plan is to promote the recovery and minimise the risk of extinction of the ecological community through:

- achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- increasing protection of sites in good condition;
- increasing landscape function of the ecological community through management and restoration of degraded sites;
- increasing transitional areas around remnants and linkages between remnants; and

- bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

This recovery plan will be implemented over a five-year period potentially using funding from the Australian Government and resources provided by state, territory and local government bodies, with the assistance of non-government/community organisations and private landholders.

# PART A: GENERAL INFORMATION

## 1. Introduction

This National Recovery Plan for *White Box–Yellow Box–Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (subsequently referred to throughout this plan as "Box-Gum Grassy Woodland") has been prepared under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In developing this recovery plan consideration has been given to the objects of the EPBC Act as set out in Section 3(1) of the Act and developed in accordance with the requirements specified in Section 271 of the EPBC Act and in Regulation 7.12 of the *Environment Protection and Biodiversity Conservation Regulation 2000* (EPBC Regulation).

Box–Gum Grassy Woodland is an ecological community that occurs along the western slopes and tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT to central Victoria (Beadle 1981). Further investigation is required regarding the existence of the listed community in South Australia.

It occurs in the following bioregions of the Interim Biogeographic Regionalisation of Australia (IBRA): Brigalow Belt South, Murray Darling Depression, Nandewar, New England Tableland, NSW North Coast, NSW South Western Slopes, Sydney Basin, South East Coastal Plain, South East Corner, South Eastern Highlands, South Eastern Queensland, Riverina and Victorian Midlands.

The overall aim of this recovery plan is to promote the recovery and prevent the extinction of the critically endangered ecological community, known as Box-Gum Grassy Woodland. The specific objective to be achieved within the life-span of this recovery plan is to minimise the risk of extinction of the ecological community through:

- achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- increasing protection of sites in good condition;
- increasing landscape function of the community through management and restoration of degraded sites;
- increasing transitional areas around remnants and linkages between remnants; and
- bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

This objective will be achieved across the geographic distribution of Box-Gum Grassy Woodland and within five years of the adoption of this recovery plan.

This recovery plan provides the basis for a strategic, regional and local community-based approach to conserving this ecological community and its threatened component species. It addresses the issues that currently threaten the ecological community and seeks to achieve conservation of the ecological community through implementation of recovery actions. It builds upon, and is consistent with, information in other state and territory recovery and action plans, and priority actions for Box-Gum Grassy Woodland and threatened species associated with the ecological community. It is also consistent with management plans for conservation reserves that exist under state and territory legislation.

# 2. Conservation Status

Box-Gum Grassy Woodland is listed as a "critically endangered" ecological community under the EPBC Act. The Commonwealth Threatened Species Scientific Committee (TSSC) has deemed the ecological community eligible for listing as critically endangered as it meets the following criteria:

- A very severe decline in geographic distribution; and
- A reduction in ecological community integrity across most of its geographic distribution.

The estimated loss of more than 90% of its pre-European distribution has in turn lead to a critical loss of integrity (structure, composition and ecological processes) (TSSC 2006). The result is that less than half of the remaining 10% is considered likely to meet the minimum condition criteria of the listed ecological community (TSSC 2006).

**Australian Capital Territory:** *Yellow Box-Red Gum Grassy Woodland,* a component of this ecological community, is listed as endangered under the *Nature Conservation Act 1980* (NC Act).

**New South Wales:** *White Box-Yellow Box-Blakely's Red Gum Woodland* is listed as an endangered ecological community under the *Threatened Species Conservation Act 1995* (TSC Act). This listing also recognises derived native grasslands as part of this ecological community. Other tree species listed under the EPBC Act that may occur in association with this ecological community such as Fuzzy Box (*Eucalyptus conica*) and Grey Box (*E. microcarpa*) are listed under the TSC Act (in areas where they dominate) as separate threatened ecological communities.

**Queensland:** The ecological community is a component of a number of Regional Ecosystems (ecological communities assigned a conservation status based on its current remnant extent in a bioregion) listed under the *Vegetation Management Act 1999* (VM Act) as endangered. These include: 13.3.1, 13.3.4, 13.12.8 and 13.12.9. It is also a component of Regional Ecosystems 13.11.8 and 12.8.16 listed as "of concern".

**Victoria:** This ecological community is not listed as threatened under the *Flora and Fauna Guarantee Act 1998* (FFG Act). However, the ecological community broadly equates to the Ecological Vegetation Classes (EVC) in the following table:

| **Bioregion** | **Ecological Vegetation Class** | **Bioregion conservation status*** |
|---|---|---|
| Central Victorian Uplands | 47: Valley Grassy Forest<br>175_62: Granitic Grassy Woodland<br>175_61: Grassy Woodland | Vulnerable<br>Endangered<br>Endangered |
| Dundas Tablelands | 67: Alluvial Terraces Herb-rich Woodland<br>175: Grassy Woodland | Endangered<br>Endangered |
| East Gippsland Lowlands | 175_61: Rainshadow Grassy Woodland<br>175_62: Limestone Grassy Woodland | Depleted<br>Depleted |
| East Gippsland Uplands | 175_61: Rainshadow Grassy Woodland<br>175_62: Limestone Grassy Woodland | Depleted<br>Depleted |
| Goldfields | 47: Valley Grassy Forest<br>67: Alluvial Terraces Herb-rich Woodland<br>70:Hillcrest Herb-rich Woodland<br>175_61: Low Rises Grassy Woodland<br>175_62: Granitic Grassy Woodland | Vulnerable<br>Endangered<br>Depleted<br>Vulnerable<br>Vulnerable |
| Greater Grampiams | 67: Alluvial Terraces Herb-rich Woodland<br>175: Grassy Woodland | Least Concern<br>Endangered |
| Highlands Northern Fall | 175: Grassy Woodland | Depleted |
| Highlands Southland Fall | 175: Grassy Woodland | Depleted |
| Murray Fans | 175: Grassy Woodland | Endangered |
| Northern Inland Slopes | 47: Valley Grassy Forest<br>67: Alluvial Terraces Herb-rich Woodland<br>175_61: Low Rises Grassy Woodland<br>175_62: Rainshadow Grassy Woodland<br>175_63: Shrubby Granitic-outwash Grassy Woodland | Endangered<br>Endangered<br>Endangered<br>Endangered<br>Endangered |

| | | |
|---|---|---|
| | 187: Plains Grassy Woodland/Grassy Woodland Complex | Endangered |
| Otway Plain | 175: Grassy Woodland | Endangered |
| Victorian Riverina | 47: Grassy Valley Forest<br>67: Alluvial Terraces Herb-rich Woodland<br>175_61: Low Rises Grassy Woodland<br>175_62: Shrubby Granitic-outwash Grassy Woodland | Vulnerable<br>Vulnerable<br>Endangered<br>Endangered |

* Status: DSE (1996-2009)

It can also be a component of the following EVCs.

| **Bioregion** | **Ecological Vegetation Class** | **Bioregion conservation status*** |
|---|---|---|
| Dundas Tablelands | 55: Plains Grassy Woodland<br>71: Hills Herb-rich Woodland<br>704: Lateritic Woodland<br>882:Shallow Sands Woodland | Endangered<br>Vulnerable<br>Depleted<br>Vulnerable |
| Goldfields | 3: Damp Sands Herb-rich Woodland<br>22: Grassy Dry Forest<br>55: Plains Grassy Woodland | Endangered<br>Vulnerable<br>Endangered |
| Greater Grampians | 22: Grassy Dry Forest<br>195: Seasonally Inundated Shrubby Woodland<br>282: Shrubby Woodlands<br>283: Plains Sedge Woodland<br>704: Lateritic Woodland | Depleted<br>Least Concern<br>Least Concern<br>Vulnerable<br>Depleted |
| Highlands Northern Fall | 47: Valley Grassy Forest<br>55: Plains Grassy Woodland | Vulnerable<br>Endangered |
| Northern Inland Slopes | 55: Plains Grassy Woodland<br>188: Plain Grassy Woodland/Valley Grassy Forest Complex | Endangered<br>Endangered |
| Victorian Riverina | 55_61: Plains Grassy Woodland<br>55_62: Riverina Plains Grassy Woodland<br>187: Plains Grassy Woodland/Grassy Woodland Complex<br>188: Plains Grassy Woodland/Valley Grassy Forest Complex | Endangered<br>Endangered<br>Endangered<br><br>Endangered |
| Wimmera | 3: Damp Sands Herb-rich Woodland<br>195: Seasonally Inundated Shrubby Woodland<br>283: Plain Sedge Woodland<br>803:Plains Woodland | Vulnerable<br>Least Concern<br>Depleted<br>Endangered |

* DSE (1996-2009)

A number of species for which Box-Gum Grassy Woodland provides habitat are subject to international, national or state conservation agreements and legislation (see Table 1). Actions outlined in this plan to improve the long-term viability of this ecological community can also be expected to improve conservation outcomes for these species.

The EPBC Act regulates actions that may result in significant impact on this listed ecological community, such as clearing trees or understorey vegetation in or next to the community, inappropriate grazing and burning regimes, introduction of potentially invasive pasture species, firewood collection and use of chemical fertilisers in patches which increase the nutrient levels. Any such action that is likely to have a significant impact on the ecological community must be referred to the Australian Government Minister for the Environment and may need to undergo an environmental assessment and approval process. In addition, there are other EPBC-listed ecological communities that intergrade with and/or are adjacent to Box-Gum Grassy Woodland, including Grassy Eucalypt Woodland of the Victorian Volcanic Plain, Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia, Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT and Weeping Myall Woodlands.

# 3. Description of the Listed Ecological Community

The listed ecological community can occur either as woodland or derived grassland (i.e. a grassy woodland where the tree overstorey has been removed) (DEH 2006) and provides

important habitat for a suite of woodland animals including marsupials, reptiles, amphibians, birds and invertebrates.

*White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* listed under the EPBC Act is defined as follows:

The ecological community must be, or have previously been, dominated or co-dominated by one or more of the following overstorey species (or hybrids of these species with any other *Eucalyptus* species): White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) or Blakely's Red Gum *(E. blakelyi)* [or Western Grey Box *(E. microcarpa)* or Coastal Grey Box (*E. moluccana*) in the Nandewar bioregion]. It must have a predominately native understorey (i.e. more than 50% of the perennial vegetative groundlayer must comprise native species). The area covered by the ecological community (i.e. the patch size) must be greater that 0.1 hectares (ha) and contain 12 or more native understorey species (excluding grasses), including one or more important species (as listed in Appendix 1). If the groundlayer does not meet this last criterion (i.e. does not contain 12 or more native forb species and one or more important species) then the patch size must be 2 ha or greater in area and have an average of 20 or more mature trees per ha, or natural regeneration of the identified dominant overstorey eucalypts (DEH 2006).

These minimum condition criteria are displayed diagrammatically in Appendix 2 to assist in identification. Areas which do not meet the criteria are not considered to be part of the listed ecological community. In addition, communities with a continuous shrub layer of more than 30% cover are excluded from the listed ecological community, as they are considered to be shrubby woodland and do not constitute Box-Gum Grassy Woodland (DEH 2006).

Areas which are degraded to the extent they are excluded from the community definition may still retain important components of the ecological community (e.g. seed bank, soil biota) and/or provide important habitat for fauna (fallen logs, tree hollows, native grasses, paddock trees, bush rocks, rocky outcrops). Consequently, the restoration and management of these degraded areas is important for the successful recovery of the ecological community. This objective to move Box-Gum Grassy Woodland from lower to higher condition states through changed management is best illustrated in the State and Transition Model in Appendix 3.

It is important to note that areas excluded from the community definition above may still meet the definitions of related communities listed under the Acts of other jurisdictions. For example, the NSW listed EEC *White Box – Yellow Box – Blakely's Red Gum Woodland* is broader in definition than the nationally listed EEC and so may protect areas that are not classified as the listed community at the national level.

## 3.1 Structure

This ecological community can exist in a number of structural forms as a consequence of modification by human activity. In its unmodified form this ecological community is woodland; that is the crowns of the overstorey trees are clearly separated with a canopy cover between 20-50% (Walker and Hopkins 1990, Yates and Hobbs 1997, McIntyre et al. 2002). Underlying this open tree cover is a characteristically dense groundlayer of native grasses and forbs[1].

Shrubs can be a natural component of grassy woodlands, forming an important component of the ecological community. Shrubs may be present with a generally sparse or patchy distribution but may become dominant over a localised area (TSSC 2006; Prober and Thiele 2004). On poorer soils the Box-Gum Grassy Woodlands grades into shrubby woodlands (Prober & Thiele 1993).

Over much of its former range, modification as a result of clearing and grazing has resulted

[1] Non-woody plants that are not grasses.

in either a much reduced tree cover producing open woodlands or isolated trees (with a canopy cover of less than 20%) or removal of the overstorey trees altogether creating derived native grasslands.

Alternatively the overstorey remains but the native grassy groundlayer has been removed and/or modified by pasture improvement, such that the groundlayer is now dominated by exotic species (McIntyre et al. 2002). Areas where the groundlayer is dominated by exotic species do not comprise part of the listed ecological community but, as discussed above, may still retain important community components (e.g. soil biota, tree hollows). Consequently the restoration and management of these areas will be addressed as part of this recovery plan.

## 3.2 Floristics

Within this ecological community the overstorey is, or was previously, dominated (or co-dominated) by White Box and/or Yellow Box and/or Blakely's Red Gum. In the Nandewar bioregion areas dominated or co-dominated by Coastal Grey Box and/or Western Grey Box also comprise part of the listed ecological community. These dominant species may include hybrids with any other *Eucalyptus* species.

Other co-dominant or associated tree species may include: Drooping She-oak (*Allocasuarina verticillata*), Kurrajong (*Brachychiton populneus*), Black Cypress Pine (*Callitris endlicheri*), White Cypress Pine (*C. glaucophylla*), Apple Box (*Eucalyptus bridgesiana*), Argyle Apple (*E. cinerea*), New England Stringybark (*E. caliginosa*), Fuzzy Box (*E. conica*), Long-leaved Box (*E. goniocalyx*), Red Stringybark (*E. macrorhyncha*), Brittle Gum (*E. mannifera*), Western Grey Box (*E. microcarpa*), Coastal Grey Box (*E. moluccana*), Red Box (*E. polyanthemos*) and Candlebark (*E. rubida*) (Beadle 1981; Austin et al. 2002; DEC 2005). Hybridisation is a natural occurrence common in *Eucalyptus* species, and hybrids of some eucalypt species may be present in the canopy layer.

Due to the wide geographic distribution of this ecological community, the species composition of Box-Gum Grassy Woodland understorey varies in response to changes in climate from north to south (Prober 1996). This notwithstanding, in relatively intact stands the groundlayer is usually characterised by open swards of Kangaroo Grass (*Themeda triandra*, known in NSW as *T. australis*), Snow Grass (*Poa sieberiana*) and/or River Tussock (*P. labillardieri*). This sward is interspersed with a diversity of forbs and other grasses including; Wiregrasses (*Aristida* spp.), Vanilla Lilies (*Arthropodium* spp.), Common Woodruff (*Asperula conferta*), Wallaby Grasses (*Austrodanthonia* spp.), Speargrasses (*Austrostipa* spp.), Weeping Grass (*Microlaena stipoides*), Bulbine Lily (*Bulbine bulbosa*), Redgrasses (*Bothriochloa* spp.), Tick-trefoils (*Desmodium brachypodum* and *D. varians*), Bluegrasses (*Dichanthium* spp.), Rock Fern (*Cheilanthes sieberi* ssp. *sieberi*), Common Everlasting (*Chrysocephalum apiculatum*), Flax Lilies (*Dianella* spp.), Nodding Chocolate Lily (*Dichopogon fimbriatus*), Common Wheat Grass (*Elymus scaber*), Native Geraniums (*Geranium retrorsum* and *G. solanderi*), Native Soyas (*Glycine clandestina* and *G. tabacina*), Scrambled Eggs (*Goodenia pinnatifida*), Small St John's Wort (*Hypericum gramineum*), Red-anthered Wallaby Grass (*Joycea pallida*), Scaly Buttons (*Leptorhynchos squamatus*), Native Flax (*Linum marginale*), Mat-rushes (*Lomandra* spp.), Yam Daisy (*Microseris lanceolata*), Grassland Wood Sorrel (*Oxalis perennans*), Native Sorghum (*Sorghum leiocladum*) and Creamy Candles (*Stackhousia monogyna*) (Keith 2004; DEC 2005).

Prober and Thiele (2004) studied the east-west patterns in box-gum woodland understorey. They found changes in the understorey composition from the Tablelands in the east to the Plains in the west where Grey and Bimble Box dominate the overstorey. They concluded that both climatic and lithological factors were important.

As Box-Gum Grassy Woodland becomes degraded the dominance of Kangaroo Grass and *Poa* species declines and other native grasses such as *Austrodanthonia* spp., *Austrostipa* spp. and *Bothriochloa* spp. become dominant (Moore 1953a). With further degradation, native grasses are replaced by annual and perennial exotic species. While a number of native forb species can withstand and/or benefit from some disturbance, a suite of native forbs are lost early in this degradation sequence and only a few survive in the most highly degraded remnants (Moore 1953a, 1953b; Moore 1970; Prober and Thiele 1995).

A sparse shrub layer comprising wattles (*Acacia* spp.), Native Blackthorn (*Bursaria spinosa*), Native Olive (*Notelaea microcarpa*) and pea shrubs such as *Eutaxia*, *Dillwynia* and *Templetonia* may be present.

## 3.3 Fauna

Integral to Box-Gum Grassy Woodland is the suite of fauna dependent upon the habitat provided by this ecological community for foraging, roosting, nesting, raising young, dispersal, movement and/or migration. These include birds, arboreal and ground-dwelling mammals, reptiles, amphibians and invertebrates. Many of these fauna species may also use other vegetation types (e.g. forests and shrubby woodlands) for one or more of these activities, but some are almost exclusively dependent upon grassy woodland and/or native grasslands, for example the Five-clawed Worm Skink (*Anomalopus mackayi*) and the Striped Legless Lizard (*Delma impar*).

Fauna species are inextricably linked to a functioning woodland/grassland ecosystem. The ecosystem is a source of food and habitat for fauna, while ecosystem services provided by fauna include: plant pollination, seed dispersal, nutrient recycling, maintenance of soil structure, control of herbivorous insects and provision of disturbance which assists in maintaining floristic diversity (ACT Government 2004).

The decline and fragmentation of Box-Gum Grassy Woodland vegetative components has led, not unexpectedly, to a similar decline in their associated fauna assemblages. This decline results not only from the death of individuals and habitat loss as a consequence of clearing (i.e. animals have less area in which to live), but also from habitat fragmentation. Fragmented habitat can make it difficult, if not impossible, for many species to migrate, disperse and/or exchange genetic material across the landscape. It also increases competition (inter and intra-species) for remaining resources and the risk of predation. Nectar, an important food resource for fauna, is more abundant on the fertile soils on which Box-Gum Grassy Woodlands are found. Mac Nally et al. (2009) attributed collapses in bird populations at a regional scale to lower breeding success due to reduced food, particularly through loss of habitat quality of wooded vegetation.

**TABLE 1: Threatened species and ecological communities that may occur in Box-Gum Grassy Woodland listed under Commonwealth, State and Territory legislation and/or on IUCN Red list[1].**

| SPECIES | COMMON NAME | IUCN[1] | Cwlth[2] | ACT[3] | NSW[4] | Qld[5] | Vic[6] |
|---|---|---|---|---|---|---|---|
| **FLORA** | | | | | | | |
| *Acacia atrox* | Myall Creek Wattle | | | | E | | |
| *Acacia omalophylla* | Yarran Wattle | | | | | | E |
| *Ammobium craspedioides* | Yass Daisy | | V | | V | | |
| *Bothriochloa biloba* | Lobed Redgrass | | V | | | V | V |
| *Dichanthium setosum* | Bluegrass | | V | | V | NT | |
| *Digitaria porrecta* | Finger Panic Grass | | E | | E | NT | |
| *Discaria pubescens* | Australian Anchor Plant | | | | | NT | V |
| *Diuris pedunculata* | Small Snake Orchid | | E | | E | | |
| *Diuris punctata* var. *punctata* | Purple Diuris | | | | | | V |
| *Goodenia macbarronii* | Narrow Goodenia | | | | V | | V |
| *Glycine canescens* | Silky Glycine | | | | | | E |

| SPECIES | COMMON NAME | IUCN[1] | Cwlth[2] | ACT[3] | NSW[4] | Qld[5] | Vic[6] |
|---|---|---|---|---|---|---|---|
| *Hibbertia humifusa* subsp. *erigens* | Euroa Guinea-flower | | V | | | | V |
| *Homopholis belsonii* | Belson's Panic | | V | | | E | |
| *Leucochrysum albicans* var. *tricolor* | Hoary Sunray (white form) | E | E | | | | |
| *Picris evae* | a hawkweed | | V | | V | V | |
| *Prasophyllum petilum* | Tarengo Leek Orchid | | E | E | | | |
| *Rutidosis leptorrhynchoides* | Button Wrinklewort | | E | E | | | E |
| *Senecio garlandii* | Woolly Ragwort | | V | | V | | E |
| *Swainsona recta* | Small Purple Pea | | E | E | E | | E |
| *Swainsona sericea* | Silky Swainson-pea | | | | V | | V |
| *Thesium australe* | Austral Toadflax | | V | | V | V | V |

| **FAUNA** | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Anomalopus mackayi* | Five-clawed Worm-skink | | V | | E | E | |
| *Aprasia parapulchella* | Pink-tailed Worm-lizard | | V | | V | | E |
| *Burhinus grallarius* | Bush Stone-curlew | NT | | | E | | E |
| *Climacteris picumnus victoriae* | Brown Treecreeper (eastern subspecies) | | | V | V | | |
| *Chthonicola sagittata* | Speckled Warbler | LC | | | V | | V |
| *Dasyurus maculatus maculatus* | Spotted-tail Quoll | NT | E | V | V | V | E |
| *Delma impar* | Striped Legless Lizard | V | V | V | V | | E |
| *Geophaps scripta* | Squatter Pigeon | LC | | | E | V | |
| *Grantiella picta* | Painted Honeyeater | NT | | V | V | V | V |
| *Hieraaetus morphnoides* | Little Eagle | LC | | | | | |
| *Hoplocephalus bitorquatus* | Pale-headed Snake | | | | V | | |
| *Lathamus discolor* | Swift Parrot | E | E | V | E | E | E |
| *Lophoictinia isura* | Square-tailed Kite | LC | | | V | NT | V |
| *Melanodryas cucullata cucullata* | Hooded Robin (south-eastern form) | LC | | V | V | | |
| *Melithreptus gularis gularis* | Black-chinned Honeyeater (eastern subspecies) | LC | | | V | NT | |
| *Neophema pulchella* | Turquoise Parrot | LC | | | V | NT | NT |
| *Ninox connivens* | Barking Owl | LC | | | V | | E |
| *Paralucia spinifera* | Bathurst Copper Butterfly | E | V | | | | |
| *Pedionomus torquatus* | Plains Wanderer | E | V | | E | V | |
| *Perunga ochracea* | Perunga Grasshopper | | | V | | | |
| *Petaurus norfolcensis* | Squirrel Glider | LC | | | V | | E |
| *Phascogale tapoatafa* | Brush-tailed Phascogale | NT | | | E | | V |
| *Phascolarctos cinereus* | Koala | LC | | | V | V | |
| *Polytelis swainsonii* | Superb Parrot | V | V | V | V | | E |
| *Pomatostomus temporalis temporalis* | Grey-crowned Babbler (eastern subspecies) | LC | | | V | | E |
| *Saccolaimus flaviventris* | Yellow-bellied Sheathtail-bat | LC | | | V | | |
| *Stagonopleura guttata* | Diamond Firetail | NT | | | V | | V |
| *Suta flagellum* | Little Whip Snake | | | | V | | |
| *Synemon plana* | Golden Sun Moth | | CE | E | E | | E |
| *Tympanocryptis pinguicolla* | Grassland Earless Dragon | | E | E | | E | CE |
| *Tyto novaehollandiae* | Masked Owl | LC | | | V | | E |
| *Underwoodisaurus sphyrurus* | Border Thick-tailed Gecko | NT | V | | V | NT | |
| *Varanus rosenbergi* | Rosenberg's Goanna | | | | V | | V |
| *Xanthomyza phrygia* | Regent Honeyeater | E | E | E | E | E | CE |
| **ECOLOGICAL COMMUNITIES** | | | | | | | |
| Aquatic Community of the Natural Drainage System of the Lower Catchment of the Darling River | | | | | E | | |
| Temperate Woodland Bird Community | | | | | | | E |
| White Box Yellow Box Blakely's Red Gum Woodland | | | | | E | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Yellow Box-Red Gum Grassy Woodland | | | E | | | |
| Inland Grey Box Woodland | | | | E | | |
| Fuzzy Box Woodland | | | | E | | |

**CE:** Critically Endangered; **E:** Endangered; **V:** Vulnerable; **NT:** Near Threatened; **LC:** Least Concern.

[1] **IUCN:** *2008 Red List of Threatened Species*
[2] **Cwlth:** *Environment Protection and Biodiversity Conservation Act* 1999
[3] **ACT:** *Nature Conservation Act 1980*
[4] **NSW:** *Threatened Species Conservation Act* 1995 & *Fisheries Management Act* 1994
[5] **Qld:** *Nature Conservation Act* 1992
[6] **Vic:** *Flora and Fauna Guarantee Act* 1988

The impact of these processes on fauna populations is further exacerbated by on-going degradation of the remaining habitat as a result of inappropriate grazing, pasture improvement, timber harvesting, firewood collection, "tidying up", fire fuel management, regrowth removal and/or weed invasion. The outcome of these activities is the continued loss of habitat elements within remaining patches (native groundlayer, species diversity, fallen timber, hollow trees). As a consequence, many species occurring within Box-Gum Grassy Woodland are now listed as threatened under state and/or Commonwealth legislation, as listed in Table 1. Recovery of the ecological community can be expected to directly benefit the recovery of these species.

# 4. Past and Present Distribution

Box-Gum Grassy Woodland is a geographically widespread but now highly fragmented ecological community, found along the slopes and tablelands of Queensland and NSW, through the ACT to Victoria (Beadle 1981). It occurs in areas with an annual rainfall between 400-800 mm at altitudes of 170-1200 m above sea level (NSW Scientific Committee 2002; TSSC 2006). Prior to European settlement this ecological community formed an almost continuous band comprising several million hectares (Beadle 1981). However, its occurrence on moderate to high fertility soils has resulted in the preferential clearing of large areas of this ecological community for cropping and/or its modification by pasture improvement and grazing (Specht 1981; Benson 1991; Prober and Thiele 1993; Prober and Thiele 2005). Current estimates indicate that only 405,000 ha of the ecological community in various condition states remain (Australian Government 2007). An indicative map showing the estimated distribution of Box-Gum Grassy Woodland remnants is shown in Appendix 4.

In Queensland this ecological community occurs within the Brigalow Belt and New England Tablelands bioregions. Regional Ecosystem data indicates that 67% of the pre-European (pre-1750) extent of this ecological community has been cleared (EPA 2003), and the remainder has been modified by grazing (TSSC 2006). Only a small proportion of what remains is considered to meet the minimum condition criteria that defines the listed ecological community.

In NSW it is found within the North Coast, New England Tablelands, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, South East Corner and South Western Slopes bioregions. In the central and southern half of the state, studies have shown that less than 1% of the pre-1750 extent remains in the Central Lachlan region (Austin et al. 2000*),* less than 7% in the Holbrook area (Gibbons and Boak 2002), and around 4% within the NSW South Western Slopes and Southern Tablelands bioregions, existing as remnants that have greater than 20% canopy cover, and are 10 ha in size or larger (Thomas et al. 2000). Thomas et al. (2000) also estimate that in south-eastern NSW the extent of White Box-Yellow Box-Blakely's Red Gum Woodland has been reduced to around 5% of its pre-1750 distribution, existing as remnants that have greater than 20% canopy cover, and are 10 ha in size or larger. Further, it is considered that only 0.05% of Box-Gum Grassy Woodland in NSW remains in near to original condition (Prober and Thiele 2005).

In Victoria this ecological community occurs predominantly within the Northern Inland Slopes as well as the Highlands–Northern Fall, Central Victorian Uplands, Victorian Riverina, Goldfields, Dundas Tablelands, Greater Grampians, Highland–Southern Fall, East Gippsland Lowlands, East Gippsland Uplands, Otway Plains and Murray Fans bioregions and may occur in the Wimmera bioregion. Data from the Ecological Vegetation Classes which may conform with Box-Gum Grassy Woodland indicate that less than 6% of the pre-1750 extent remains (TSSC 2006). Further analysis is required to determine the reservation status of BGGW but reservation levels of the main constituent EVC, Grassy Woodland, in each bioregion are, on average, below 10% of the pre-European extent (Sue Berwick, pers. comm.).

Box-Gum Grassy Woodland also occurs in the ACT which lies predominantly within the South Eastern Highlands bioregion. It is estimated that 32,000 ha of *Yellow Box-Red Gum Grassy Woodland* existed in the ACT pre-1750, of which 34% now remains in a partially or moderately modified form (ACT Government 2005). A further 5,955 ha contains remnants in a substantially or severely modified condition that at present do not meet the condition criteria for the ecological community.

The ecological community may have historically occurred in South Australia but further investigation is required to confirm if the listed community still exists there.

Box-Gum Grassy Woodland is one of the more poorly represented ecological communities in the national conservation reserve system (Specht 1981; Yates and Hobbs 1999). Due to its occurrence on high fertility soils, much of the ecological community is on privately owned land, existing as isolated patches within an agricultural matrix of cropping, improved pastures and/or disturbed vegetation communities.

The occurrence on predominantly privately owned land also means the spatial distribution and quality of remnants remains largely unknown. While extensive field work will fill some of the information gaps, problems of access (due to private tenure) make it unlikely all remaining occurrences of the listed ecological community will be correctly identified. The difficulty with the identification of areas of remnant Box-Gum Grassy Woodland is further exacerbated by on-going clearing and modification. The composition of the characteristic grassy groundlayer within this ecological community is often difficult to identify by remote sensing methods, particularly in variegated landscapes[2]. Additionally, this stratum can be readily modified and degraded by inappropriate management (e.g. overgrazing, herbicide overspray/drift, heavy application of fertiliser) and/or weed infestation. Consequently, mapping the condition of this ecological community across its geographic range using current technology is problematic, and at best represents a snapshot in time.

As so few remnants remain, both little-disturbed and degraded remnants are critical to the survival of this ecological community. Degraded remnants are particularly important as

[2] Variegated landscapes are those where modification has largely been through clearing of the overstorey and shrub layers to facilitate grazing of native pastures. In these areas cropping is limited, and derived native grasslands and/or remnant woodland still cover 60-90% of the landscape (McIntyre et al. 2002).

habitat for fauna (including many threatened species and declining woodland birds), for conserving genetic diversity in many woodland species, and for their contribution to landscape values. They also play important roles in landscape-scale resilience and providing opportunities for habitat restoration and integration of conservation and production.

### 4.1 Habitat Critical to the Survival of the Ecological Community

At the time of preparation of this plan, the knowledge and understanding of why particular assemblages of plant and animal species occur on any given site is extremely limited. By its nature, the occurrence and long-term viability of an ecological community is the result of a multitude of environmental factors and a complex array of species' interactions. It is questionable whether it would ever be possible to define and locate habitat that is critical for a widespread ecological community that is considered critically endangered, precisely because it has been cleared, fragmented and degraded to the point where its medium- and long-term survival is threatened.

However, in very broad terms, habitat critical to the survival of Box-Gum Grassy Woodland is on the moderate to highly fertile soils of the western slopes of NSW and Queensland, the northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. Given the currently highly fragmented and degraded state of this ecological community, all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in Section 3 should be considered critical to the survival of this ecological community. In addition, degraded woodland areas not considered part of the listed ecological community may also be essential to the long-term conservation of Box-Gum Grassy Woodland, by virtue of their landscape setting (e.g. providing connectivity) or remaining flora/fauna habitat features (e.g. occurrence of rare or threatened species, tree hollows), and should also be considered as potential habitat critical to the survival of this ecological community. The importance of degraded areas to the survival of the listed ecological community should therefore be assessed on a site-by-site basis.

To assist the recovery of this ecological community more work is required to identify those areas important for the conservation and maintenance of landscape connectivity, coupled with greater education and incentives for private and public land managers to expand and improve the management of existing remnants.

## 5. Interests Potentially Affected by the Recovery Plan

Box-Gum Grassy Woodland occurs on both public and private land, under a wide range of tenures. Remnants can be found on road, railway and other utility easements, private land, industrial land, travelling stock reserves/routes, town commons, in cemeteries, urban parks, land under Aboriginal title, national parks and nature reserves. Consequently, interest groups are broad-ranging and include Commonwealth, state/territory and local government agencies, private landholders and lessees (including industry), Aboriginal communities, communication networks, research institutions, conservation focuses networks and farm management focussed networks.

This recovery plan responds to the requirement of the EPBC Act and as such influences the implementation of planning and development assessment legislation in each state and territory that the ecological community occurs. The recovery plan is consistent with state and territory Recovery and Action Plans for Box-Gum Grassy Woodland and will further support the Catchment Action Plans (CAPs) of local Natural Resource Management bodies (NRM)/Catchment Management Authorities (CMAs) and the recovery plans and actions for threatened species associated with this ecological community.

The recovery plan intends to recognise the needs and concerns of the range of managers

of land containing Box-Gum Grassy Woodland and to facilitate their involvement in the implementation. The involvement is also aimed at achieving a greater sense of ownership of the process and outcomes, which should assist in the consequential management of sites, encouraging a more sustainable approach to land management in general.

# 6. Social and Economic Impacts

Land on which Box-Gum Grassy Woodland occurs is generally fertile and highly productive and, prior to European settlement, was of great importance to Indigenous communities. It now supports a large proportion of agricultural industries in south-eastern Australia and is important to the economic and social viability of towns and communities across its geographic distribution.

## 6.1 Social Impacts

There will be a number of social impacts from the implementation of the recovery plan. Social benefits generally arise from the maintenance and improvement in the condition of biodiversity in predominantly agricultural landscapes and include:

- addressing community concerns regarding the continued loss of biodiversity and possible extinction of an iconic ecological community and its component species, and strengthening community networks;
- addressing landholder/farmer concern about weeds and management of remnants;
- recognition of the Indigenous cultural values of this ecological community through continuing contact and presence of archaeological sites;
- opportunities for tourism and education in regard to the protection and enhancement of this ecological community and its component species; and
- maintenance of visual amenity and landscape setting that represents an archetypal Australian rural landscape that visitors expect when enjoying the Australian countryside.

The implementation of the recovery plan may have negative social impacts associated with the restriction of rural, residential, agricultural and infrastructure development. Adverse impacts will be minimised through consultation with affected parties.

## 6.2 Economic Impacts

There will be a number of economic impacts from the implementation of the recovery plan.

Positive economic benefits stem largely from the protection and enhancement of ecosystems services provided by Box-Gum Grassy Woodland that benefit agriculture, including:

- habitat for beneficial native species - woodland birds, bats, predatory insects (which control insect pests) and native insects (for pollination of crops);
- maintenance of soil structure, fertility and prevention of erosion;
- contribution to the maintenance of water quality;
- assisting in the prevention of soil and water salinity;

- provision of a carbon sink;
- shade and shelter for crops and livestock;
- drought resistant, low-input grazing resources;
- potential for alternate income streams - nature-based tourism, bush foods;
- maintenance of a wild gene pool; and
- seed resource base for regeneration.

Property prices are also reflecting the increase in value brought by sustainable management practices and retained areas of natural bushland. In recent years there has been an increase in the marketing of bushland properties to attract buyers interested in conservation for "lifestyle", farmstays or B&B enterprises. Several organisations such as Conservation Brokers in Victoria (www.conservationbroker.net.au) and NSW Nature Conservation Trust (www.naturetrust.org.au) specialise in marketing these types of properties.

There is growing recognition within farming communities of the extensive production benefits brought by maintaining biodiversity on-farm. However, the initial outlay costs of changed farming practices, including equipment, fencing and weed management costs, are often prohibitive. Maintaining and improving degraded sites may also reduce the total productive area on farm, and restrict further rural, residential and infrastructural development.

While there are many benefits to retaining and managing woodland remnants, conservation of biodiversity, particularly on private land, depends on the behaviour and decisions of the managers of that land. The costs to undertake conservation works include both the financial costs of on-ground works and the foregone rate of return from alternative uses of the land (Aretino et al; 2001). Jenkins (1996) found that farmers are self motivated to undertake conservation works such as replanting and fencing but have limited time and money. Concerns were raised in the Jenkins study by farmers that excessive expenditure on Landcare works could threaten the economic viability of their farms. The vast majority recommended that the government provide financial assistance for undertaking conservations works. A study by Elix and Lambert (1997) of landholders with grassy White Box Woodlands identified the following factors as barriers to conservation:

- financial constraints
- lack of knowledge and awareness of the value of grassy White Box Woodlands
- difficulties in changing already established attitudes to rural management.

Many programs are now in place to mitigate the negative financial impacts to individual landholders in recognition that there are broader benefits to society in the management of biodiversity, including Box-Gum Grassy Woodlands. While financial assistance towards on-ground costs such as fencing and weed control has been available since the 1980s it is only recently that compensation for loss of potential income has been available. For example, Greening Australia's Whole of Paddock Rehabilitation Project[3] offers a stewardship payment, to offset loss of production for temporary removal of grazing at approximately 1 Dry Sheep Equivalent or $50/ha/year and the Australian Government's Stewardship program[4] allows for loss of income arising from any restriction of use of areas for production or any other income generating purposes to be included in the bid price.

[3] http://www.greeningaustralia.org.au/uploads/Our%20Resources%20-%20pdfs/ACT_WOPR09.pdf
[4] http://www.nrm.gov.au/stewardship

# PART B: THREATS

## 7. Historic and On-going Threats

The activities and processes which led to the decline in Box-Gum Grassy Woodland are still on-going. However, the now highly fragmented, isolated and modified nature of remnants make Box-Gum Grassy Woodland less resilient than ever to these degrading forces. Even those few areas managed within the conservation reserve system are subject to degradation and require active management. Consequently, even with immediate human intervention it will be difficult to reverse these trends (TSSC 2006). The factors which have contributed, and continue to contribute to, the loss of this ecological community are described below. These threats are generally consistent across the geographical distribution of the ecological community.

### 7.1 Land Use and Management Change

Changes in the use and management of land containing Box-Gum Grassy Woodland or land adjacent to the ecological community can have a significant impact on remnants. Agricultural development, urban/rural residential and urban development, and the development, maintenance and upgrade of public infrastructure have resulted in the clearing and modification of large areas of the ecological community since European settlement. Queensland and NSW have state legislation to control the clearing of native vegetation, and Victoria and the ACT have requirements to consider the impacts of native vegetation removal in their planning approval processes. However, despite these controls, the removal and modification of Box-Gum Grassy Woodland continues.

The seriousness of the threat on-going clearing poses to native flora and fauna is recognised by the listing of "*Clearing of native vegetation*" as a Key Threatening Process under the NSW TSC Act, "*Land clearance*" under the EPBC Act and "*Habitat fragmentation*" in Victoria as a Threatening Process for fauna under the *Flora and Fauna Guarantee Act 1988* (FFG Act).

In NSW, the *Native Vegetation Act 2003* (NV Act) permits the clearing of native vegetation (including within listed threatened ecological communities) via an array of "*Routine Agricultural Management Activities*" (RAMAs), such as the construction, operation and maintenance of rural infrastructure. A similar range of agricultural activities and a number of industries (e.g. mining, transport, electricity and community infrastructure) are excluded from clearing controls under the Queensland legislation *Vegetation Management Act 1999* (VM Act).

#### *Agricultural and Horticultural Development*

Large areas of this ecological community have been cleared and modified since European settlement for agricultural purposes (cropping, irrigation, and pasture improvement). The development and operation of agricultural enterprises resulting in clearing and modification of native vegetation and other impacts, continue to be major threats to the remaining areas of Box-Gum Grassy Woodland, primarily due to their occurrence on fertile soils and predominantly privately owned land. This is a consequence of:

- increases in the size of farm machinery and use of global positioning technology in cropping operations requiring the removal of paddock trees to allow for greater turning circles and larger unobstructed paddocks;
- an increase in small area horticultural enterprises such as grapes and olives;

- an increase in the use of feed-lots;
- expanding cropping enterprises and pasture modification;
- the development of silviculture enterprises (e.g. Radiata Pine plantations);
- altered soil fertility and increasing land degradation problems (erosion, salinity, soil structure decline) on areas already cleared; and
- a poor understanding by land managers of the environmental services provided by remnant vegetation/paddock trees.

Whilst maintaining biodiversity on-farm is perceived as beneficial by most farmers, the costs as a result of loss of productivity and recovery work can be prohibitive, especially during the transitional period of changing farming practices.

### *Rural Residential and Urban Development*

In recent years there has been an increasing demand for urban development and rural residential subdivisions that impact upon Box-Gum Grassy Woodland. This has particularly occurred around many of the larger towns along the western slopes and tablelands of NSW, Victoria and within the ACT. This type of development results in not only the direct impacts of loss and fragmentation of native vegetation (as described above for houses, gardens, fences, roads, powerlines) but involves a range of other indirect impacts as a consequence of closer human settlement. These include:

- changes to surface water runoff patterns and soil hydrological regimes;
- changes to soil nutrient status from fertilisers and waste water disposal;
- increased predation pressure as consequence of higher concentrations of domestic pets (particularly cats);
- increased risk of weeds from introduced and locally non-indigenous plant species (trees, shrubs and grasses) used in gardens and difficulty in implementing weed control programs;
- increased disturbance (noise, lights and human activity);
- soil compaction from off-road recreational activities (cars/bikes/horses/etc.); and
- illegal dumping.

These indirect impacts exacerbate the detrimental impacts of clearing and fragmentation by reducing the habitat quality of remnants for native flora and fauna.

### *Mining*

Mining poses a significant threat to Box-Gum Grassy Woodland because it is an industry generally excluded from clearing controls. Significant impacts have occurred in the Sydney Basin and NSW North Coast Bioregions, although past and present mineral, petroleum and coal mining impacts occur throughout the Box-Gum Grassy Woodland distribution.

Land clearing is the main impact of mining, and tends to be severe and localised. Clearing may further result from service infrastructure to mining activities. Wider impacts from mining activities may stem from pollution, sedimentation or diversion of water ways, erosion, salinity and changed soil profiles.

Rehabilitation of mining sites has generally been poorly implemented in the past. Loss of topsoil from the original site, and specifically topsoil seed reserves, affects the rehabilitation potential of sites.

### *Public Infrastructure*

Many of the larger and higher quality remnants of Box-Gum Grassy Woodland occur on travelling stock routes (TSRs), road reserves and railway corridors (Prober and Thiele 1993). However, these areas are subject to on-going infrastructure maintenance and upgrade activities such as road widening, clearing, mowing, weed spraying, grading and burning. They are also often targeted for future infrastructure development, including powerline, gas and water pipeline construction, and telecommunication cable and tower installation. These developments may involve a range of activities, including clearing, ripping, excavation, stockpiling of topsoil and other materials, movement of vehicles and machinery and changes to surface water flows, which can have a detrimental impact on the quality and extent of remnant Box-Gum Grassy Woodland. These activities can result in further fragmentation, loss of habitat elements (native groundlayer, hollow trees), changes to soil moisture regimes and nutrient status, the creation of bare patches and the spread of high threat weeds. Grading of roadsides is a particular disturbance that appears to be the primary agent for the continuing spread of the high threat weeds African Lovegrass *(Eragrostis curvula)*, and Coolatai Grass (*Hyparrhenia hirta*) on the north-west slopes (Spark and Nadolny 2004). In many cases the resultant weed invasion is irreversible, given the lack of successful permanent control techniques.

Physical disturbances on land adjacent to Box-Gum Grassy Woodland remnants can also have detrimental impacts. For example, drainage works (along roadsides and associated with urban areas and agricultural contour banks) often direct surface water into remnant vegetation increasing moisture levels and changing the soil nutrient status. In these less than favourable conditions for native species, weeds often dominate.

The size and high quality of Box-Gum Grassy Woodland that occurs on some TSRs and areas of Crown land is often a serendipitous consequence of historic and current management which allows for long rest periods between disturbance/stock grazing events. However, funding arrangements for the NSW Livestock Health & Pest Authorities (LHPA) [formally Rural Lands Protection Boards (RLPBs)] have resulted in recent years in the relinquishment of a number of larger TSRs and vacant Crown land, (including areas of remnant Box-Gum Grassy Woodland) and letting of short- and long-term leases for neighbouring landholders on TSRs by the LHPAs. These areas may then be managed as per the adjoining private land, often being subject to longer grazing periods, shorter and potentially inappropriately timed or non-existent rest periods and greater risk of weed invasion. In Victoria areas of remnant Box-Gum Grassy Woodland on crown land (unused roads, unreserved crown land) are leased for grazing. This usually leads to poor outcomes for conservation due to overgrazing and lack of weed control.

## 7.2 Conflicting Management Practices

Given this ecological community is generally poorly represented within the conservation reserve system and a large proportion occurs on private land, there is significant potential for adverse consequences to the long-term survival of Box-Gum Grassy Woodland if remnant areas are not managed appropriately.

### *Grazing Regimes and Pasture Management*

If not appropriately managed, livestock grazing can have a detrimental impact on Box-Gum Grassy Woodland by altering the structure and composition of the flora components of the ecological community through selective grazing of more palatable and regenerating

species, trampling, soil compaction, changed soil nutrient status and weed invasion (McIntyre et al. 1993; Prober 1996). Sheep grazing is potentially more destructive than that of cattle because of differences in grazing habits. Typically sheep graze more uniformly than cattle, grazing down to soil level and selecting the most palatable plant species, including regenerating canopy species (Wells 1969 cited in Lunt 1991). Cattle have a greater potential to trample and compact the ground than do sheep if the ground is wet, which can cause damage to native plant tubers and soil structure, and result in changes to drainage and differential germination of species (i.e. favouring exotic species over natives) (Rainer Rehwinkel pers. comm. 2009). The resulting changes in plant species diversity and composition within remnants can also lead to reductions in the diversity of the woodland fauna assemblage (Johnson and Beck 1988; Loyn 1991; Saunders 1994; Bromham et al. 1999; Spark and Nadolny 2004).

Prober and Thiele (2004) found a significant difference between the floristic composition of the remnants on cemeteries and TSRs/roadside which they attributed to their different grazing histories. Cemeteries have little or no grazing history and generally exhibited a higher diversity of native grasses while TSRs/roadsides usually have intermittent grazing, which may lead to some species, both native and exotic, dominating. A significant difference in understorey composition was seen between eastern and western woodlands, potentially attributable to overstorey composition and different grazing histories. Future management practices will need to be tailored accordingly, with emphasis on understorey composition and individual species' dominance.

### *Firewood Collection and 'Tidying-up'*

The collection of firewood from Box-Gum Grassy Woodland remnants significantly reduces the habitat value. Dead standing trees and fallen timber provide protection and feeding substrates for a variety of woodland birds, mammals, reptiles, amphibians and invertebrates. Fallen timber also provides the base material and environmental conditions for nutrient recycling. Additionally, the disturbance caused during the collection of firewood can lead to the spread of weeds as a result of the removal of material and the movement of people and vehicles within remnants.

Woodlands and forests of the western slopes and tablelands (which include Box-Gum Grassy Woodland) are most threatened by dead timber removal as they contain preferred firewood species (DECC 2003). The significance of the threat posed by this activity is recognised by the listing of the "*Removal of dead wood and dead trees*" as a Key Threatening Process under the NSW TSC Act.

"Tidying-up" is an activity which generally involves the removal of standing dead timber, fallen logs, rock and litter from woodland areas. Many people are unaware of the ecological consequences of this activity. Further, it is an activity often considered integral to good land management (ANZECC 2001) and is sometimes carried out for supposed fire hazard reduction. However, the removal of standing or fallen dead timber, surface rock and litter significantly reduces habitat (nesting, shelter and foraging substrates) for many woodland fauna species (invertebrates, amphibians, reptiles, small mammals) and has been linked to the loss of woodland birds (Reid 1999). These elements are also essential to the maintenance of nutrient cycles within woodlands providing the raw materials and habitat for the many organisms (insects, fungi and micro-organisms) which break down and incorporate this material into the soil.

The detrimental impact of "tidying up" on the natural ecosystems is currently recognised by the listing of the "*Loss of hollow-bearing trees from Victorian native forests*" and "*Loss of coarse woody debris from Victorian native forests and woodlands*" as Potentially Threatening Processes under the FFG Act. Similarly, "*Loss of hollow-bearing trees*" and "*Removal of dead wood and dead trees*" are listed as Key Threatening Processes in NSW under the TSC Act. "*Bushrock removal*" is also listed as a Key Threatening Process in NSW under the TSC Act.

### *Changed Fire Regimes*

It is likely that prior to European settlement, periodic burning by bushfires and Indigenous people played an important role in the development and maintenance of grassy ecosystems. On the other hand, too frequent or extensive burning may limit recruitment of some species, cause local extinctions of fire sensitive species, facilitate the spread of some exotic species (such as Coolatai Grass), reduce fauna habitat features (fallen logs, hollow trees, litter) and threaten fauna populations (Clarke 1999; Davies 1999). Morgan and Lunt (1999) found that a lack of fire in Australian temperate grasslands can lead to sward collapse and weed invasion.

The threat posed by inappropriate fire regimes is recognised in Victoria with the listing of "*High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition"* and *"Inappropriate fire regimes causing disruption to sustainable ecosystem processes and resultant loss of biodiversity"*, as Potentially Threatening Processes under the FFG Act. Similarly in NSW, "*High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition"* is listed as a Key Threatening Process under the TSC Act.

### *Increased Soil Nutrients and Use of Chemicals*

Increased soil nutrient status as a consequence of fertiliser application, run-off and spray drift from adjoining paddocks, soil disturbance or stock camps causes changes in soil structure and soil biota and results in a more favourable environment for weeds. Changes to the soil nutrient status can result in a loss of native understorey species and dieback of overstorey species (Windsor 1999), with negative flow-on effects to the fauna assemblage.

The use of herbicides and other pesticides to control weeds and agricultural insect pests can have significant impacts on Box-Gum Grassy Woodland remnants. Herbicides can create bare patches which allow weeds to establish or spread, change groundlayer composition and threaten the health of overstorey trees. For example, aerial spraying in northern NSW for St John's Wort control has in the past defoliated significant areas of Box-Gum Grassy Woodland, while the use of herbicides around grave-sites in cemeteries is likely to have significant knock-on effects on native species adjacent to and downslope of the spraying.

Other pesticide use can have detrimental impacts on the natural food webs and therefore the fauna assemblages within Box-Gum Grassy Woodland, the extent of which is yet to be fully understood.

Native plants are adapted to the inherent nutrient status of the soils which support them. The application of fertilisers (e.g. superphosphate) and soil ameliorants (e.g. gypsum or lime) alters the natural soil nutrient status and availability, and thus can change the species composition and diversity within native plant communities and reduce the habitat value for fauna.

### *Mowing or Slashing Regimes*

Mowing and/or slashing may be used as alternatives to burning to open out dense swards of Kangaroo Grass, and thus encourage other native herbs and grasses. However, mowing can easily facilitate the spread of weeds (e.g. Coolatai Grass and African Lovegrass) as a result of poor machinery hygiene and/or through the smothering of native species and creation of bare patches by slashings left on the site. Additionally, if mowing height is too low (<10 cm), low growing grasses [e.g. Windmill Grass (*Chloris truncata*)] and exotic forbs [e.g. Flatweed (*Hypochaeris radicata*)] can become abundant, replacing taller tussock grasses and changing both the structure and species composition of the groundlayer (McIntyre et al. 2002). If done at the wrong time, mowing/slashing may also threaten the

replenishment of the soil seed store. Mowing/slashing can also be detrimental to some fauna if too low, or at breeding times (e.g. for bush stone-curlew).

### *Revegetation Management*

The extensively cleared and fragmented nature of remnant Box-Gum Grassy Woodland indicates that in many areas active regeneration techniques will be required to ensure the long-term viability of this ecological community. However, there is potential for well-intentioned projects using these techniques to lead to further degradation of remnants and competition by planting inappropriate species (exotics or locally non-indigenous natives), planting trees and shrubs at inappropriate densities, over-collection of seed for regeneration purposes, and facilitating weed invasion through disturbance to the soil and groundlayer in preparation for planting.

Additionally, planting of exotics and/or locally non-indigenous native trees, shrubs and grasses adjacent to or adjoining remnants may lead to the spread of wildlings and changes to groundlayer species composition. There is also concern, although little is currently known, about the potential genetic impact of planting locally indigenous species sourced from geographically distant areas (Eddy 2002). However, a recent review of this issue highlighted the problems associated with using local seed which may be of poor quality, which can lead to restoration failure (Broadhurst et al. 2008). The scale of local adaptation of many species is largely unknown and the “use local seed” recommendation in many guidelines is based on a precautionary principle. In fragmented ecosystems where many of the remaining remnants are small it can be extremely difficult to source locally genetically robust seed. Broadhurst et al. (2008) recommended that restoration projects opt for a better seed source even if it must be sourced from further away rather than using low quality local seed.

## 7.3 Degrading Landscape Processes

### *Weed Invasion*

The term ‘weed’ is used to describe any species, native or exotic, that is not considered a natural part of the ecological community. Weeds are generally considered detrimental to a system as they compete with locally indigenous flora species for the available resources (water, light and nutrients) and can lead to a decline in the diversity and regenerative capacity of native species. They can also reduce and/or change the fauna habitat values of woodlands by affecting the type and availability of food resources (seeds and fruits), amount of foliage cover, light penetration and litter volume. Such changes can have significant impacts on the natural food webs and fauna populations within the woodland ecosystem.

Weed invasion is generally favoured by soil disturbance, alterations to surface water flows and changes in soil nutrient status (use of fertilisers), overgrazing and sometimes fire. The spread of weeds is facilitated by the movement of machinery, vehicles, people and animals across the landscape. All Box-Gum Grassy Woodland remnants have some level of weed invasion, and it is likely that all will require some degree of active weed management to ensure long-term integrity. Some weed species are particularly threatening to Box-Gum Grassy Woodland as they are highly competitive and actively exclude locally indigenous species. Prober et al. (2002) found a difference in nitrate levels in degraded remnants and rarely grazed reference sites. Higher nitrate levels are associated with increased weed invasion, with exotic annuals replacing perennial natives (Prober et al. 2002).

Significant weeds that affect Box-Gum Grassy Woodland include:

- **Perennial grasses:** Potentially pose the greatest weed threat to Box-Gum Grassy Woodland, as they can completely dominate the woodland groundlayer. Commonly, these species are adaptable to a range of environmental and climatic conditions, produce large quantities of seed, have a persistent seed bank and are tolerant of heavy grazing, fire and chemical applications. Consequently, they are readily spread, difficult to control and as yet occupy only a proportion of their potential ranges (Parsons and Cuthbertson 1992; Muyt 2001; Spark and Nadolny 2004). There are currently no known practical methods for the broad-scale control of these species and research should be undertaken as a matter of urgency to ensure the recovery of this ecological community. Species of particular concern are:

  - Coolatai Grass, which has invaded extensive areas of woodland on the NSW North West Slopes over the past 50 years and is rapidly colonising roadside remnants of Box-Gum Grassy Woodland in the Upper Hunter. Coolatai Grass invasion is often independent of disturbance;

  - Chilean Needlegrass (*Nassella neesiana*), African Lovegrass and Serrated Tussock (*N. trichotoma*), which are highly invasive weeds common on the New England and Southern Tablelands of NSW; and

  - Phalaris (*Phalaris aquatica*), a widely used pasture grass and an aggressive invader of grassy ecosystems.

  The urgency of the threat posed by these introduced perennial grasses is recognised by the listing of the "*Invasion of native plant communities by exotic perennial grasses"* (TSC Act) and *"Invasion of native vegetation by "environmental weeds"* (FFG Act) as threatening processes in NSW and Vic respectively. Chilean Needlegrass, for example, is increasingly becoming a serious pasture and environmental weed in south eastern Australia and is difficult to remove once widely established.

- **Perennial herbs:** For example, St John's Wort (*Hypericum perforatum*) and Wild Sage (*Salvia verbenaca*). St John's Wort has invaded extensive areas of Box-Gum Grassy Woodland and without control, can dominate the groundlayer.

- **Annual grasses:** For example, Wild Oats (*Avena* spp.), Bromes (*Bromus* spp.), Rye-grasses (*Lolium* spp.), Veldt Grasses (*Ehrharta* spp.) and Fescues (*Vulpia* spp.) readily invade disturbed remnants, and are prominent in the groundlayer in many remnants in southern NSW, the ACT and Victoria.

- **Annual and biennial herbs:** For example, Clovers and Medics (*Trifolium* and *Medicago* spp.), Capeweed (*Arctotheca calendula*), Thistles (e.g. *Cirsium vulgare, Carthamus lanatus*) and Paterson's Curse (*Echium plantagineum*) occur to varying degrees in most remnants.

- **Woody weeds:** Substantial increases in the number of plantations of European Olive (*Olea europaea*) have occurred in the past decade. This species is problematic in other ecosystems, and without attention could become a major problem in Box-Gum Grassy Woodland. African Olive (*Olea europaea* subsp. *cuspidata*), English Hawthorn (*Crataegus monogyna*), Sweet Briar (*Rosa rubiginosa*), Scotch Broom (*Cytisus scoparius*), African Boxthorn (*Lycium ferocissimum*), Radiata Pine (*Pinus radiata*), Blackberry (*Rubus fruticosus)* and Privets (*Ligustrum* spp.) are also significant problems in some areas.

Victoria has listed "*Invasion of native vegetation by Blackberry (Rubus fruticosus)" as a* Potentially Threatening Process under the FFG Act.

### *Climate Change*

Climatic variation is one of the primary determining factors in the spatial distribution of species and the ecosystems they form. Climate change has occurred throughout geological time but human activity is now acknowledged as significantly accelerating the rate of this natural process (IPCC 2007). The specific impacts on Box-Gum Grassy Woodland are as yet unknown. However, changing climate patterns, including rising temperatures and decreasing rainfall, are likely to contribute to reductions in extent, changed species composition, loss of species diversity due to fragmentation and isolation of remnants and changes in understorey structure. Predictions have been made as to the possible impacts affecting the agro-climatic zones in which the majority of remnant Box-Gum Grassy Woodland occurs: Temperate Sub-humid and Temperate Cool-season Wet zones (Dunlop and Brown, 2008). Hotter summers, warmer winters with fewer frosts and higher evaporation rates are predicted, leading to more frequent fires with higher intensity. These changes are likely to favour new frost-sensitive species and summer-opportunistic weed species currently held at bay by regional rainfall patterns and/or temperature ranges (CSIRO, Australian Bureau of Meteorology 2007). Changes in seasonality are likely to see initial thickening of vegetation due to increases in carbon dioxide leading to shifts in competitive relationships between woody and grass component species (Conroy and Ghannoum 2006).

It is predicted that the greatest impacts will be on highly fragmented remnants, restricting the ability of component species to move across the landscape to areas of more suitable climate and/or habitat and it is likely that the rate of local and regional extinction within these communities will significantly increase.

Losses in nectarivorous bird populations are forecast as nectar becomes less abundant with flowering events being less frequent in a drying climate (Mac Nally et al. 2009). Poor flowering years leads to movement of bird populations to other areas, which leads to high use of energy, mortality and reduced breeding.

The listing of Key Threatening Processes "*Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases*" under the EPBC Act and *"Anthropogenic climate change"* in NSW under the TSC Act), and the Potentially Threatening Process of *"Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases*" in Victoria under the FFG Act; is a recognition of the significant impact of climate change on species, populations and ecological communities.

Actions to combat the impacts of climate change in Box-Gum Grassy Woodland will be required to focus on enhancing the resilience of existing vegetation, habitats and species through reducing the impact of immediate threats to extent and condition.

### *Salinity*

Across much of the distribution of Box-Gum Grassy Woodland dryland salinity is a major land degradation issue. A study in 2007 estimated that almost 2000 ha of woody vegetation in the Boorowa Shire in the South West Slopes bioregion of NSW was affected by dryland salinity, representing nearly 6% of Yellow Box–Blakely's Red Gum woodland and about 1% of White Box (*E. albens* Benth) woodland in the shire (Seddon et al*.* 2007).

Dryland salinity results from the widespread clearing of native trees and deep-rooted native perennial grasses, which actively extract water from the soil, and their replacement with shallow-rooted annual crops and/or weeds. As a consequence, more water enters the soil profile, causing water tables to rise, mobilising naturally occurring salts in the soil and carrying them to the soil surface.

The impact of dryland salinity on native vegetation communities is well documented and results in:

- declining tree health and eventual death;
- changes to understorey species composition with rising salt levels, salt tolerant species dominate;
- declining groundcover and the appearance of large bare areas as soil structure breaks down and erosion increases; and
- declining surface water quality, as salts are transported into the drainage system.

While the direct impacts of dryland salinity on native fauna have not been studied, it is logical to assume that declining habitat health, loss of particular habitat elements (overstorey, midlayer, groundlayer and litter) and poor water quality as a result of salinity will result in a corresponding decline in fauna assemblages.

### *Acid Soils*

Soil acidification is a natural process which may be markedly accelerated by agriculture. Improved pasture areas located near to Box-Gum Grassy Woodland remnants will generally have higher soil nitrogen levels and thus a greater risk of nitrate leaching. Nitrate leaching is a major acidifying process, particularly where annual species predominate and nitrate is more easily leached below the root zone.

Product removal associated with agriculture may also increase acidifying processes, although it is dependent on the crop. For example, lucerne hay removes the equivalent of 70 kg of CaCO3 per ton of hay, while wheat removes only 9 kgs per ton of grain (Upjohn et al. 2005).

The implications are that agricultural land close to woodland areas may acidify resulting in loss of perennial species and weed ingress which could impact on adjacent woodlands. High quality woodlands are unlikely to be directly acidified, since they are usually low nitrogen systems with little or no nutrient leakage. Problems are most likely to occur where mismanagement of perennial native grasses, or oversowing of legumes with superphosphate application, could cause destabilisation of adjacent native grasslands. Most native grasses have medium to high tolerance of soil acidity, however native legumes may have much higher sensitivities. Further study is required to determine more exact impacts and tolerances.

### *Declining Tree Health and Regeneration*

General decline in tree health in rural areas, coupled with reduced or lack of recruitment is a serious threat to the long-term viability of Box-Gum Grassy Woodland. Across much of its former range, this ecological community now occurs as small isolated remnants and/or is represented by scattered paddock trees. Trees in such landscapes are subject to a range of impacts including increased insect attack, changed soil nutrient and hydrological regimes, increased chemical drift, root disturbance, excessive mistletoe infestations and soil compaction. These impacts result both directly and indirectly from human activity. The detrimental effect of these impacts on the ecological community are further exacerbated by a lack of regeneration as a consequence of changed environmental conditions, conflicting grazing regimes, continued cultivation and/or clearing of regrowth for grazing (as permitted under the NV Act in NSW). Once these scattered trees and small remnants succumb either through age (senescence) or ill health (dieback) significant remnant areas of this ecological community will be lost. It is predicted that with the currently inadequate rate of regeneration, paddock trees will no longer be a feature of the agricultural landscape after 120 years (Gibbons et al. 2008). Current management recommendations which concentrate on increased recruitment will not be enough to reverse the loss (Gibbons et al. 2008).

## 7.4 Other Potential Threats

### *Animal Pests*

Introduced animal species are considered a significant threat to Box-Gum Grassy Woodland. Herbivores, such as rabbits, hares, goats and deer, increase grazing pressure, prevent regeneration of native trees and shrubs and facilitate the spread of weeds. Digging by rabbits and pigs causes soil and groundlayer disturbance. In the case of pigs, their preference for eating underground storage organs of native lilies, orchids and other forbs has a major impact on these species. Predators such as foxes, dogs and feral cats are a significant threat to native fauna, while introduced birds (e.g. Common Myna (*Acridotheres tristis*), European Starling (*Sturnus vulgaris*)) and the Honeybee (*Apis mellifera*) compete with native species for nesting sites and habitat resources.

The significant landscape and habitat changes that have occurred since European settlement have led to ecosystem imbalances and resulted in some native animals becoming pest species. For example, the Noisy Miner (*Manorina melanocephala*) can often dominate small woodland remnants, significantly reducing the numbers of small insectivorous birds. In turn this has lead to increases in herbivorous insect populations resulting in tree dieback and defoliation (Loyn 1987; Grey et al. 1997).

The importance of the threat posed by introduced pest animal species is recognised by various listings under legislation summarised in Table 2, below.

**TABLE 2: Animal Pests listed under legislation as a Threatening Process**

| Animal Species | Relevant Legislation * |
|---|---|
| Goat | • EPBC Act<br>• TSC Act |
| Rabbit | • EPBC Act<br>• TSC Act<br>• FFG Act |
| Bees | • TSC Act<br>• FFG Act |
| Deer | • TSC Act<br>• FFG Act |
| Fox | • EPBC Act<br>• TSC Act<br>• FFG Act |
| Cat | • EPBC Act<br>• TSC Act<br>• FFG Act |

* Full Threatening Process listing titles appear in Appendix 5

### *Disease*

*Phytophthora cinnamomi* is an introduced root-rot fungus which represents a major threat to native ecosystems. A microscopic soil-borne organism, widespread in southern Australia, *P. cinnamomi* attacks the roots and basal stem tissue of living plants. It interferes with the movement of water and nutrients to plants, causing root-rot and may result in the death of the plant (Botanic Gardens Trust undated). It is known that some component species of Box-Gum Grassy Woodland [e.g. grass trees (*Xanthorrhoea* spp.)] are susceptible to dieback caused by *P. cinnamomi* (Keith McDougall, pers. comm.). "*Dieback caused by the root-rot fungus* (*Phytophthora cinnamomi*)" is listed as a Key Threatening Process under the EPBC Act, TSC Act and FFG Act.

### *Collection/removal of Native Flora*

The severity of the impact of the collection and removal of plant specimens (e.g. orchids, grass trees) for gardens and landscaping is currently unknown. It may, however, pose a potential threat given the increasing interest in backyard landscaping and the high cost of propagated specimens in commercial nurseries. "*Collection of native orchids*" is listed as a Potentially Threatening Process under the FFG Act in Victoria.

Similarly, the increasing interest in the harvesting and propagation of native seed (trees, shrubs and grasses) for use in re-vegetation projects could prove detrimental to the long-term viability of Box-Gum Grassy Woodland remnants should insufficient consideration be given to the recruitment requirements of the source ecological community.

# 8. Recovery Actions to Date

Significant work has already been undertaken in regard to the recovery of Box-Gum Grassy Woodland. This has included work by state, territory and regional Natural Resource Management (NRM) agencies, Conservation Management Networks (CMNs), non-government organisations (NGOs), universities and research institutes, scientists and ecologists and individual landholders. Various Australian Government programs have funded much of this work in cooperation with funding, in-kind support, and reserve and conservation agreement management by state and ACT governments. Details of the recovery actions undertaken to date are summarised in the subsections below.

## 8.1 Baseline Information

Critical to the recovery of the ecological community is baseline data regarding the location, quality and management regimes of remnant sites. Baseline data enables the measurement of change, through additional monitoring, as a result of management activities. In the absence of this information it will be impossible to determine the rate of decline and whether recovery actions are successful in improving the status of Box-Gum Grassy Woodland.

### *Ecological Community Extent and Condition Mapping*

Accurately quantifying and mapping both the current extent and condition of Box-Gum Grassy Woodland is a complex task due to the ecological community being geographically widespread, highly fragmented and occurring on a wide range of tenures in varying condition states. Estimates of extant and pre-clearing extent have been derived from existing vegetation mapping data from relevant state and territory mapping programs. These estimates have generally been based on overstorey species and therefore have not considered remnant condition, therefore while indicative, result in an overestimation of the extent. A summary of the estimated extent of Box-Gum Grassy Woodland in each

jurisdiction is contained in Appendix 6.

Projects considering remnant condition in mapping the ecological community have been undertaken primarily in the Southern Tablelands and South-West Slopes regions of NSW, and Northern Victoria. These include:

- Using multi-image multi-spectral analysis of satellite imagery in the South Eastern Highlands of NSW creating data of structural formations of grassy vegetation (ERIC 2001; Walter and Schelling 2004; Walter and Schelling 2005).

- Pilot project in the South West Slopes bioregion to identify high value biodiversity assets, including Box-Gum Grassy Woodland, using rapid assessment in conjunction with remote sensing techniques and expert local knowledge (DECC 2008 unpublished).

- EVC mapping of Victoria (DSE 2002-2009).

- Mapping of threatened grassy vegetation communities of the Goulburn Broken Catchment in Victoria (DSE 2006) and North East Catchment of Victoria (Earl et al. 2007).

These projects have been successful in predicting various types of grassland and open woodland (Baines and Dunford 2008), and in combination with onsite surveys, have been used to develop regional models that include Box-Gum Grassy Woodland in various condition states.

A project to collate all existing state and territory mapping datasets relevant to Box-Gum Grassy Woodland was conducted by the Environmental Resource Information Network (ERIN) within the Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), in association with state-based experts on Box-Gum Grassy Woodland. The objective of this project was to generate a map of the extent of the ecological community using the most accurate information available. The results are at Appendix 4. Further work on data licensing is needed to make the compiled data available to all government agencies.

Verification that Box-Gum Grassy Woodland remnants identified from the project meet the definition of the listed ecological community will be continuous as a result of ongoing survey programs, including those conducted by the Grassy Box Woodlands (GBW) CMN on location and condition of sites on member's properties. Site assessments of TSRs, cemeteries, roadside reserves, local government and Crown reserves, and private lands containing Box-Gum Grassy Woodland will enhance the accuracy of the collated data over time. The development of minimum condition criteria and assessment methodology by the Australian Government has assisted land managers in the local identification of the listed ecological community which in turn has aided the quantification of extent on private property.

### *Component Species Surveys*

Much is yet to be learned of the composition, distribution and/or ecology of Box-Gum Grassy Woodland component species, although research has been carried out on specific threatened species in recent years. Some of the component species of Box-Gum Grassy Woodland have individual threatened status and are the subject of surveying and monitoring, including Regent Honeyeater (*Xanthomyza phrygia*), Swift Parrot (*Lathamus discolor*), Grassland Earless Dragon (*Tympanocryptis pinguicolla*), Golden Sun Moth (*Synemon plana*) and Striped Legless Lizard. Other research programs and surveys have improved baseline information on the Box-Gum Grassy Woodland component species, including:

- site surveys conducted throughout the South Eastern Highlands and NSW South

Western Slopes by NSW Department of Environment, Climate Change and Water (DECCW) (data from which is held on the NSW Grassy Ecosystems Database), which has assisted in developing a greater understanding of species distributions and abundances throughout these regions;

- Cowra Woodland Birds Program;
- surveys of threatened and declining birds in the NSW sheep-wheat belt (Reid 1999, 2000);
- vegetation and bird surveys of Box-Gum Grassy Woodland remnants on TSRs and private land in the NSW sheep-wheat belt undertaken in conjunction with the GBW CMN and DECCW;
- vegetation assessments in North East Victoria which provide information from a selection of sites mainly on public land, including the Goulburn Broken catchment (DSE 2006) and North East catchment (Earl et al. 2007);
- data recorded through the implementation of the NSW Property Vegetation Planning process; and
- surveys conducted under various university, CSIRO, state agency and NGO research programs (Radford and Bennett 2007).

Further research is required before the complex species' relationships and interdependencies and resource cycling within Box-Gum Grassy Woodland is fully understood. However, enough is known to begin reducing critical threats within an adaptive management framework.

***Summary of Baseline Information Actions Undertaken to Date:***

- The development of databases that include information on CMN members (land managers with Box-Gum Grassy Woodland remnants), remnant location, component flora and fauna species and remnant condition from surveys of CMN members' sites and other sites (TSRs, reserves, cemeteries, roadsides, etc) with Box-Gum Grassy Woodland;
- Development of minimum condition criteria and an assessment method, as part of the Australian Government listing, to assist land managers in the identification of the listed ecological community (DEH 2006);
- Use of remote sensing techniques to develop regional models which include Box-Gum Grassy Woodland in various condition states;
- Mapping of Box-Gum Grassy Woodland extent; and
- Surveys conducted during various university, CSIRO, state agency and NGO research programs.

## 8.2 Protection of Box-Gum Grassy Woodland

Some sites of Box-Gum Grassy Woodland have been recognised as significant and are protected under various mechanisms. With the exception of the ACT, in which substantial areas of Box-gum Grassy Woodland are protected in public reserves, the number of remnants protected within the conservation reserve system still represents only a small proportion of existing remnants and only a very small proportion of the Box-Gum Woodland that is thought to have existed at the time of European settlement. Identifying priority areas for long-term and in-perpetuity protection is an important component of managing the recovery of the ecological community. Appendix 7 lists the public reserves in each state and territory which are known to contain Box-Gum Grassy Woodland, and Appendix 8 lists sites listed on the Register of the National Estate that are known to contain remnants of Box-Gum Grassy Woodland.

### *Australian Capital Territory*

The ACT still contains large areas (patches greater than 100 ha) of relatively well connected good condition Box-Gum Grassy Woodland remnants, as a consequence of the system of leasehold title and Land Management Agreements which have limited grazing pressure and prevented intensive pasture improvement (ACT Government 2004). The remaining areas are located at Gungahlin, Majura-Kowen, Callum Brae-Jerrabomberra and on rural land south and west of Canberra, existing as *Yellow-Box-Red Gum Grassy Woodland.* In 2003, it was estimated that about 7,035 ha of the remaining Box-Gum Grassy Woodland are within land use categories that do not permit clearing for urban and similar activities. This includes about 2,940 ha protected within nature reserves (see Appendix 7). 2990 ha are located in land zoned as Broadacre and Rural under the Territory Plan, some of which are under long term rural leases and Land Management Agreements. 840ha of Box-Gum Grassy Woodland are located on land identified in the Territory Plan as urban or related land use categories (ACT Government 2004).

### *Queensland*

Some areas of the Regional Ecosystems of which Box-Gum Grassy Woodland is a component (detailed in Section 2) are protected within the formal conservation reserve system. A number of conservation mechanisms are available to landholders for the protection and restoration of Box-Gum Grassy Woodland including:

- '*NatureAssist',* a component of the Queensland Department of Environment and Resource Management (DERM) Nature Refuge Program under the NC Act(Q), to encourage conservation on private land. Currently there are 268 nature refuges across Queensland, protecting 550,000 ha of privately owned land (Qld EPA 2008), although the exact extent of Box-Gum Grassy Woodland under these agreements remains to be quantified. Reserves which are known to contain Box-Gum Grassy Woodland are listed in Appendix 7.

- Land for Wildlife. A voluntary scheme managed by Greening Australia in cooperation with DERM, which aims to encourage and assist private landholders to provide habitats for wildlife on their property (Greening Australia 2007).

- The Environmental Stewardship Program Box Gum Grassy Woodland Large High Quality Sites project, delivered through the Australian Government's Caring for our Country initiative, was implemented in three NRM regions of southern Queensland in 2008/2009. The project targeted Box-Gum Grassy Woodland areas of 50ha or greater occurring on private land and provided funding via a competitive auction process. Nine successful land managers have been contracted to carry out management activities over 15 years to conserve 1370 ha of Box-Gum Grassy

Woodland. Management actions pertinent to these projects include improving ground layer diversity through grazing management and control of weeds. The Queensland Murray-Darling Committee is the contracted delivery agent for the Environmental Stewardship program in Queensland. Of those land managers contracted in Queensland, three have opted to covenant their sites.

### *New South Wales*

In NSW, Box-Gum Grassy Woodland is currently known to occur within at least 42 national parks, nature reserves and state conservation areas, although in some cases these remnants are quite small. A number of reserves with small remnants of BGGW were gazetted following the Southern Comprehensive Regional Assessment, including Stoney Creek Nature Reserve and Cuumbuen Nature Reserve. Additionally, the two sections of Queanbeyan Nature Reserve both contain areas of Box-Gum Grassy Woodland. New remnant areas of Box-Gum Grassy Woodland were added to the formal reserve system with the enactment of *Nandewar and Brigalow Community Conservation Area Act 2005* (e.g. Barayamal National Park on the northwest slopes). The exact area of the ecological community protected in NSW is currently still to be quantified, however in the South-Western Slopes bioregion, estimates suggest approximately 8000 ha occurs in national parks and nature reserves (Benson 2008). Reserves which are known to contain Box-Gum Grassy Woodland are listed in Appendix 7.

The development of a regional Protected Area Network (PAN) along the Dananbilla–Illunie Range in the Young–Cowra–Boorowa area of the south-west slopes has facilitated the protection of large patches of Box-Gum Grassy Woodland in four nature reserves and conservation agreements on private lands.

A number of Box-Gum Grassy Woodland remnants are listed under the Register of the National Estate, as shown in Appendix 8, including the Bala TSR Remnant Vegetation Site near Boorowa and Winton Cemetery Woodland Remnant near Tamworth.

Crown land reserves gazetted for environmental protection and passive recreation that contain Box-Gum Grassy Woodland include Brooks Hill Reserve near Bungendore and Gale Reserve at Queanbeyan.

A variety of mechanisms have been used to protect Box-Gum Grassy Woodland on private and public land, including:

- Conservation Agreements (CA) with DECCW, established under the NSW *National Parks and Wildlife Act 1974* (NPW Act), are voluntary covenants that provide protection and conservation of natural and cultural heritage values on private and public land. These can be both in-perpetuity or for a defined period of time. Currently, at least 15 CAs protect Box-Gum Grassy Woodland sites on private and public land including high quality remnants existing within the grounds of cemeteries at Monteagle, Currabubula, Wallendbeen, Marrar, North Berry Jerry and Stockinbingal. The exact area of the ecological community within CAs is yet to be determined.

- The NGO Bush Heritage Australia currently owns and manages two properties in NSW that protect Box-Gum Grassy Woodland: Tarcutta Hills Reserve and Scottsdale Reserve, protecting an estimated 80 ha and 486 ha of Box-Gum Grassy Woodland respectively.

- Trust Agreements under the NSW *Nature Conservation Trust Act 2001*, administered by the NSW Nature Conservation Trust (NCT). These can protect areas of native vegetation by registering covenants on land title. These are applied to the NCT revolving fund scheme which purchases, covenants and on-sells private land of high conservation value. The NCT has handled covenants on several properties for the protection of areas of Box-Gum Grassy Woodland, including

through the revolving fund scheme (Nature Conservation Trust 2009).

- The Environmental Stewardship Program has delivered four competitive reverse auction rounds since 2007 in NSW. These rounds have targeted conservation of Box-Gum Grassy Woodland in five CMA regions – Lachlan, Murrumbidgee, Namoi, Central-West and Border Rivers-Gwydir. To date a total of 192 land managers in NSW have been contracted for up to 15 years under the Program to manage and protect over 25,000 ha. Of those land managers contracted in NSW, 31 have opted to covenant their sites. Box-Gum Grassy Woodlands will be one of the targeted endangered ecological communities in the Environmental Stewardship Multiple Ecological Communities Project to be delivered across the Central West, Namoi and Border Rivers- Gwydir NRM regions in 2010/2011.

Other mechanisms are available for the protection of Box-Gum Grassy Woodland including Property Vegetation Plans (PVP) under the NV Act, administered by the NSW CMAs. PVPs are voluntary, legally binding agreements between a landholder and the local CMA regarding the management of vegetation on individual properties. In addition, Wildlife Refuge agreements with DECCW under the NPW Act, Land for Wildlife voluntary property registration scheme coordinated by the Community Environment Network (CEN) in partnership with DECCW, and the Biobanking credit trading system to offset clearing of native vegetation and fauna habitat, are also available for the protection of Box-Gum Grassy Woodland.

### *Victoria*

Areas of Box-Gum Grassy Woodland are protected within the formal Victorian reserve system, including within the Chiltern-Mt Pilot National Park and Natural Features Reserve. The largest protected intact remnant is in the Snowy River National Park. Reserves within the formal reserve system which are known to contain Box-Gum Grassy Woodland are listed in Appendix 7.

In the Goulburn Broken Catchment, 31 high quality remnants have been identified on both public and private land with management and monitoring plans prepared for each (DSE, 2006).

Puckapunyal Military Area, Puckapunyal, contains remnants of Box-Gum Grassy Woodland and is listed on the Register of the National Estate. The Dookie Bushland Reserve, Dookie, and the Boxwood Historic Reserve are significant remnants in northwest Victoria, as are, large areas on Defence land within the Wodonga area and in the Wodonga Retained Environment Network on local government and private land.

The ecological community is not listed as threatened in Victoria however Bush Heritage Australia owns and manages two properties and the Trust for Nature has the capacity to protect properties in Victoria which have Box-Gum Grassy Woodland through a covenanting process.

Other mechanisms are available for the protection and restoration of Box-Gum Grassy Woodland including the “ecoMarkets” project under the Victorian Government Our Environment, Our Future Sustainability Action Statement 2006, which includes the, BushTender and EcoTender programs; and the BushBroker native vegetation credit trading system. Land for Wildlife, a voluntary scheme which aims to encourage and assist private landholders to provide habitats for wildlife on their property, is also available for Box-Gum Grassy Woodland protection. Various local incentive programs are funded via the Catchment Management Authorities. These mechanisms have the potential to provide long-term protection and restoration of Box-Gum Grassy Woodland remnants (DSE Website 2008).

### *Environmental Stewardship Program*

The Environmental Stewardship Program is part of the Australian Government's Caring for our Country initiative. It assists private land managers to maintain and/or improve the condition and extent of targeted matters of National Environmental Significance (NES) under the EPBC Act. The Program aims to fill a gap in natural resource management by providing market-based incentives for private land managers to engage in the long-term protection and rehabilitation of biodiversity assets on their land. Land managers can enter into funding agreements for up to 15 years. Box-Gum Grassy Woodland is the first biodiversity asset targeted by the Environmental Stewardship Program. The Environmental Stewardship Program is working in partnership with Catchment Management Authorities and Natural Resource Management Regions as delivery agents to run competitive reverse auction funding rounds in target regions. To date a total of 201 land managers have been contracted under Environmental Stewardship through five funding rounds, resulting in the management and protection of over 26,400 ha of Box-Gum Grassy Woodland in New South Wales and Queensland. In 2010-11, the Environmental Stewardship Program will focus on maintaining and/or improving the condition and extent of multiple ecological communities (MEC) in selected NRM regions in NSW and South Australia. The NSW MEC project will again target Box-Gum Grassy Woodland as one of three ecological communities targeted in the Central West, Namoi and Border Rivers-Gwydir Catchment Management Authority (CMA) regions. The other ecological communities to be targeted are the Natural Grasslands on Basalt and Fine-textured Alluvial Plains of northern NSW and southern Queensland, and Weeping Myall Woodland. See www.nrm.gov.au/stewardship/ for contacts and more information.

### *Summary of Box-Gum Grassy Woodland Protection Actions Undertaken to Date*

- Establishment of a number of reserves across the geographic extent of the ecological community;
- Listing of sites containing Box-Gum Grassy Woodland on the Register of the National Estate;
- Establishment of a variety of mechanisms for the conservation of Box-Gum Grassy Woodland on private and public land across the geographic extent of the ecological community;
- Facilitation of land manager access to financial and other incentives for Box-Gum Grassy Woodland conservation activities, including CMA incentive schemes and the Environmental Stewardship Program; and
- Development of conservation management plans for protected/high quality sites in all states and the ACT, including actions that relate to the maintenance or enhancement of habitat for component species.

## 8.3 Community Engagement in Box-Gum Grassy Woodland Conservation

Community involvement is crucial to the recovery of Box-Gum Grassy Woodland, given the highly fragmented nature of remnants and their occurrence on predominantly private land. As a consequence of the listing of the ecological community under the EPBC Act, an increasing number of private landholders and public land managers are becoming actively involved in Box-Gum Grassy Woodland conservation activities, while an even greater number are requesting information on appropriate management. There are numerous community land management networks across the range of Box-Gum Grassy Woodland including Aboriginal networks, Landcare, production focussed groups and nature conservation focussed groups. The ability of these networks to incorporate biodiversity conservation information into their communication processes to date has been varied.

Critical to the community's engagement in and understanding of Box-Gum Grassy Woodland has been the production of a flora field guide, funded partly through the Natural Heritage Trust. This publication, *Grassland Flora: a field guide for the Southern Tablelands (NSW & ACT)* Eddy et al. (1998) focussed on the ground flora and while designed for the south-eastern NSW region, has found wide application throughout the range of the Box-Gum Grassy Woodland. It has been instrumental in increasing people's knowledge of the flora of this community.

### *Conservation Management Networks*

Launched in October 1999, the Grassy Box Woodland (GBW) Conservation Management Network (CMN) was the first such network established in Australia. The NSW National Parks and Wildlife Service and research scientists Drs Suzanne Prober and Kevin Thiele were funded by the National Reserve System Program to develop a new model for the long-term conservation of highly fragmented ecosystems that are difficult to conserve through acquisition.

The GBW CMN aims to link Box-Gum Grassy Woodland remnants and their owners/managers through a single network dedicated to protecting and managing this important ecosystem and to provide long-term, targeted, flexible, and responsive support to owners/managers, NGOs, researchers and government agencies involved in the management of Box-Gum Grassy Woodland remnants. The GBW CMN also provides an opportunity to encourage members to consider in-perpetuity conservation mechanisms such as a Conservation Agreement.

GBW CMN members continue to manage their Box-Gum Grassy Woodland remnants for a variety of purposes, although an important focus must be the protection of their natural values. The benefits of membership (from Prober, Thiele and Higginson undated) include:

- formal recognition of the contribution of landholders and managers to woodland conservation;
- contact with other Network members, relevant government agency/NGO extension officers and scientists;
- sharing expertise and experience in Box-Gum Grassy Woodland management;
- access to up-to-date information regarding Box-Gum Grassy Woodland and its management;
- planning advice to enable integration of Box-Gum Grassy Woodland conservation into regional, local and property plans; and
- advice and assistance with funding applications, legal protection of Box-Gum Grassy Woodland remnants and promotion and publicity of woodland conservation efforts.

Staffing for the GBW CMN currently comprises one co-ordinator located in Queanbeyan, NSW, and one GBW CMN Endangered Ecological Community Catchment Officer employed by the Lachlan CMA. The widespread distribution of Box-Gum Grassy Woodland remnants requires significant resources in order to provide effective on-ground, local support for land managers, new members and to assist local Landcare groups to incorporate biodiversity management into their programs.

As at September 2010, the GBW CMN and the Southern Tablelands Grassy Ecosystem CMN had a combined membership of 1318 across NSW (T McLeish, pers. comm., 2010), including some institutional members in the ACT (such as university and CSIRO scientists), which equates to an equal (if not greater) number of sites of Box-Gum Grassy Woodland being actively managed for conservation outcomes. Membership continues to grow but more recently the GBW CMN has focused on forming partnerships with existing community

networks such as Landcare to influence more managers, including Australian Government funding for a jointly managed project “Communities in Landscapes”

The GBW CMN runs a variety of activities and programs aimed at increasing public awareness of conservation issues and improved management of Box-Gum Grassy Woodland. In addition, the GBW CMN has an on-going program of Box-Gum Grassy Woodland survey on private and public lands aimed at improving the knowledge base in regards to the extent and quality of remnants across its NSW distribution.

Other CMNs contributing to the protection of Box-Gum Grassy Woodland include:

- Southern Tablelands Grassy Ecosystem CMN: established with Australian Government funding in 2002 and focuses on improving the conservation of both Box-Gum Grassy Woodland and the Natural Temperate Grassland of the Southern Tablelands (NSW and the ACT) endangered ecological community. These two EPBC Act listed threatened ecological communities often co-occur, either at the property-scale or at the landscape-scale under the management of Local Government Areas or LHPA;

- Far South Coast CMN: funded by the NSW Southern Rivers CMA and DECCW, supports landholders managing native vegetation on private property, including Box-Gum Grassy Woodland;

- Monaro Grassland CMN: works with private land managers in southern NSW “*to develop and secure conservation of grassland sites across all land tenures*” (Eddy 2007) and focuses on natural and derived grassland sites, including the derived remnants of Box-Gum Grassy Woodland in the north and south-west of the Monaro region; and

- The Victorian Broken-Boosey, Gippsland Plains, Northern Plains, Goldfields and Wedderburn CMNs: focus on the protection, management and improvement of habitat and biodiversity within the rural landscape, a component of which is Box-Gum Grassy Woodland.

### *Engagement of Aboriginal Communities*

A draft copy of this plan was provided to Aboriginal Reference Groups in NSW across the range of the ecological community.

In addition, a pilot project in partnership with the Aboriginal Reference Groups (ARG) of the Lachlan and Central West CMAs of NSW and DECCW was conducted to identify:

- current Aboriginal community involvement in Box-Gum Grassy Woodland management;

- areas within the catchments that contain Box-Gum Grassy Woodland which are of particular significance to Aboriginal people;

- Aboriginal community interest in contributing to the preparation of the national recovery plan and implementation of recovery actions both on Aboriginal and public land; and

- Most effective mechanisms to harness traditional knowledge of Box-Gum Grassy Woodland and component species to strengthen current knowledge and assist in the recovery of the ecological community.

The ARGs advise the CMAs on priority natural resource management and cultural heritage issues for Aboriginal communities and act as a conduit for the exchange of information

between CMAs and local Aboriginal communities on natural resource management issues (DECC 2008). The CMAs and the ARGs work with the Aboriginal communities within each catchment to implement natural resource management programs.

The pilot project assisted the Orange and Young Local Aboriginal Land Council to develop plans of management for three significant Box-Gum Grassy Woodland sites. The plans were completed in February 2010 and facilitate the ongoing restoration of these sites, highlighting opportunities for wider community education. For example, one site has the potential to incorporate a native plant nursery to propagate local seed, with the Council further envisaging a walking track through the site to best show cultural and ecological values.

The success and expansion of the pilot projects in Young and Orange should increase future involvement and facilitate engagement of Aboriginal communities in Box-Gum Grassy Woodland site restoration.

Further Aboriginal interest in Box-Gum Grassy Woodland across its range will be identified and Aboriginal community involvement in the conservation management of Box-Gum Grassy Woodland will be facilitated during the life of the recovery plan (see Action 3.5). All activities will be undertaken in a manner that respects the cultural traditions of Aboriginal groups throughout the range of this ecological community.

### *Summary of Community Engagement Actions Undertaken to Date*

- Provision of advice by CMNs, state and territory NRM agencies to private and public land managers, community groups, TAFE, local government, Local Aboriginal Land Councils and schools;
- CMN-organised extension activities (workshops, conferences, training, field days, site visits) for private landholders, public land managers, regional NRM agencies and local government;
- Liaison between state and regional NRM agencies, CMNs, NGOs, universities and research organisations;
- Co-ordination of research and survey programs and negotiation of access to Box-Gum Grassy Woodland sites on private property (facilitated by CMNs);
- Development of GBW CMN education materials (brochures, posters, curriculum activities) including the publication and distribution of a quarterly newsletter, *"Woodland Wanderings"* and the Southern Tablelands Grassy Ecosystem CMN newsletter, *"The Austral Bugle"* (www.gbwcmn.net.au);
- Production and wide distribution of *Grassland Flora: a field guide for the Southern Tablelands (NSW & ACT)* Eddy et al. (1998) to raise communities' awareness of the flora of Box-Gum Grassy Woodland;
- Provision of signage to GBW CMN members to identify Box-Gum Grassy Woodland remnants;
- Development of Box-Gum Grassy Woodland information kit to assist land managers in identifying, managing and protecting threatened native vegetation communities of the Goulburn Broken catchment (DSE 2006);
- Development of two Biolink projects in the north-east of Victoria: Chilton-Mt Pilot Biolink and Greta- Warbuy Killawarra Biolink targeting threatened vegetation including BGGW. These are a partnership between DSE, North-East CMA, Department of Primary Industries (Vic) and TFN (Vic);

- Native vegetation-ECV identification and management training (Sue Berwick pers. comm.);

- Preparation of EVC brochures and “Managing your Patch of Bush kit” which included information of Box-Gum Grassy Woodlands (Titcumb 2002);

- Targeted program in 2007/08 promoting BGGW in the North-East catchment of Victoria through leaflets and incentives;

- Promotion of “best practice” management guidelines (Sharp et al. 2005; Oliver et al. 2008) through GBW CMN members and public land managers (http://gbwcmn.net.au/files/AdaptiveManagement09.pdf) ;

- Development of an Environmental Stewardship Training Manual; and

- Pilot project within Lachlan and Central West catchments of NSW to engage Aboriginal communities in Box-Gum Grassy Woodland recovery.

## 8.4 Ecosystem Function and Management Research

Box-Gum Grassy Woodland and its component species require long-term management that will maintain, and ideally enhance, the conservation values of remnant areas. Appropriate management should be irrespective of the protection status of a site, although this may vary between sites depending upon landscape setting, disturbance and land use history.

Restoration of Box-Gum Grassy Woodland entails moving the ecological community from lower to higher condition states through changed management systems, as illustrated in the State and Transition Model in Appendix 3. Understanding how the ecological community functions, what functions are absent in individual remnants and how they can be returned is fundamental to recovery. Understanding the benefits of improved management of Box-Gum Grassy Woodland to the broader landscape, including benefits to agricultural production and the movement of native fauna, is an important area of investigation. The development and dissemination of ‘best practice’ management information as it becomes available is crucial.

A significant proportion of research into the ecology of Box-Gum Grassy Woodland has been undertaken in central and southern NSW and the ACT. The Agricultural Landscapes Program of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Sustainable Ecosystems has undertaken research to improve ecological integrity and economic performance of farms and rural enterprises, including those affecting Box-Gum Grassy Woodland. This research has been undertaken in partnership with rural industries, universities and state government, including Charles Sturt University and The Fenner School of Environment and Society at Australian National University (ANU). The ACT Government, ANU and CSIRO are currently collaborating in the Mulligans Flat-Goorooyaroo Study, which focuses on Box-Gum Grassy Woodland management and the response to various experimental management actions such as fire, grazing exclusion, addition of woody debris and feral animal exclusion in two ACT nature reserve (ANU, 2008).

The following are examples of important research (not comprehensive) undertaken into ecosystem function and management of Box-Gum Grassy Woodland which are applicable to the successful recovery of the ecological community.

### *Component Species Composition*

Research of Box-Gum Grassy Woodland component species has focussed on ecosystem function as well as the impacts of various management actions including fragmentation,

grazing and burning. Research has shown that species composition and ecological functioning varies across its distribution from north to south, primarily arising from climatic changes (Prober 1996).

Studies of flora component species by Prober, Lunt and Thiele (2002) found that at a landscape scale, species richness of the groundlayer within little disturbed Box-Gum Grassy Woodland remnants declines naturally with increasing soil fertility. But at a local scale (i.e. within a remnant) soils under mature trees are more fertile and support a greater richness of understorey species than open areas. They also found that while Kangaroo Grass dominates open areas, Snow Grass tends to dominate under trees, and the abundance of both grasses is generally lower under trees facilitating the establishment of subsidiary species. Snow Grass and potentially Tussock Grass (*P. labillardierei*), because of their apparent preference for higher fertility soils, may be useful in restoring degraded areas with higher nutrient concentrations.

Prober, Thiele and Lunt (2002) also looked at the physical and chemical properties of topsoil as determinants of understorey composition within remnants. Results showed that the soils of modified remnants were relatively low in nutrients, more acidic and more compacted than ungrazed remnants, and that high soil nitrate levels favour the dominance of annual and biennial weeds [including Rye Grass (*Lolium rigidum*), Black Oats (*Avena barbata*) and Paterson's Curse (*Echium plantagineum*)]. Subsequent studies have demonstrated that temporary reductions in soil nitrate levels, through the addition of carbon sources (such as sugar or sawdust), limit weed growth and favour the establishment and growth of native groundlayer species (Prober et al. 2005; Smallbone et al. 2007). However, only plots seeded with Kangaroo Grass maintained low nitrate levels on the cessation of carbon addition (Prober and Lunt 2009).

Studies of fauna component species have included relationships between species and characteristics of Box-Gum Grassy Woodland remnants (Seddon et al. 2003) and the investigation of the use of species as indicators of Box-Gum Grassy Woodland condition (Lindenmayer et al. 2000; Freudenberger and Brooker 2004).

### *Landscape Connectivity*

Fragmentation of Box-Gum Grassy Woodland due to clearing has lead to a critical loss of landscape connectivity and placed many component species at risk of local extinction. A high level of landscape connectivity is important to the maintenance of healthy ecosystems as it facilitates dispersal/interaction of species and the exchange of genetic material across the landscape. Landscape connectivity can be continuous (corridors) or discontinuous (patches which act as 'stepping-stones' between areas of habitat) and is dependent upon movement abilities of individual species.

Research undertaken by the CSIRO on the Brown Treecreeper (*Climacteris picumnus victoriae*) in southern NSW indicates that paddock trees may be as important for the movement of species as the traditional linear corridors (Doerr and Davies 2007). Recommendations from this study for best management practice in relation to landscape connectivity include:

- maintain and restore a variety of types of connectivity within any given landscape, including traditional corridors, vegetated drainage depressions and paddock trees;
- ensure that paddock trees are separated by no more than 80-100 m;
- while they may provide habitat, corridors should not be relied upon as habitat; and
- restoration of connectivity should only be a priority in landscapes where patches support only small populations and are no more than 1.5 km apart. In all other areas the restoration priorities should focus on improving patch quality and size, especially those within 1.5 km of larger remnants.

A number of programs have been established that aim to improve landscape function of Box-Gum Grassy Woodland, including connectivity. These include the Great Eastern Ranges Initiative and the key project areas of Kosciuszko to Coast, Slopes to Summit and Southern Highlands Link. Box-Gum Grassy Woodland is a focus of these projects and they have conducted conservation action planning workshops to identify priorities for conservation.

### *Patch Size*

The minimum size requirement for a viable patch of remnant Box-Gum Grassy Woodland is highly dependent on a number of variables, including existing structure, habitat elements present, component species, disturbance history, surrounding landuse and connectivity to other remnants. Additionally, minimum patch size will depend upon which group or species of woodland flora or fauna are being considered. Studies by Prober and Thiele have shown that in the absence of outside disturbance, patches less than 2 ha can be viable habitat for many grasses and forbs (Prober and Thiele 1995); whereas in highly fragmented landscapes, birds such as the Peaceful Dove (*Geopelia striata*) and Fan-tailed Cuckoo (*Cacomantis flabelliformis*), may require patches greater than 400 ha (Barrett et al. 1994). Prober and Brown (1994) also identified that White Box require a minimum population of 500 trees to maintain genetic diversity. The TSSC listing advice for Box-Gum Grassy Woodland identifies a viable patch supporting high species richness as having a minimum size of 0.1 ha (TSSC 2006).

### *Paddock Trees*

While scattered paddock trees may or may not constitute part of the listed ecological community, over large areas of its former range, scattered paddock trees are remaining representations of Box-Gum Grassy Woodland. Research conducted to date has identified the important role paddock trees play in maintaining ecosystem health and biodiversity within agricultural landscapes, by providing habitat for flora and fauna, facilitating species movement, maintaining gene pools, protecting soil biota and preventing soil degradation, salinity and erosion (Law et al. 2000; Fischer and Lindenmayer 2002; Gibbons and Boak 2002; Wilson 2002; Oliver et al. 2006; Lumsden and Bennet 2005).

Gibbons et al. (2008) estimated that paddock trees and small remnants (<0.5 ha) represent approximately 40% of the remaining Box-Gum Grassy Woodland. Consequently, in landscapes where clearing has reduced the extent of remnant woodlands to less than 30%, paddock trees are a key resource for woodland restoration (McIntyre *et al.* 2002). However impacts resulting from surrounding land use, coupled with isolation, have led to a relatively high mortality rate (0.6-2.4% lost per annum) and a low regeneration rate (approximately 20%) (Gibbons et al. 2008). Gibbons et al. (2008) predict that, without a change in management, within 120 years paddock trees will no longer be a feature of the agricultural landscape. Fischer et al. (2009) also acknowledged that under current management practices million of hectares would be treeless in the next few decades. However, the study found that the practice of reduced fertiliser use with fast-rotational grazing, which is characterised by prolonged rest periods in between short, intensive grazing events, could provide increased opportunity for regeneration.

Management priorities include protecting paddock trees from clearing, chemical spray drift (herbicides and other pesticides), root disturbance (cultivation), fertiliser application and changes to soil-water regimes. Additionally, recruitment within highly cleared landscapes should be encouraged either in small islands and/or within nearby remnants.

### *Hollow-bearing Trees*

The function of hollow-bearing trees within Box-Gum Grassy Woodland has been the subject of considerable research in recent years. Studies have found that the presence, abundance and size of hollows are positively correlated with tree basal diameter, which is

an index of age (Lindenmayer et al. 1991a; Bennett et al. 1994; Shelly 2005). The minimum size-class at which trees consistently (>50% of trees) contain hollows varies depending on the species and environmental conditions, yet is always skewed toward the larger, more mature trees.

Eucalypts containing large hollows are rarely less than 220 years old (Gibbons and Lindenmayer 2002). Larger, older trees also provide a greater density of hollows per tree (e.g. Bennett et al. 1994; Lindenmayer et al. 2000; Shelly 2005). As such, large old hollow-bearing trees are relatively more valuable to hollow-using fauna than younger hollow-bearing trees. The latter are important as a future resource.

Although large hollow-bearing trees are numerically rare, vertebrate species strongly select them as nest and roost sites. A review of roost selection by bats demonstrated consistent selectivity for large hollow-bearing trees (Kalcounis-Rüppell et al. 2006). Many vertebrates are known to select hollows with specific characteristics, indicating that suitable hollows represent a fraction of the total hollow resource (Gibbons *et al.* 2002; Kalcounis-Rüppell et al. 2006).

In agricultural landscapes hollow-bearing trees typically persist as isolated mature individuals in cleared paddocks or in small fragmented vegetation remnants (Bennett et al. 1994; Gibbons and Boak 2002). Such trees frequently suffer from poor health (e.g. 'dieback') and have a shorter lifespan than in forested landscapes (Yates and Hobbs 1997). Eventual loss of current hollow-bearing trees, and a lack of recruitment of younger trees to replace them, will result in a large decrease in the hollow resource over the wide geographic area covered by agricultural landscapes in the medium term.

### *Fallen Logs and Litter*

Studies into the invertebrate faunal assemblages have shown that a decline in fallen logs and litter leads to a similar decline in the abundance and diversity of invertebrate groups within Box-Gum Grassy Woodland (Bromham 1999; Martin and Major 2001; Lindsay 2008). A strong relationship between high levels of fallen timber and the presence of mammals, including the Yellow-footed Antechinus (*Antechinus flavipes*) and Common Ringtail Possum (*Pseudocheirus peregrinus)* has also been demonstrated by Lindenmayer (Montague-Drake 2008).

Fallen logs and litter (leaves, small twigs and branches) are important as they provide shelter, foraging substrates and food for a range of fauna (vertebrate and invertebrate) and additionally, provide the basic resource and suitable microclimate for nutrient recycling. Conflicting grazing and/or fire regimes, firewood collection as well as the desire to “tidy up” bushland patches often remove these elements from remnant areas.

Modelling undertaken as part of the Mulligans Flat–Goorooyaroo Woodland Experiment by Killey (2008) suggests the expected volume of fallen timber in high quality *Yellow Box-Red Gum Woodland* remnants ranges between 7–12 cubic metres/ha, and is generated predominantly by large old senescing trees. Thus to maintain and/or improve ecological function, management of remnants should focus on protection of these large old trees, and promote the progression of degraded remnants towards uneven age stands which include old senescing trees (Killey 2008). Restoring logs to box-gum grassy woodlands has been shown to be beneficial in increasing beetle species richness and assemblage heterogeneity (Barton et al. 2009).

### *Fencing*

Fencing remnant areas to restrict domestic stock grazing is widely recommended to assist in improving vegetation condition. Research undertaken into the effect of fencing on vegetation condition has demonstrated variable results generally attributed to different land use histories, starting condition, management within fenced sites and intrinsic site

conditions (Spooner et al. 2002; Tremont 2005). However, these studies have demonstrated that fencing remnants can lead to improvements in the floristic diversity and vegetative cover of the groundlayer, better tree regeneration, less cover of introduced annual weeds and reduced soil compaction. Studies have also shown that there is a need to consider limiting the use of barbed wire on the top strands of fences around woodland remnants to reduce potential impacts on fauna species (Lindenmayer et al. 2003).

### *Fire*

As previously discussed, it is likely that periodic burning by bushfires and Indigenous people played an important role in the development and maintenance of Box-Gum Grassy Woodland. Several studies have shown that burning can reduce dominance by Kangaroo Grass and by preventing a build up of plant litter in inter-tussock spaces stimulate growth and flowering of other native species (Stuwe and Parsons 1977; Davies 1999). However, cessation of burning for 14 years at a site on the South West Slopes did not lead to sward collapse in that grassland during the time of the study (Prober et al. 2007).

Snow Grass does not recover as rapidly as Kangaroo Grass after burning, and the relative dominance of these two grasses in remnants appears to be regulated by the fire frequency (Prober et al. 2007). The Kangaroo Grass/Snow Grass understorey is most resilient to various fire regimes when both species remain in moderate abundance (Prober et al. 2007)

Few fire studies have been undertaken to date in groundlayer dominated by other grass species such as Redgrass (*Bothriochloa macra*), Wallaby Grass (*Austrodanthonia* spp.) and/or Speargrass (*Austrostipa* spp.). Consequently, research by CSIRO is continuing to determine appropriate fire regimes for Box-Gum Grassy Woodland in all its various condition states across its geographic range.

While appropriate burning regimes will depend on the initial floristic composition and history of a remnant, early results from research conducted in southern NSW suggest that autumn burning cycles approximately every 5-8 years are adequate to maintain floristic diversity in Box-Gum Grassy Woodland remnants dominated by Snow Grass and Kangaroo Grass (Prober, Thiele and Lunt 2007). Mosaic burns should be applied to all remnants (i.e. burning small areas at staggered intervals) to allow survival of soil and ground fauna (including invertebrates, amphibians and reptiles) and maintain overstorey regeneration (Barlow 1998; Eddy 2002; McIntyre et al. 2002). Sites where burning is practiced should also retain unburnt areas, to provide refuges for species of fauna and flora that may be fire intolerant. Monitoring changes in species composition and habitat elements post-burning is essential to ensure fire regimes are maintaining or improving remnant quality, rather than contributing to further degradation.

### *Grazing Management*

Research assessing the impact of different grazing regimes on Box-Gum Grassy Woodland indicates that levels of degradation in remnants increase as grazing intensity from domestic stock increases, and that grazing regimes have a greater influence on remnant quality than does patch size (Prober and Thiele 1995). Sites subject to heavy grazing, particularly set-stocking, over long periods of time generally have lower native species diversity and consequently an increased dominance of exotic species (Lindsay and Cunningham 2009a). Grazing alters the structure and composition of the flora components of the ecological community by the selective grazing of more palatable species, trampling, soil compaction, changed soil nutrient status and weed invasion (McIntyre et al. 1993; Prober 1996). Grazing has also been shown to reduce the rate of litter decay, a crucial step in nutrient recycling (Lindsay 2008). The top soil for grazed sites is enriched with various forms of nitrogen and phosphorous (Lindsay and Cunningham 2009a). Reductions in the diversity of the woodland fauna assemblage can also be directly related to changes in plant species diversity and composition within remnants (Johnson and Beck 1988; Loyn 1991; Saunders 1994; Bromham 1999; Spark and Nadolny 2004). Thus, as a general rule, increasing the

level of grazing within a remnant is likely to degrade it further.

It has also been found that the history of grazing is as important as current use, as change in the soil structure to pre-grazing levels can be extremely long, i.e. 30 years plus (Lindsay and Cunningham 2009a).

However, it has long been accepted that if a strategic grazing regime is targeted at controlling weeds or thinning dense grass swards at particular times of the year, it can lead to improved plant species diversity and cover. Lunt et al. (2007) reviewed all the ecological factors that influence vegetation responses to grazing. The results of this investigation indicate that livestock grazing has the greatest potential to assist conservation outcomes in degraded sites on fertile soils, where grazing may promote native plant diversity by reducing the biomass of dominant species (native or exotic). In contrast, domestic stock grazing is likely to either have no effect or a negative impact where good condition vegetation exists on poorer soils. Lunt et al. (2007) provides a coarse flowchart to indicate where managed grazing may result in a positive conservation outcome. Further research is required to establish effective management of grazing regimes including when, where and how grazing might be useful in maintaining and/or enhancing the biodiversity values of remnants across the geographic distribution of the ecological community.

A study by Lindsay and Cunningham (2009b) found that sites with grazing removed had benefits for components of the invertebrate community, including beetles and for the process of litter decomposition.

Areas of Box-Gum Grassy Woodland which are principally managed for conservation may be impacted by over-abundant numbers of kangaroos where such grazing pressure is not appropriately managed. The ACT Government has commenced a study into the effects of kangaroo grazing on the structure and composition within Natural Temperate Grasslands and Box-Gum Grassy Woodland Ecological Communities.

### *Regrowth Thinning*

Without adequate regeneration to replace existing mature trees in remnants or scattered across paddocks, Box-Gum Grassy Woodland condition will deteriorate. Unfortunately tree regeneration is often seen by land managers as a threat to productivity by reducing the grazing capacity of an area. Stands of regenerating trees do self-thin over time as a result of competition for water and nutrient resources, disease, insect attack and catastrophic events (storms, floods and droughts). However, eucalypts are long-lived (potentially more than 300 years) and as a result this process is slow and often in conflict with human requirements.

While some manual thinning of prolific stands of eucalypt regrowth may be beneficial for agricultural production and potentially may mimic the natural process of self-thinning, further research is required to determine the amount of thinning that can be undertaken without impacting on the long-term viability of the ecological community.

### *Replanting*

Research has shown that remnant vegetation provides habitat for a different array of species than replanted areas (Montague-Drake 2008) and replanting should only be considered as value adding to remnant vegetation, not as a viable replacement. Replanted areas rarely duplicate the total function of the natural ecological community and differing habitat values may include structural complexity, tree hollows, fallen timber, vegetative litter, groundlayer composition/cover and soil nutrient/moisture regimes. Many of the values of remnant vegetation will be absent from areas of replanting for long periods of time (e.g. tree hollows need 80-150 years to form).

However, replanting of overstorey species will be necessary in many extensively cleared remnants to retain and restore function. The reintroduction of understorey seed will be

necessary to rehabilitate degraded remnants, as native seedbanks that are short-lived are exhausted and natural seed dispersal is no longer happening (Prober and Thiele 2005).

A "*Restoration Study*" undertaken by Lindenmayer in 2000 showed blocks of tree replanting within a mosaic of native grasslands, remnant woodland and paddock trees can provide important habitat for a range of fauna species (Montague-Drake 2008). This study confirmed that, in terms of provision of wildlife habitat, planting size and shape matters. The study also found that bigger blocks are better than smaller, and blocks are better than strips (Montague-Drake 2008).

A study on avifaunal collapse in woodlands in largely agricultural landscapes recommended restoration, including replanting, as most beneficial in the more-fertile areas, particularly those adjoining existing remnants (Mac Nally et al. 2009).

### *Development of Management Guidelines*

Various guidelines relating to the management of Box-Gum Grassy Woodland remnants have been developed to disseminate the findings of ecosystem function and management research to landholders and managers. These include:

- *"Wildlife on farms: how to conserve native wildlife"* (Lindenmayer et al. 2003);
- *"Managing native grassland: a guide to management for conservation, production and landscape protection"* (Eddy 2002);
- *"Managing native pastures for agriculture and conservation"* (Langford et al. 2004);
- *"Managing and Conserving Grassy Woodlands"* (McIntyre et al. 2002);
- *"Grassy Vegetation in North-western NSW and Guidelines for its Management and Conservation" (*Nadolny et al. 2003);
- *"Grassy Ecosystems Management Kit: A guide to Developing Conservation Management Plans."* (Sharp et al. 2005*)*;
- *"Birds in woodland remnants in the Central Lachlan Catchment: remnant characteristics and management guidelines"* (Briggs et al. 2003);
- "*Possible Management Actions for Box Gum Woodlands*" (Oliver et al. 2008);
- *"Grassy Woodland Threatened in the Goulburn Broken Catchment"* (DSE 2005a) and *"Grassy Woodland Threatened in the North East Catchment*- draft*"* (DSE 2005b); and
- *"Caring for our Country, Environmental Stewardship Box Gum Grassy Woodland Project, Field and Training Manual*" (DEWHA 2008a). In addition, Greening Australia is developing a *Box Gum Grassy Woodlands Land Managers Handbook* for DSEWPaC.

### *Summary of Ecosystem Function and Management Research Actions Undertaken to Date*

- Investigation into the impacts of various management actions on flora species composition of grassy ecosystems including fragmentation, grazing and burning.
- Research into the ecology and habitat requirements of some component species.

- Research, primarily in central and southern NSW into various restoration strategies/methods to improve species diversity/cover, habitat values and regeneration within degraded remnants.

- Investigation into the impact of the high threat weed, Coolatai Grass on component flora and fauna species.

- Investigation into the use of birds and reptiles as indicators of Box-Gum Grassy Woodland condition.

- Development of various management guidelines to assist landholders in the assessment, management and monitoring of grasslands and grassy woodlands.

- The development of "*Possible Management Actions for Box Gum Woodlands*" (Oliver et al. 2008) to maintain or improve the quality of remnants for inclusion in the Property Vegetation Planning - Threatened Species Assessment Tool (NSW);

## 8.5 Compliance and Regulatory Activities

The listing of Box-Gum Grassy Woodland as a "critically endangered" ecological community under the EPBC Act means that any activity (development or management) that is likely to have a significant impact on the ecological community must be referred to the Australian Government Minister for the Environment and undergo an environmental assessment and approval process. As a consequence, state and territory governments have been required to make provisions within their policy and planning processes in order to identify the community, assess these activities and minimise potential impacts.

Similarly, threatened component species of Box-Gum Grassy Woodland have been protected under state and territory legislation.

### *Summary of Strategic Planning, Compliance and Regulatory Actions Undertaken to Date*

- Listing of Box-Gum Grassy Woodland and a number of component species under Commonwealth and state/territory legislation which require Commonwealth, state, regional and local authorities/agencies to consider the impact of development activities.

- Preparation of action plans (ACT), recovery plans, Priorities Action Statements and threat abatement plans (Commonwealth, NSW) for threatened Box-Gum Grassy Woodland component species.

- Incorporation of threatened grassy woodland dependent species and Box-Gum Grassy Woodland as an endangered ecological community into the Property Vegetation Plan (PVP) decision support tools (NSW).

- Development by the Australian Government of minimum condition criteria and an assessment method to assist land managers in the identification of the listed ecological community (DEH 2006).

- Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands – a joint ACT/NSW initiative.

- Development of the Wodonga Retained Environment Network Strategy to protect native vegetation, largely Grassy Woodland EVC and the Box-Gum Grassy Woodlands and derived Grassland endangered community in peri-urban Wodonga (Davidson et al. 2006).

# PART C: RECOVERY PLAN - OBJECTIVES, PERFORMANCE CRITERIA AND ACTIONS

## 9. Recovery Plan Objectives

The overall objective of this recovery plan is to promote the recovery and prevent the extinction of the critically endangered ecological community, known as Box-Gum Grassy Woodland. The specific objective to be achieved within the life-span of this recovery plan is to minimise the risk of extinction of the ecological community through:

- achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- increasing protection of sites with high recovery potential;
- increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- increasing transitional areas around remnants and linkages between remnants; and
- bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

This objective will be achieved across the geographic distribution of Box-Gum Grassy Woodland and within five years of the adoption of this recovery plan.

## 10. Recovery Plan Actions

The recovery actions considered critical to achieving the objective and the performance criteria against which success or failure will be determined are outlined in Table 3.

As discussed, this recovery plan covers an ecological community which extends from southern Queensland to northern Victoria, involving four state/territory and Commonwealth jurisdictions. As a consequence of this large geographic area and the numerous tenures and land managers (government agencies, NGOs and private landholders) involved, specific responsibility for recovery actions has not been assigned.

This recovery plan seeks to build upon all the recovery actions and achievements to date. Improving baseline information regarding the extent and quality of Box-Gum Grassy Woodland is considered a priority under this recovery plan. Research and monitoring programs are essential to the implementation and currency of “best practice” management and critical to determining the success of recovery actions. The outcomes and learnings of research and management actions undertaken as part of implementing the plan will be fed back into modifying and re-prioritising recovery actions during the life of the plan.

Continuing support for the CMNs is also considered a priority under this recovery plan. This program will enable the delivery of numerous recovery actions (outlined in Table 3) in an efficient and cost effective manner, as well as provide coordination for other projects which may otherwise be undertaken independently. These networks are considered critical given the geographic extent, highly fragmented nature and number of government and private land-managers involved in the recovery of this ecological community. An independent network of extension officers has proven successful in liaising with private landholders and encouraging involvement in conservation of the ecological community.

Realistic and practical landholder incentives are also an essential part of encouraging widespread participation and cooperation from private landholders. These incentives may include council rate relief/rebates, pest and weed control grants, fencing grants, providing access to extension officers, best management practice or property management plans and stewardship payments.

## 11. Performance Criteria

The criteria against which these objectives will be measured are outlined in detail in Table 3. In general terms, however, the performance criteria for the objectives of this plan include:

- An increase in the area of the listed ecological community and degraded sites under conservation management agreements and/or within the formal reserve system;
- An increase in areas which meet the minimum condition criteria for the nationally listed ecological community;
- Maintenance of floristic diversity, structural complexity and ecological function of the ecological community across its distribution;
- A reduction in the level of specific threats;
- An improvement in the landscape connectivity for remnants of the listed ecological community; and
- An improvement in the overall condition of Box-Gum Grassy Woodland remnants within formally reserved areas, areas protected under various conservation agreements and priority areas on publicly managed land (e.g. TSRs, road reserves) across its geographic range.

## 12. Implementation Schedule

An indicative implementation schedule for the five year life of this recovery plan is outlined in Table 5.

## 13. Monitoring, Reporting and Review

The recovery plan will be formally reviewed by the Australian Government against the performance criteria outlined in Table 3 after five years from the commencement of the plan in order to determine the implementation of actions and their effectiveness.

**TABLE 3: RECOVERY ACTIONS AND PERFORMANCE CRITERIA TO ACHIEVE THE OBJECTIVES OF THE RECOVERY PLAN**

| **STRATEGY 1:** | **IMPROVE BASELINE INFORMATION** |
|---|---|
| **Recovery Actions:** | 1.1 Establish agreed protocols across jurisdictions for the assessment of Box-Gum Grassy Woodland condition in Year 1 of the recovery plan implementation, and apply these on an ongoing basis.<br><br>1.2 Share data and reporting between jurisdictions, government and non-government agencies.<br><br>1.3 Investigate the occurrence of Box-Gum Grassy Woodland in South Australia.<br><br>1.4 Collate existing survey and mapping data relating to Box-Gum Grassy Woodland into a central, updatable repository for use by stakeholder government agencies in mapping extent, protected areas and priority areas. Update repository on an annual basis.<br><br>1.5 Identify gaps in survey and mapping data across the predicted distribution of Box-Gum Grassy Woodland and engage communities and conduct future surveys to fill these gaps.<br><br>1.6 Investigate the further use of remote sensing and other assessment techniques to assist with the preceding actions and with Actions 2.2, 2.3 and 2.4.<br><br>1.7 Establish and apply protocols for non-technical monitoring[5] of remnant areas. These should include as many of the elements as possible of the condition assessment protocols developed in Action 1.1. These protocols are to reflect the condition assessment protocols developed under Action 1.1.<br><br>1.8 Identify gaps in current monitoring to ensure the geographic range and ecological variation within the ecological community is represented, and to coordinate implementation and analysis of all monitoring.<br><br>1.9 Improve baseline knowledge of condition and generate benchmark data against which sites can be assessed for management actions and cost effectiveness of revegetation ranked. |
| **Potential Contributors:** | State Government NRM agencies, Commonwealth DSEWPaC |
| **Partners:** | GBW CMN, Universities and research institutions, regional NRM agencies[6], NRM NGOs (e.g. Greening Australia, Friends of Grasslands, Landcare Groups, NCT, TFN Vic) |
| **Performance Criteria:** | • On-going improvement in the knowledge of the extent and quality of Box-Gum Grassy Woodland including the filling of information gaps as they become apparent.<br><br>• Review of vegetation data in South Australia undertaken.<br><br>• Data sharing, monitoring and reporting occurring across jurisdictions. |

[5] Monitoring that requires limited botanical experience
[6] Includes local government

**TABLE 3: RECOVERY ACTIONS AND PERFORMANCE CRITERIA TO ACHIEVE THE OBJECTIVES OF THE RECOVERY PLAN**

| **STRATEGY 2:** | **INCREASE PROTECTION OF BOX-GUM GRASSY WOODLAND** |
|---|---|
| **Recovery Actions:** | 2.1 Develop and implement an agreed strategy across jurisdictions for the establishment of a comprehensive, adequate and representative system of protected Box-Gum Grassy Woodland sites.<br><br>2.2 Identify gaps in current reserve and off-reserve conservation protection in representing the geographic and ecological variation within the ecological community.<br><br>2.3 Using results of Action 2.2, identify key Box-Gum Grassy Woodland sites to be considered for acquisition by government and non-government acquisition programs, including degraded areas for restoration.<br><br>2.4 Using results of Action 2.2, identify key sites important to the maintenance/improvement of landscape connectivity of Box-Gum Grassy Woodland remnants to be managed under conservation agreements or similar protection mechanisms.<br><br>2.5 Negotiate protection for identified sites through a range of NGO and Government in-perpetuity conservation and management agreements and protective covenants.<br><br>2.6 Continue to encourage provision and uptake of funding for incentive and long-term stewardship schemes that target protection of Box-Gum Grassy Woodland remnants, especially on private land.<br><br>2.7 Avoid where possible the conversion of public land containing Box-Gum Grassy Woodland to freehold and ensure it is managed appropriately.<br><br>2.8 Develop and implement management plans incorporating best practice management for priority Box-Gum Grassy Woodland sites, including all reserves and public land sites.<br><br>2.9 Develop quantitative targets for areas reserved, improved and managed for conservation purposes. |
| **Potential Contributors:** | Regional NRM agencies, State Government NRM agencies, Commonwealth DSEWPaC |
| **Partners:** | NRM NGOs (e.g. Greening Australia, Friends of Grasslands, Landcare Groups, NCT), CMNs, TFN (Vic) |
| **Performance Criteria:** | • Targets for areas reserved, improved and managed for conservation purposes met and an improved network connecting existing Box-Gum Grassy Woodland remnants is protected under reservation and/or conservation agreements across its geographic extent and incorporating the ecological variation within the ecological community.<br><br>• Land managers have access to and actively take up stewardship funding available for managing areas of Box-Gum Grassy Woodland for conservation outcomes. Areas are identified for targeted funding.<br><br>• On-going review of protection mechanisms, and where appropriate modification of preferred protection mechanisms in respect of monitoring and research results.<br><br>• Management plans for protected sites are prepared and implemented. |

**TABLE 3: RECOVERY ACTIONS AND PERFORMANCE CRITERIA TO ACHIEVE THE OBJECTIVES OF THE RECOVERY PLAN**

| **STRATEGY 3:** | **IMPROVE COMMUNITY ENGAGEMENT** |
|---|---|
| **Recovery Actions:** | 3.1. Support the continued operation of the CMNs in NSW, and extension of the GBW CMN into Queensland and the ACT including employment of a national coordinator. Support continued operations of CMNs or other effective groups in Victoria (via bioregional networks or priority area basis).<br><br>3.2. Employ 10 part-time facilitators across the geographic extent of Box-Gum Grassy Woodland to support land managers and facilitate the implementation of actions in this recovery plan. Close consultation with regional NRM agencies will be encouraged to avoid duplication of effort. Provide further training and support to current extension staff in the conservation of Box-Gum Grassy Woodland.<br><br>3.3. Develop and maintain a central database to support the implementation of the recovery plan including details of Box-Gum Grassy Woodland sites across the range of tenures and jurisdictions, details of conservation agreements/reservation areas, management activities, monitoring results and details of other initiatives as deemed appropriate.<br><br>3.4. Educate stakeholders in the identification, management, monitoring and benefits of Box-Gum Grassy Woodland remnants, including local government and state government infrastructure management agencies, through the distribution of information material, newsletters, exhibits at field days, workshops and training.<br><br>3.5. Identify Aboriginal interest in Box-Gum Grassy Woodland sites and facilitate Indigenous involvement in conservation management of remnant Box-Gum Grassy Woodland on Aboriginal and public land for the 5 year duration of the recovery plan.<br><br>3.6. Install markers and signs, including utilising current signage programs, to indicate the location of high quality occurrences of Box-Gum Grassy Woodland along linear reserves including: roads, tracks, rail and utility easements. |
| **Potential Contributors:** | CMNs, state NRM agencies and regional NRM agencies |
| **Partners:** | Regional NRM agencies, Indigenous organisations, public land management agencies, weeds councils, utility agencies, local government, schools, Landcare groups |
| **Performance Criteria:** | • Funding for the CMNs is secure and on-going.<br><br>• CMN activities extended into Victoria and Queensland.<br><br>• CMN facilitators are employed in partnership with regional NRM agencies and the GBW CMN across the extent of Box-Gum Grassy Woodland.<br><br>• A central database is maintained to track protection, management and/or restoration of Box-Gum Grassy Woodland sites. All jurisdictions/tenures contributing to the stored information, for use by all relevant agencies.<br><br>• Effective communication/education programs are delivered.<br><br>• Increasing land manager, community and Indigenous involvement in Box-Gum Grassy Woodland conservation and increasing numbers accessing incentive and stewardship funding for Box-Gum Grassy Woodland conservation management.<br><br>• An increasing number of land managers are implementing “best practice” management on Box-Gum Grassy Woodland sites.<br><br>• Increased area and number of locations managed and achieving an improvement in extent and condition. |

**TABLE 3: RECOVERY ACTIONS AND PERFORMANCE CRITERIA TO ACHIEVE THE OBJECTIVES OF THE RECOVERY PLAN**

| **STRATEGY 4:** | **CONTINUE ECOSYSTEM FUNCTION AND MANAGEMENT RESEARCH** |
|---|---|
| **Recovery Actions:** | 4.1. Investigate the long-term effects of management activities (e.g. grazing, fire regimes, mowing/slashing, fertilising, chemical use, regeneration, hydrology and drainage, feral animal control, weed control and prevention, cultivation), through research and monitoring of Box-Gum Grassy Woodland at selected sites across its range.<br><br>4.2. Identify best practice models from existing research and individual site success (e.g. GBW CMN and Action 3.3) to promote to stakeholders.<br><br>4.3. Identify sites with high recovery potential and target restoration at these remnants for cost-effectiveness. Ensure identified sites cover a range of condition states (see Appendix 3) so that cost effective models are investigated to improve functionality (transition of State 3 to State 2) and to restore understorey species (transition of State 2 to State 1).<br><br>4.4. Investigate the impact of high threat weeds on component species and develop control methods that will not adversely impact the existing diversity in Box-Gum Grassy Woodland. Nominate high threat weeds not already listed for noxious weed status in each jurisdiction.<br><br>4.5. Survey and analyse the distribution of component species other than vascular plants, (e.g. invertebrates, reptiles, birds and non-vascular plants), to gain an understanding of geographic variations and ecological relationships, and their management needs. Investigate the potential to develop faunal groups as indicators of condition. Incorporate research results into management practices including any regional differences.<br><br>4.6. Monitor condition and diversity of protected sites under varying management regimes. Identify regional differences and causes.<br><br>4.7. Continue to disseminate research results to stakeholders. Link with other organisations and programs (e.g. Greening Australia, Friends of Grasslands, Landcare Groups, NCT) to develop, promote and facilitate "best management" practice. |
| **Potential Contributors:** | Universities and research institutions, State Government NRM agencies, regional NRM agencies, NRM NGOs, DSEWPaC |
| **Partners:** | Public land management agencies, rural fire services, universities and research organisations, weed councils, private land managers, NRM NGOs (e.g. Greening Australia, Friends of Grasslands, Landcare groups, NCT), CMNs |
| **Performance Criteria:** | • "Best practice" guidelines are dynamic and continue to be updated and informed by research and stakeholder experience. Results of all research projects are documented and "best practice" guidelines widely distributed.<br><br>• Monitoring programs are in place and results show an improvement in the quality (condition) of protected Box-Gum Grassy Woodland sites.<br><br>• Further sites are identified for recovery actions and restoration guidelines prepared.<br><br>• Restoration activities based on vegetation condition/habitat enhancement are underway.<br><br>• Current approaches to landscape restoration validated, particularly models for where to increase the extent and connection of remnants. |

**TABLE 3: RECOVERY ACTIONS AND PERFORMANCE CRITERIA TO ACHIEVE THE OBJECTIVES OF THE RECOVERY PLAN**

| **STRATEGY 5:** | **IMPROVE COMPLIANCE AND REGULATORY ACTIVITIES** |
|---|---|
| **Recovery Actions:** | 5.1. Develop and implement a strategy to:<br>• enhance the understanding of government and non-government organisations regarding Box-Gum Grassy Woodland conservation issues; and<br>• improve consideration of Box-Gum Grassy Woodland conservation in the development consent process and/or in local/regional planning (e.g. CMA, local councils, LHPAs, government agencies).<br>5.2. Integrate conservation issues associated with Box-Gum Grassy Woodland with other landscape conservation programs (e.g. land degradation, salinity control and biodiversity programs).<br>5.3. Require development assessments to be undertaken by qualified ecologists, at an appropriate time of year. |
| **Potential Contributors:** | Commonwealth DSEWPaC, state NRM and regional NRM agencies |
| **Partners:** | Local government, regional NRM agencies, public land management agencies, utility authorities, rural fire services |
| **Performance Criteria:** | • Box-Gum Grassy Woodland is identified as a threatened ecological community in all relevant landscape conservation programs, regional strategies and other planning documents, (e.g. CAPs, local environment plans, regional catchment strategies, biodiversity action plans, water sharing plans)<br>• No net loss of Box-Gum Grassy Woodland incorporated as a principle in all relevant environmental plans, as indicated by monitoring data from Action 4.6<br>• Relevant Local and State government bodies have developed policies and plans that identify Box-Gum Grassy Woodland remnants as areas of high conservation value and direct resources to manage areas accordingly.<br>• An assessment/management guide suitable for non-specialist decision-makers has been developed and distributed to all organisations.<br>• Deficiencies in legislation and regional planning frameworks are documented and where applicable recommendations for change are made to relevant government agency.<br>• Assessment standards for assessment of Box-Gum Grassy Woodlands and a process to decline inadequate reports. |

# PART D: MANAGEMENT PRACTICES

As outlined in Section 7, on-going clearing, fragmentation and degradation are the major threats to this ecological community. The biodiversity within Box-Gum Grassy Woodland lies predominantly in the grassy groundlayer, hence the importance ascribed to derived grasslands in the listing of this ecological community. Management practices within, and/or adjacent to, remnant areas of Box-Gum Grassy Woodland can significantly impact on floristic cover and composition and fauna habitat values of the ecological community.

## 14. Guide for Decision Makers

In determining whether proposed development activities may have a significant impact on Box-Gum Grassy Woodland, decision makers should refer to the Listing Advice (TSSC 2006) and the EPBC Act Policy Statement on *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DEH 2006). This document provides information to aid decision makers in determining the presence of the listed ecological community on a site, how to assist recovery, and examples of activities that may potentially have a significant impact on the ecological community and thus require environmental assessment.

### 14.1 Management Practices Essential to the Maintenance and/or Improvement of Box-Gum Grassy Woodland

In determining whether proposed development activities may have a significant impact on the ecological community, decision makers (consent authorities and/or regional planning agencies) should consider the site management practices in Table 4 below. These practices are considered essential to the recovery of Box-Gum Grassy Woodland, as they provide for the on-going survival and reproduction of the suite of flora and fauna species which comprise the ecological community. Development activities which will potentially lead to a change in any one of these conditions within, or adjacent to, an area of Box-Gum Grassy Woodland could have a significant impact on the listed ecological community. Such developments require referral for environmental assessment and approval under the EPBC Act.

Many of the impacts associated with development activities can be reduced if they are considered at the planning stage. For example, ensuring developments are restricted to previously cleared land and/or degraded sites, providing adequate buffers between urban/rural residential/agricultural development and remnant vegetation and/or placing controls on the ownership of domestic pets in subdivisions that adjoin remnants. Decision makers should also note that the management practices outlined in Table 4 will further facilitate the improvement of degraded areas of Box–Gum Grassy Woodland.

| TABLE 4: Current Best Practice Site Management Practices for the Continued Existence of Box-Gum Grassy Woodland | |
|---|---|
| **Maintain or improve soil conditions** | • Avoid physical disturbance (e.g. cultivation, ripping, excavation).<br>• Avoid chemical changes (e.g. use of fertilisers or soil ameliorants).<br>• Avoid soil compaction from vehicles/machinery or stock camps. |
| **Maintain or improve drainage conditions / existing hydrological regime** | • Do not direct run-off (from roads, urban developments, contour banks) into remnant areas.<br>• Do not divert existing run-on from remnant areas (e.g. diversion drains). |
| **Control exotic plant introductions** | • Prevent the introduction of exotic pasture species (i.e. pasture improvement).<br>• Prevent the introduction of non-indigenous native species.<br>• Ensure machinery hygiene protocols are implemented to prevent the spread of weeds.<br>• Prevent the stockpiling of topsoil or overburden within remnant areas.<br>• Implement a weed control program to control weed invasion, wildlings from adjacent tree plantings (e.g. Radiata Pine and European Olives) and garden escapees. Implement a buffer zone to help control weed introductions and protect remnant from herbicide drift. |
| **Avoid inappropriate native tree planting** | • Do not plant indigenous native trees/shrubs in high quality and/or small derived grassland sites.<br>• Use high quality seed. Where practical this should be of local provenance, but high quality non-local seed should be used in preference to low quality local seed.<br>• Plant trees and shrubs at natural grassy woodland densities. |
| **Maintain or improve connectivity** | • Ensure existing links are maintained between Box-Gum Grassy Woodland remnants and/or between Box-Gum Grassy Woodland and other native vegetation types, for example grassland, woodland, forest, riparian and/or wetlands.<br>• Expand sites to increase viability where possible. |
| **Avoid excessive shading** | • Prevent changes which will result in prolonged shading (e.g. dense tree plantings). |
| **Maintain or improve structural diversity** | • Prevent the removal of regenerating trees and shrubs within remnant patches.<br>• Prevent firewood collection or the “tidying up” of fallen dead timber and leaf litter.<br>• Prevent rock removal.<br>• Prevent the removal of standing dead hollow trees.<br>• Maintain complete structure of woodland without allowing a full canopy to develop, shading out understorey species. |
| **Ensure adequate buffers are retained** | • Protect areas of Box-Gum Grassy Woodland from adjacent land use (e.g. urban and agricultural development) that may potentially impact on its integrity. |

| TABLE 4: | Current Best Practice Site Management Practices for the Continued Existence of Box-Gum Grassy Woodland |
|---|---|
| **Minimise chemical use** | • Weed control should use spot-spraying, basal spraying, stem injection or cut and paint application methods.<br>• Avoid overspray and minimise impacts on non-target species.<br>• Monitor treated areas to ensure weeds do not establish on any resultant bare patches. |
| **Implement strategic grazing** | • Ensure remnant areas are rested at appropriate times, for example when perennial native ground cover species are flowering and seeding.<br>• Limit grazing during drought periods.<br>• Grazing levels should not be increased above historical levels. Where a site has never before been grazed by livestock, an alternative (e.g. fire, no intervention) should be used for management.<br>• Maintain a minimum of 80% ground cover at all times and biomass at an appropriate level to the region and season. Monitor outcomes to determine effectiveness and adapt management efforts. |
| **Implement appropriate burning regimes** | • The minimum fire interval suggested for Box-Gum Grassy Woodlands is five years, with a maximum interval of 40 years[7]. Fire regimes implemented should have regard to the floristic composition and condition of the remnant. For example, remnants dominated by Snow Grass and Kangaroo Grass were found to regenerate well with autumn burning cycles approximately every 5-8 years, where this had historically occurred (Prober et al. 2008). Such high frequency burning cycles may negatively impact other native species, however, and further research is required before burning regimes can be explicitly determined.<br>• Any burning should be applied to remnants in mosaics (i.e. burning small areas at staggered intervals) to allow survival of soil and ground fauna (including invertebrates, amphibians and reptiles) and promote diversity in the states of the ecological community.<br>• Sites where burning is practiced should retain unburnt areas, to provide refuges for species of fauna and flora that may be intolerant of fire.<br>• Timing of burns must be considered in relation to the flowering and seeding of native and exotic species. Where possible burns should be carried out after natives have seeded but before weeds flower and seed.<br>• Be aware that some weed species (e.g. Coolatai Grass) increase with burning. |

[7] Adaptive Management Guidelines for Box Gum Grassy Woodlands, produced by the NSW Department of Environment, Climate Change and Water and the Grassy-Box Woodland Conservation Management Network. Available at http://gbwcmn.net.au/files/AdaptiveManagement09.pdf .
The NSW Rural Fire Service also provides fire thresholds for Vegetation Categories – see individual Bush Fire Risk Management Plans at http://www.rfs.nsw.gov.au/dsp_content.cfm?cat_id=1040

| TABLE 4: Current Best Practice Site Management Practices for the Continued Existence of Box-Gum Grassy Woodland | |
|---|---|
| **Avoid inappropriate mowing / slashing** | • If mowing/slashing is used to reduce biomass within remnants and increase species diversity, it should be carried out sporadically, and in a mosaic pattern to allow for the retention of refuges for tall tussock grasses, regenerating overstorey and groundlayer dependent fauna as well as habitat features (such as fallen logs, litter). The height of the slasher must be sufficient to maintain enough cover to offer native fauna species protection.<br>• Mow/slash at appropriate times (e.g. late summer or autumn after native ground layer plants have seeded and become dormant).<br>• On-road sides, only mow areas essential for visibility and safety, in most cases this will be to the table drain. Mow from clean areas out.<br>• Ensure machinery hygiene protocols are implemented to avoid the spread of weeds. |
| **Control feral animals** | • Protect native fauna and flora populations by controlling feral predators; foxes, dogs, cats, pigs within and/or adjacent to remnant areas.<br>• Do not push fallen or felled timber into stacks or windrows within remnant areas as these form harbours for foxes, cats and rabbits.<br>• If ripping is used to control rabbits within remnants ensure machinery hygiene procedures are adhered to, and ripped areas are monitored to prevent weed infestations.<br>• Protect native flora by controlling feral grazers (e.g. rabbits, goats and deer) within remnants. Erecting appropriate fencing (e.g. fencing of stock dams, individual guards for targeted threatened plants) may help. |
| **Exclude commercial apiary sites** | • Do not permit commercial apiarists to place bee hives within the area. Landholders should not allow the placement of bees on their property within 3 km of the remnant. |

## TABLE 5: Implementation and Costing Table for Recovery Actions Identified for Box-Gum Grassy Woodland

| | | Estimated Costs / Year in $ Thousands | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Action No** | **Action Title** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total Cost** | **Priority[1]** | **Potential Contributors** |
| 1.1 | Establish agreed protocols for the assessment of Box-Gum Grassy Woodland condition and apply on an on-going basis. | 20 | + | + | + | + | **20** | 1 | • CMNs<br>• State and regional NRM agencies<br>• Universities and research organisations |
| 1.2 | Share data and reporting between jurisdictions, government and NGOs. | # | # | # | # | # | | 1 | • All levels of government<br>• NGOs |
| 1.3 | Investigate the occurrence of Box-Gum Grassy Woodland in South Australia. | # | | | | | | 1 | • Commonwealth and SA Government |
| 1.4 | Collate existing survey and mapping data to produce an updatable map of extent, protected areas and priority areas for landscape connectivity. | 100 | 100 | 10 | 10 | 10 | **230** | 1 | • Commonwealth and state NRM agencies |
| 1.5 | Identify gaps in survey and assessment data. | See Action 1.3 | See Action 1.3 | See Action 1.3 | See Action 1.3 | See Action 1.3 | | 2 | • State NRM agencies<br>• Industry groups |
| 1.6 | Investigate the further use of remote sensing and other assessment techniques to assist with above. | See Action 1.3 | See Action 1.3 | See Action 1.3 | See Action 1.3 | See Action 1.3 | | 2 | • State NRM agencies |
| 1.7 | Establish agreed protocols for monitoring of remnant areas by non-technical stakeholders. These protocols are to reflect the condition assessment protocols developed under Action 1.1. | 10 | + | + | + | + | **10** | 1 | • State and regional NRM agencies<br>• Universities and research organisations |
| 1.8 | Identify gaps in current monitoring to ensure the geographic range and ecological variation within the ecological community is represented, and to coordinate implementation and analysis of all monitoring. | 10 | + | + | + | + | **10** | 1 | • CMNs<br>• State and regional NRM agencies |
| 1.9 | Improve baseline knowledge of condition and generate benchmark data against which sites can be assessed for management actions and cost effectiveness of revegetation ranked. | + | + | + | + | + | | 3 | • State NRM agencies |

[1] Priority ratings: 1= Action critical to meeting plan objectives, 2= Action contributing to meeting plan objectives, 3= Action desirable but not essential to the plan.

# Costs of this action are covered as part of Action 3.1 and 3.2.

+ No direct costs are estimated for the plan, but the action must be considered by all relevant authorities and organisations.

## TABLE 5: Implementation and Costing Table for Recovery Actions Identified for Box-Gum Grassy Woodland

| Action No | Action Title | Estimated Costs / Year in $ Thousands | | | | | | Priority[1] | Potential Contributors |
|---|---|---|---|---|---|---|---|---|---|
| | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total Cost | | |
| | | | | | | | | | |
| 2.1 | Develop and implement an agreed strategy across jurisdictions for the establishment of a comprehensive, adequate and representative system of protected Box-Gum Grassy Woodland. | 20 | + | + | + | + | **20** | 1 | • State NRM agencies<br>• Universities and research organisations |
| 2.2 | Using results from Action 1.4 Identify gaps in current reserve and off-reserve conservation protection in representing the geographic range and ecological variation within the ecological community. | 150 | 150 | + | + | + | **300** | 1 | • State and regional NRM agencies<br>• Universities and research organisations<br>• NGOs |
| 2.3 | Using results of Action 2.2 identify key sites to be acquired by acquisition programs. | See Action 2.2 | See Action 2.2 | See Action 2.2 | See Action 2.2 | See Action 2.2 | | 1 | • State and regional NRM agencies<br>• Universities and research organisations<br>• NGOs |
| 2.4 | Using results of Action 2.2 identify key sites important to the maintenance/improvement of the landscape connectivity of Box-Gum Grassy Woodland remnants. | See Action 2.2 | See Action 2.2 | See Action 2.2 | See Action 2.2 | See Action 2.2 | | 1 | • State and regional NRM agencies<br>• Universities and research organisations<br>• NGOs |
| 2.5 | Negotiate the protection of key sites through a range of management agreements and protective covenants. | # | # | # | # | # | | 1 | • State and regional NRM agencies<br>• NGOs |
| 2.6 | Encourage provision of funding for incentive and long-term stewardship schemes. | #/+ | #/+ | #/+ | #/+ | #/+ | | 1 | • All levels of government |
| 2.7 | Discourage the conversion of public land containing Box-Gum Grassy Woodland to freehold and ensure it is managed appropriately. | + | + | + | + | + | | 1 | • All levels of government |
| 2.8 | Develop and implement management plans for priority Box-Gum Grassy Woodland sites, including all reserves and public land sites. | 100 | 100 | 100 | + | + | **300** | 1 | • State and regional NRM agencies<br>• NGOs<br>• CMNs |
| 2.9 | Develop targets for areas reserved, improved and managed for conservation purpose. | + | + | + | + | + | | 2 | • State and regional NRM agencies<br>• NGOs<br>• CMAs |

[1] Priority ratings: 1= Action critical to meeting plan objectives, 2= Action contributing to meeting plan objectives, 3= Action desirable but not essential to the plan

## TABLE 5: Implementation and Costing Table for Recovery Actions Identified for Box-Gum Grassy Woodland

| Action No | Action Title | Estimated Costs / Year in $ Thousands | | | | | | Priority[1] | Potential Contributors |
|---|---|---|---|---|---|---|---|---|---|
| | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total Cost | | |
| # Costs of this action are covered as part of Action 3.1 and 3.2 + No direct costs are estimated for the plan, but the action must be considered by all relevant authorities and organisations | | | | | | | | | |
| 3.1 | Employ GBW CMN coordinator. | 80 | 83.2 | 86.5 | 89.9 | 93.5 | **433.1** | 1 | • State NRM agencies |
| | CMN operating costs. | 150 | 154.5 | 159.1 | 163.9 | 168.8 | **796.3** | 1 | • State NRM agencies |
| 3.2 | Employ 10 CMN facilitators (P/T) across Box-Gum Grassy Woodland extent to co-ordinate CMN activities. | 300 | 309 | 318.2 | 327.8 | 337.6 | **1592.6** | 1 | • State NRM agencies |
| 3.3 | Database development. | 30 | | | | | **30** | 1 | • State NRM agencies |
| | On-going database maintenance. | 10 | 10 | 10 | 10 | 10 | **50** | 1 | • State NRM agencies |
| 3.4 | Develop communication and education strategies. | # | # | # | # | # | | 1 | • CMNs |
| | Educate stakeholders. | 100 | 100 | 100 | 100 | 100 | **500** | 1 | • CMNs<br>• State and regional NRM agencies* |
| 3.5 | Identify Aboriginal interests in Box-Gum Grassy Woodland sites. | 50 | #/+ | #/+ | #/+ | #/+ | **50** | 2 | • CMNs<br>• Regional NRM agencies |
| | Facilitate Indigenous involvement in conservation management. | # | # | # | # | # | | 2 | • CMNs<br>• Regional NRM agencies<br>• Local Indigenous organisations |
| 3.6 | Install markers and signs. | 10 | 10 | 10 | 10 | 10 | **50** | 3 | • CMNs<br>• State NRM agencies |

[1] Priority ratings: 1= Action critical to meeting plan objectives, 2= Action contributing to meeting plan objectives, 3= Action desirable but not essential to the plan

# Costs of this action are covered as part of Action 3.1 and 3.2 * Regional NRM includes local government

+ No direct costs are estimated for the plan, but the action must be considered by all relevant authorities and organisations

## TABLE 5: Implementation and Costing Table for Recovery Actions Identified for Box-Gum Grassy Woodland

| | | Estimated Costs / Year in $ Thousands | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Action No** | **Action Title** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total Cost** | **Priority[1]** | **Potential Contributors** |
| | | | | | | | | | |
| 4.1 | Investigate long-term impacts of management activities. | 200 | 200 | 200 | 200 | 200 | **1000** | 1 | • State and regional NRM agencies<br>• Universities and research organisations |
| 4.2 | Identify sites where current management practices are beneficial to biodiversity and promote these sites as models. | # | # | # | # | # | | 1 | • CMNs<br>• Universities and research organisations<br>• Regional NRM agencies |
| 4.3 | Investigate cost effective restoration techniques. | 250 | 250 | 250 | 250 | 250 | **1250** | 1 | • Commonwealth and state NRM agencies,<br>• Universities and research organisations<br>• NGOs |
| 4.4 | Identify high threat weeds and develop appropriate control methods. | 100 | 100 | 100 | + | + | **300** | 1 | • State and regional NRM agencies,<br>• Universities and research organisations |
| 4.5 | Survey and analyse the distribution of component species other than vascular plants to gain an understanding of their ecology and management needs, and potential use as condition indicators. | 200 | 200 | 200 | + | + | **600** | 2 | • State NRM agencies<br>• Universities and research organisations |
| 4.6 | Monitor condition and diversity of protected sites under varying management regimes. Identify any regional difference in Box-Gum Grassy Woodland ecological community response to management. | + | + | + | + | + | | 2 | • State and regional NRM agencies<br>• Universities and research organisations |
| 4.7 | Disseminate research results to stakeholders. Link with other organisations and programs to develop, promote and facilitate “best management” practice. | #/+ | #/+ | #/+ | #/+ | #/+ | | 1 | • GBW CMN<br>• Universities and research organisations<br>• State and regional NRM agencies |

[1] Priority ratings: 1= Action critical to meeting plan objectives, 2= Action contributing to meeting plan objectives, 3= Action desirable but not essential to the plan

# Costs of this action are covered as part of Action 3.1 and 3.2 + No direct costs are estimated for the plan, but the action must be considered by all relevant authorities and organisations

## TABLE 5: Implementation and Costing Table for Recovery Actions Identified for Box-Gum Grassy Woodland

| | | Estimated Costs / Year in $ Thousands | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Action No** | **Action Title** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total Cost** | **Priority[1]** | **Potential Contributors** |
| 5.1 | Develop and implement a strategy to enhance the understanding of government and non-government organisations regarding Box-Gum Grassy Woodland conservation issues and improve consideration of Box-Gum Grassy Woodland conservation in the development consent process and/or in local/regional planning. | #/+ | #/+ | #/+ | #/+ | #/+ | | 1 | • CMNs<br>• All levels of government |
| 5.2 | Integrate Box-Gum Grassy Woodland conservation issues with other landscape conservation programs. | + | + | | | + | | 2 | • All levels of government |
| 5.3 | Require development assessments to be undertaken by qualified ecologists, at an appropriate time of year. | + | + | + | + | + | | 2 | • All levels of government |
| | **Total** | **1890** | **1766.7** | **1543.8** | **1161.6** | **1179.9** | **7542** | | |

[1] Priority ratings: 1= Action critical to meeting plan objectives, 2= Action contributing to meeting plan objectives, 3= Action desirable but not essential to the plan

# Costs of this action are covered as part of Action 3.1 and 3.2

+ No direct costs are estimated for the plan, but the action must be considered by all relevant authorities and organisations

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# Appendix 1: Important Species for Box-Gum Grassy Woodland

This species list identifies selected important plant species found in the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999* that indicate that the community is in good condition. The species list was developed to complement the Listing Information Guide, and should be read in that context (Rehwinkel unpublished; Nadolny unpublished). Note that some species are useful indicators for only part of the range of the ecological community and this is indicated where possible. Further work is required to develop indicator lists for each IBRA region.

| SCIENTIFIC NAME | SYNONYM | COMMON NAME | REGION |
|---|---|---|---|
| **FERNS** | | | |
| *Cheilanthes distans* | | Bristly Cloak Fern | Southern NSW indicator |
| **GRASSES** | | | |
| *Cymbopogon refractus* | | Barbed Wire Grass | |
| *Dichanthium sericeum* | | Queensland Blue-grass | |
| *Dichanthium setosum* | | | Northern NSW indicator |
| *Digitaria porrecta* | | Finger Panic Grass | Northern NSW indicator |
| *Eulalia aurea* | | (Bory) Kunth | Northern NSW indicator |
| *Sorghum leiocladum* | | Wild Sorghum | |
| *Themeda australis* | (*Themeda triandra*) | Kangaroo Grass | |
| **HERBS** | | | |
| *Ajuga australis* | | Australian Bugle, Austral Bugle | Southern NSW indicator |
| *Ammobium craspedioides* | | Yass Daisy | |
| *Arachnorchis* spp. | | Spider Orchids | |
| *Arthropodium milleflorum* | | Vanilla-lily, Pale Vanilla-lily | |
| *Arthropodium minus* | | Small Vanilla Lily | |
| *Asperula conferta* | | Common Woodruff | Southern NSW indicator |
| *Asperula scoparia* | | Prickly Woodruff | |
| *Brachyscome diversifolia* | (*Brachycome diversifolia*) | Large-headed Daisy | |
| *Brachyscome graminea* | (*Brachycome graminea*) | Grass Dairy | |
| *Brachyscome multifida* | (*Brachycome multifida*) | Cut-leaved Daisy | |
| *Brachyscome rigidula* | (*Brachycome rigidula*) | Leafy Daisy | |
| *Brachyscome spathulata* | (*Brachycome spathulata*) | Spoon Daisy | |
| *Brunonia australis* | | Pincushion, Blue Pincushion | |
| *Bulbine bulbosa* | | Bulbine Lily, Native Onion, Native Leek, Golden Lily | |
| *Bulbine glauca* | | Rock Lily | |

| SCIENTIFIC NAME | SYNONYM | COMMON NAME | REGION |
|---|---|---|---|
| *Burchardia umbellata* | | Milkmaids | |
| *Caesia calliantha* | | Blue Grass-Lily | |
| *Calocephalus citreus* | | Lemon Beauty-heads | |
| *Calochilus robertsonii* | | Purplish Beard Orchid | |
| *Calochilus* spp. | | Beard Orchids | |
| *Calotis scabiosifolia* var *integrifolia* | | Rough Burr-daisy | |
| *Chrysocephalum apiculatum* | | Yellow Buttons, Common Everlasting | |
| *Chrysocephalum semipapposum* | | Clustered Everlasting, Yellow Buttons | |
| *Craspedia variabilis* | | Billy Buttons | |
| *Desmodium brachypodum* | | Large Tick-trefoil | |
| *Desmodium varians* | | Slender Tick-trefoil | Southern NSW indicator |
| *Dianella longifolia* | | Smooth Flax Lily | |
| *Dianella revoluta* | | Blueberry Lily, Black-Anther Flax-Lily, Spreading Flax-Lily, Blue Flax-Lily | |
| *Dichopogon fimbriatus* | | Chocolate Lily, Nodding Chocolate Lily | |
| *Dipodium punctatum* | | Hyacinth Orchid, Pink Hyacinth Orchid | |
| *Diuris chryseopsis* | | Common Golden Moths, Small Snake Orchid | |
| *Diuris dendrobioides* | | Long-tail Purple Diuris, Wedge Diuris | |
| *Diuris maculata* | | Leopard Orchid, Nanny Goats, Leopard Diuris, Spotted Double-tail | |
| *Diuris punctata* | | Purple Donkey-orchid, Purple Double-tails, Purple Diuris, Purple Cowslip, Dotted Double tails | |
| *Diuris semilunulata* | (*Diuris maculata*) | Donkey-ears | |
| *Diuris sulphurea* | | Tiger Orchid, Hornet Orchid | |
| *Eriochilus cucullatus* | | Parson's Bands | |
| *Eryngium ovinum* | (*Eryngium rostratum*) | Blue Devil | |
| *Galium gaudichaudii* | | Rough Bedstraw | |

| SCIENTIFIC NAME | SYNONYM | COMMON NAME | REGION |
|---|---|---|---|
| *Genoplesium* spp. | | Midge Orchids | |
| *Glycine clandestina* | | Twining Glycine | |
| *Glycine tabacina* | | Glycine Pea, Variable Glycine | |
| *Goodenia hederacea* | | Forest Goodenia, Ivy Goodenia | Southern NSW indicator |
| *Goodenia pinnatifida* | | Scrambled Eggs, Cut-leaf Goodenia | |
| *Hymenochilus bicolor* | (*Pterostylis bicolor*) | Bicolor Greenhood | |
| *Hymenochilus cycnocephalus* | (*Pterostylis cycnocephala*) | Swan Greenhood | |
| *Hymenochilus muticus* | (*Pterostylis mutica*) | Midget Greenhood, Blunt Greenhood, Dwarf Greenhood | |
| *Hypericum gramineum* | | Small St John's Wort | |
| *Isoetopsis graminifolia* | | Grass Cushion | |
| *Laxmannia gracilis* | | Slender Wire-Lily | |
| *Leptorhynchos elongatus* | (*Leptorhynchus elongatus*) | Lanky Buttons, Hairy Buttons | |
| *Leptorhynchos squamatus* | (*Conyza squamata, Chrysocoma squamata, Leptorhynchus squamatus*) | Scaly Buttons | |
| *Leucochrysum albicans* | | Hoary Sunray | |
| *Linum marginale* | | Wild Flax, Native Flax | |
| *Lotus australis* | | Austral Trefoil, Australian Trefoil | |
| *Microseris lanceolata* | | Yam Daisy, Murnong | |
| *Microtis parviflora* | | Slender Onion Orchid | |
| *Microtis unifolia* | | Common Onion Orchid, Onion Orchid | |
| *Oreomyrrhis eriopoda* | | Australian Carraway | |
| *Plantago gaudichaudii* | | Narrow-leaf Native Plantain, Narrow Plantain | |
| *Plantago varia* | | Variable Plantain, Small Plantain, Sagoweed | |
| *Podolepis jaceoides* | | Showy Copper-wire Daisy | |
| *Polygala japonica* | | Dwarf Milkwort | |
| *Poranthera microphylla* | | Small Poranthera, Small-leaved Poranthera | Southern NSW indicator |
| *Prasophyllum petilum* | | Tarengo Leek Orchid | |
| *Prasophyllum* spp. | | Leek Orchids | |
| *Ptilotus spp.* | | Hairy Tails, Hairy Heads | |

| SCIENTIFIC NAME | SYNONYM | COMMON NAME | REGION |
|---|---|---|---|
| *Ranunculus lappaceus* | | Common Buttercup, Australian Buttercup | |
| *Rutidosis leptorrhynchoides* | | Button Wrinklewort | |
| *Rutidosis multiflora* | | Small Wrinklewort | |
| *Sebaea ovata* | | Yellow Centaury | |
| *Sida corrugata* | | Corrugated Sida | Southern NSW indicator |
| *Stackhousia monogyna* | | Creamy Candles, Creamy Stackhousia | |
| *Stylidium graminifolium* | | Grass Trigger-plant | |
| *Stypandra glauca* | | Nodding Blue Lily | |
| *Swainsona galegifolia* | | Smooth Darling Pea | |
| *Swainsona oroboides* | | Variable Swainson-pea | |
| *Swainsona queenslandica* | | Smooth Darling Pea | |
| *Swainsona recta* | | Mountain Swainson-pea, Small Purple-pea | |
| *Swainsona reticulata* | | Kneed Swainson-pea | |
| *Swainsona sericea* | | Silky Swainson-pea | |
| *Thelymitra malvina* | | Mauve-tuft Sun-orchid, Sun-orchid | |
| *Thelymitra pauciflora* | | Slender Sun-orchid, Few-flowered Sun-orchid | |
| *Thelymitra rubra* | | Pink Sun-orchid, Salmon Sun-orchid, Red Sun-orchid | |
| *Thysanotus patersonii* | | Twining Fringe-lily | |
| *Thysanotus tuberosus* | | Common Fringe-lily | |
| *Tricoryne elatior* | | Yellow Rush-lily, Yellow Autumn-lily | |
| *Triptilodiscus pygmaeus* | (*Helipterum australe*) | Austral Sunray, Common Sunray | |
| *Velleia paradoxa* | | Spur Velleia | |
| *Viola betonicifolia* | | Showy Violet, Arrow-head Violet, Native Violet, Purple Violet | Southern NSW indicator |
| *Wurmbea dioica* | (*Anguillaria dioica*) | Early Nancy | |
| *Zornia dyctiocarpa* | | Zornia | |
| **SHRUBS** | | | |
| *Acacia decora* | | Western Silver Wattle, Showy Wattle, Western Golden Wattle, | Southern and eastern NSW indicator |
| *Acacia genistifolia* | | Spreading Wattle, Early Wattle, | |

| SCIENTIFIC NAME | SYNONYM | COMMON NAME | REGION |
|---|---|---|---|
| | | Wild Irishman | |
| *Astroloma humifusum* | | Native Cranberry, Cranberry Heath | |
| *Bossiaea buxifolia* | | Box-leaved Bitter-pea | |
| *Bossiaea prostrata* | | Creeping Bossiaea, Prostrate Bitter-pea | |
| *Daviesia genistifolia* | | Spiny Bitter-pea, Broom Bitter-pea | |
| *Daviesia latifolia* | | Hop Bitter-pea | |
| *Daviesia leptophylla* | (*Daviesia virgata*) | Narrow-leaf Bitter-pea | |
| *Daviesia mimosoides* | | Narrow-leaf Bitter-pea | |
| *Dillwynia cinerascens* | | Grey Parrot-pea | |
| *Dillwynia retorta* | | Heathy Parrot-pea | |
| *Dillwynia sericea* | | Showy Parrot-pea | |
| *Exocarpos strictus* | | Pale Ballart, Pale-fruit Ballart, Dwarf Cherry | |
| *Gompholobium huegelii* | | Pale Wedge-pea | |
| *Grevillea iaspicula* | | Wee Jasper Grevillea | |
| *Grevillea lanigera* | | Woolly Grevillea | |
| *Grevillea ramosissima* | | Fan Grevillea, Branching Grevillea, Prickly Parsley Bush | |
| *Grevillea rosmarinifolia* | | Rosemary Grevillea | |
| *Grevillea wilkinsonii* | | Tumut Grevillea | |
| *Hardenbergia violacea* | | False Sarsaparilla, Purple Coral-pea, Native Lilac | |
| *Hibbertia calycina* | | Lesser Guinea-flower | |
| *Hibbertia riparia* | (*Hibbertia stricta*) | Stream Guinea-flower, Erect Guinea-flower | |
| *Hovea linearis* | | Creeping Hovea | |
| *Indigofera adesmiifolia* | | Tick Indigo, Leafless Indigo, Broad-leaved Indigo | |
| *Indigofera australis* | | Austral Indigo, Australian Indigo, Native Indigo, Hill Indigo | |
| *Jacksonia scoparia* | | Winged Broom-pea, Dogwood, Broom | |
| *Lespedeza juncea* | | Perennial Lespedeza | |
| *Leucopogon fletcheri* | | Pendant Beard Heath | |

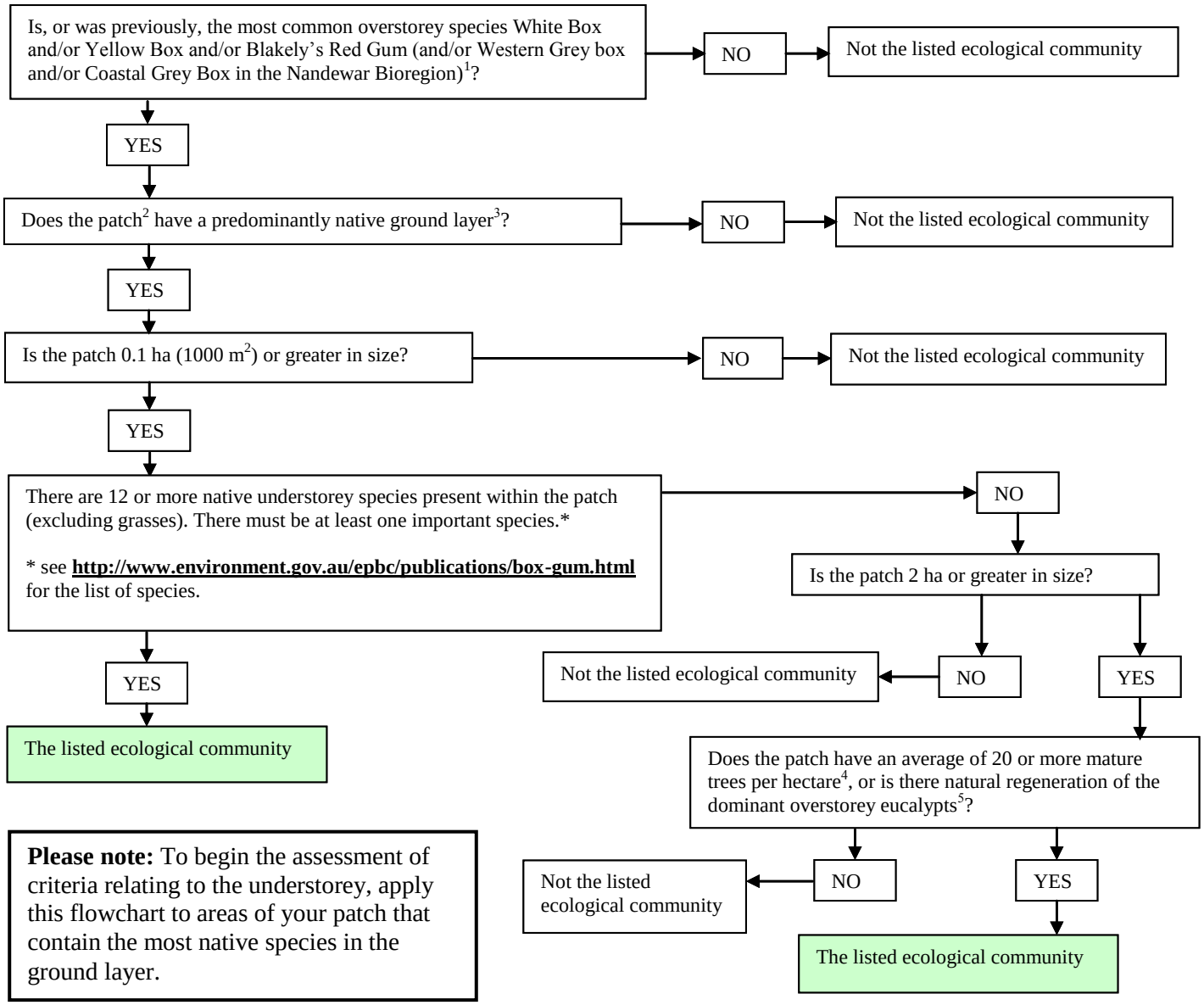
| SCIENTIFIC NAME | SYNONYM | COMMON NAME | REGION |
|---|---|---|---|
| *Leucopogon fraseri* | | Beard Heath | |
| *Leucopogon virgatus* | | Common Beard Heath | |
| *Pimelea curviflora* | | Curved Rice-flower | |
| *Pimelea glauca* | | Shrubby Rice-flower | |
| *Pultenaea microphylla* | | Spreading Bush-pea | |
| *Pultenaea procumbens* | | Heathy Bush-pea | |
| *Pultenaea spinosa* | (*Pultenaea cunninghamii*) | Bush-pea | |
| *Pultenaea subspicata* | | Low Bush-pea | |
| *Templetonia stenophylla* | | Leafy Templetonia, Leafy Mallee-pea | |

# Appendix 2: Box-Gum Grassy Woodland Identification Flowchart

Updated from: DEH (2006) *White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived grasslands. EPBC Act Policy Statement. Department of the Environment and Heritage.*

The flowchart below represents the lowest condition at which patches are included in the listed ecological community. This is not the ideal state of the ecological community. Large patches, those that link remnants in the landscape, those that occur in highly cleared areas, those that contain rare, declining or threatened species, and those that represent the entire range of the ecological community, are important for the long-term future of the ecological community.

**Determining if your land has an area of the listed ecological community**




**Please note:** To begin the assessment of criteria relating to the understorey, apply this flowchart to areas of your patch that contain the most native species in the ground layer.

[1] These dominant species may include hybrids with any other *Eucalyptus* species.

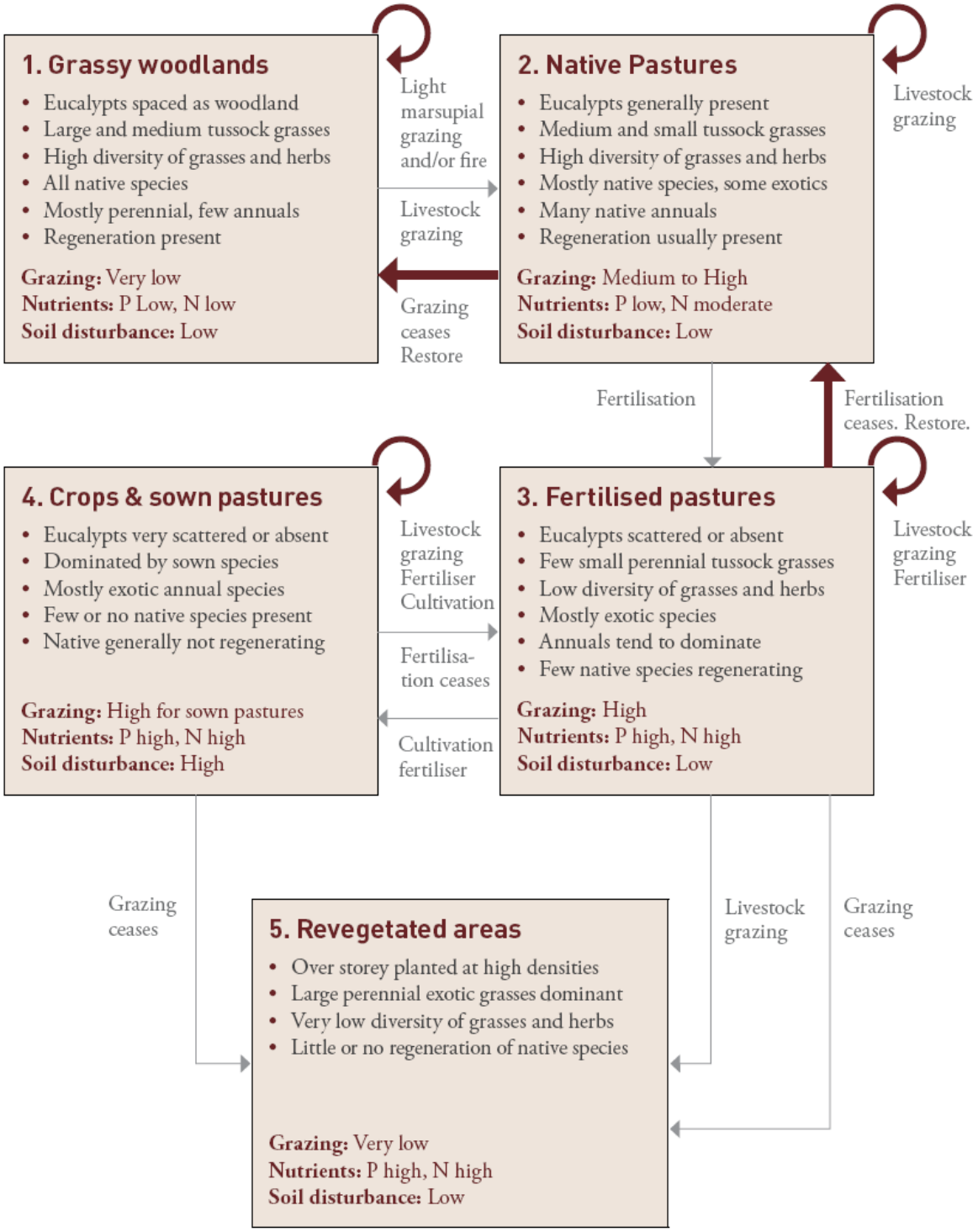
[2] Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:
• an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
• the area over which the understorey is predominantly native.

[3] A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow.

[4] Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.

[5] Natural regeneration of the dominant overstorey eucalypts occurs when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

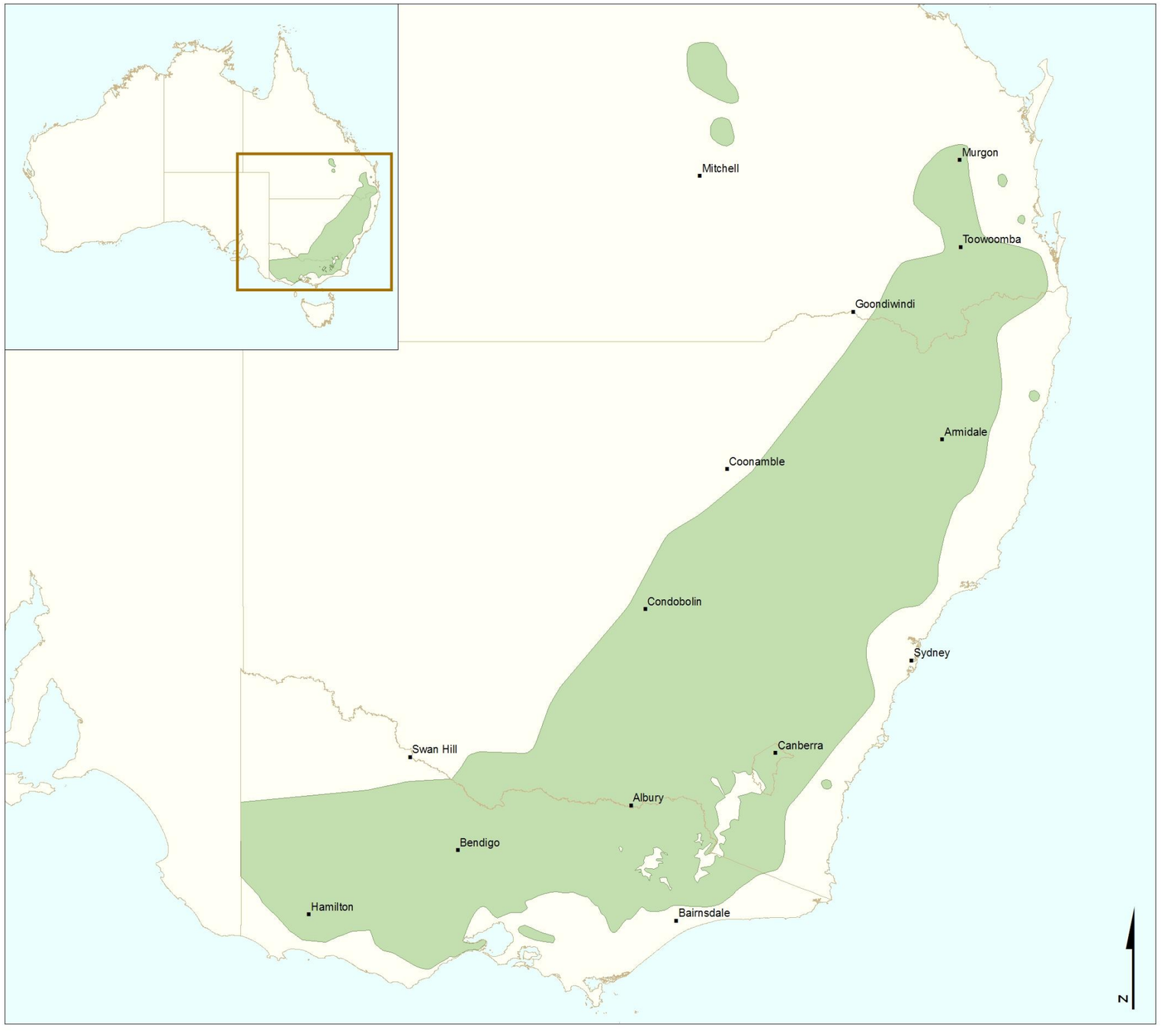
# Appendix 3: Box-Gum Grassy Woodland State and Transition Model




Reference: Department of the Environment, Water, Heritage and the Arts (2008b), *Caring for our Country - Environmental Stewardship - Box-Gum Grassy Woodland Project Implementation Plan*

## Appendix 4: Estimated Distribution of Box-Gum Grassy Woodland Remnants

# Box-Gum Grassy Woodland and Derived Native Grassland




This map shows where the state and territory environment agencies have advised that the EPBC-listed Box-Gum Grassy Woodland and Derived Native Grassland threatened ecological community may occur.

The listing advises that the community typically occurs in areas with a mean annual rainfall of between 400 and 1200mm.

**Legend**

- Locality
- Current extent where the community may occur

0 25 50 100 150 200 250 300 350 400
Kilometres

Datum: Geocentric Datum of Australia 1994

Data provided by Queensland Department of Environment and Resource Management, New South Wales Department of Environment, Climate Change and Water and Victorian Department of Sustainability and Environment.

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This map has been compiled from landscape-scale datasets, site verification is required for site based projects. Planning or investment decisions at the site-scale should use some form of ground-truthing.

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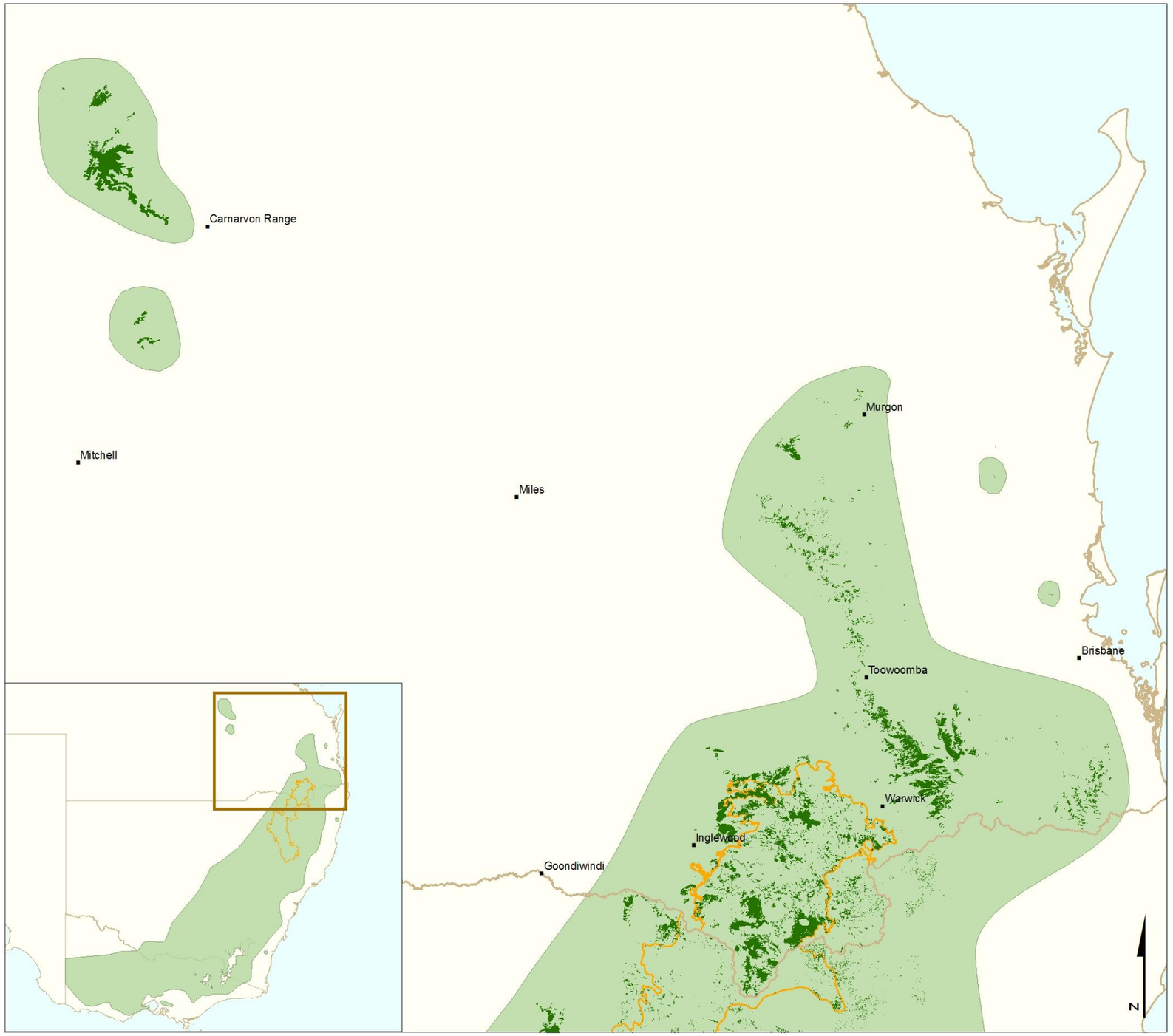
# Box-Gum Grassy Woodland and Derived Native Grassland - Queensland




This map shows where the EPBC-listed Box-Gum Grassy Woodland and Derived Native Grassland threatened ecological community is likely to, or may occur in Queensland.

The community has been mapped based on advice from the Queensland Herbarium as to which Regional Ecosystems are likely to contain the community.

The Regional Ecosystems shown on the map are 11.8.2, 11.8.2a, 11.8.8, 11.9.9a, 12.8.16, 13.3.1, 13.3.4, 13.11.8, 13.12.8 and 13.12.9.

Data for derived native grasslands and vegetation condition were not available for this map product.

**Legend**

- Locality
- Nandewar Bioregion
- Areas where the community is likely to occur
- Current extent where the community may occur

0 25 50 Kilometres 100 150

Datum: Geocentric Datum of Australia 1994

Data provided by Queensland Department of Environment and Resource Management and New South Wales Department of Environment, Climate Change and Water.

Source: Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0 (December 2005). - Queensland Herbarium

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This map has been compiled from landscape-scale datasets. Site verification is required for site based projects. Planning or investment decisions at the site-scale should use some form of ground-truthing.

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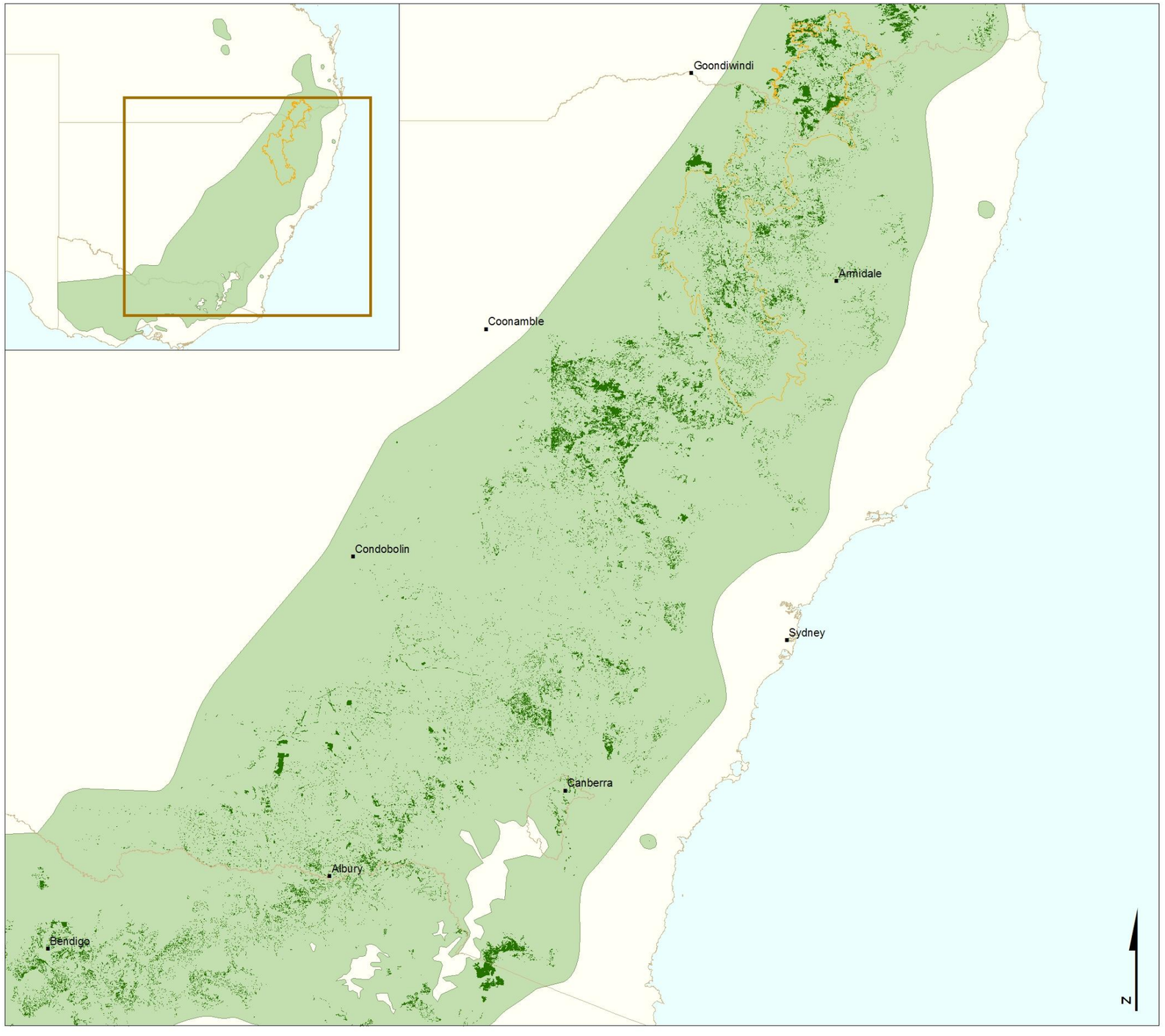
# Box-Gum Grassy Woodland and Derived Native Grassland - New South Wales




This map shows where the EPBC-listed Box-Gum Grassy Woodland and Derived Native Grassland threatened ecological community is likely to, or may occur in New South Wales.

The community has been mapped based on the attributes of vegetation data provided by the New South Wales Department of Environment, Climate Change and Water.

The map shows areas where the attributes describe dominance or co-dominace of one or more of the following species with a predominantly grassy understorey:
- Yellow Box
- White Box
- Blakely's Red Gum
- Grey Box (only in the Nandewar Bioregion)

Data for derived native grasslands and vegetation condition were not available for this map product.

**Legend**

- Locality
- Nandewar Bioregion
- Areas where the community is likely to occur
- Current extent where the community may occur

0 25 50 100 150 200 250
Kilometres

Datum: Geocentric Datum of Australia 1994

Data provided by Queensland Department of Environment and Resource Management, New South Wales Department of Environment, Climate Change and Water and Victorian Department of Sustainability and Environment.

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This map has been compiled from landscape-scale datasets. Site verification is required for site based projects. Planning or investment decisions at the site-scale should use some form of ground-truthing.

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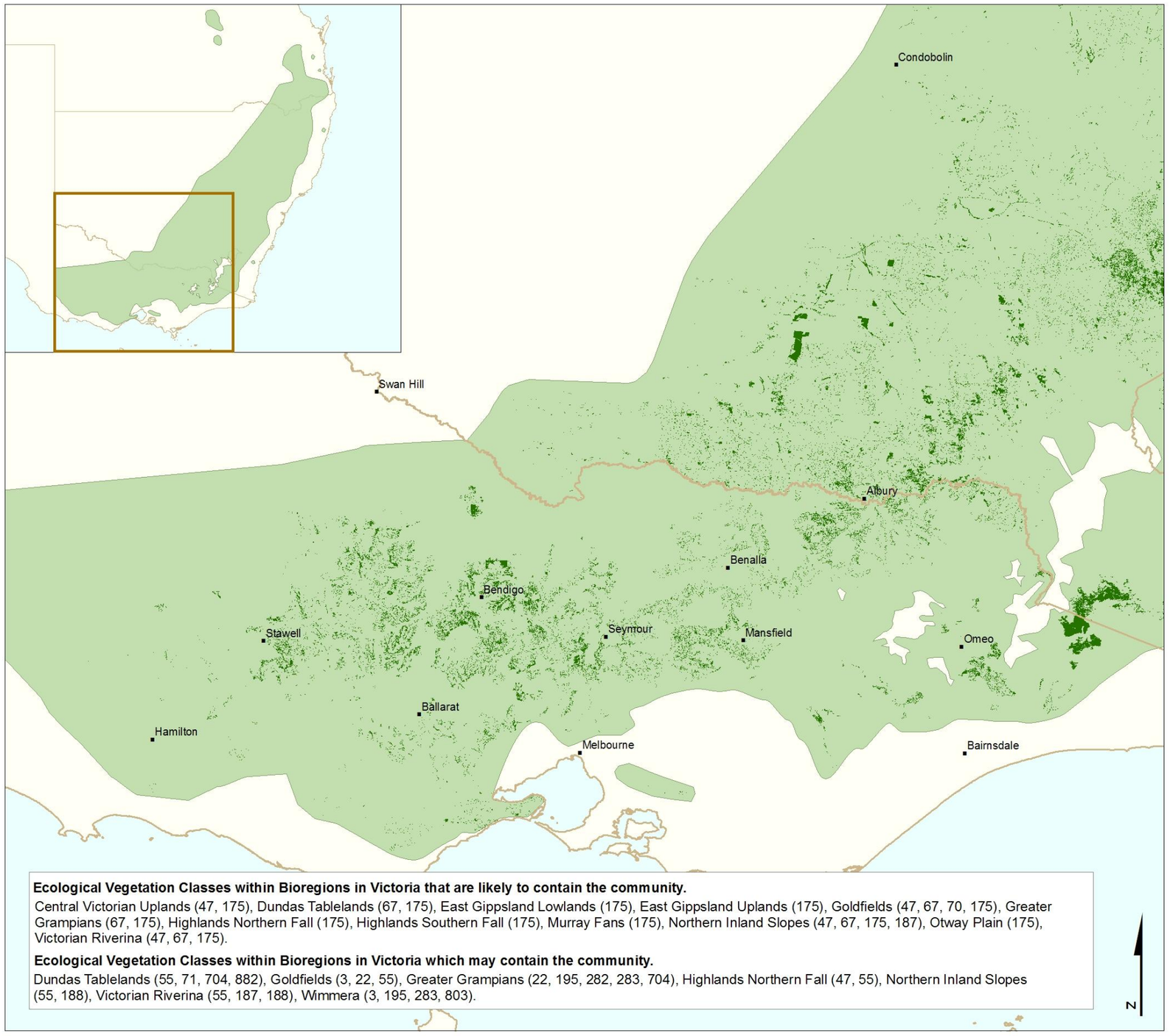
# Box-Gum Grassy Woodland and Derived Native Grassland - Victoria




This map shows where the EPBC-listed Box-Gum Grassy Woodland and Derived Native Grassland threatened ecological community is likely to, or may occur in Victoria.

The community has been mapped based on advice from the Victorian Department of Sustainability and Environment as to which Ecological Vegetation Classes (EVCs) are likely to contain the community.

The EVCs mapped are shown in the information box on the map.

Data for derived native grasslands and vegetation condition were not available for this map product.

**Legend**

- Locality
- Areas where the community is likely to occur
- Current extent where the community may occur

0 25 50 100 150 200
Kilometres

Datum: Geocentric Datum of Australia 1994

Data provided by the New South Wales Department of Environment, Climate Change and Water and the Victorian Department of Sustainability and Environment.

Source: Native Vegetation - Modelled 2005 Ecological Vegetation Classes (with Bioregional Conservation Status) - Department of Sustainability and Environment.

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This map has been compiled from landscape-scale datasets. Site verification is required for site based projects. Planning or investment decisions at the site-scale should use some form of ground-truthing.

**Ecological Vegetation Classes within Bioregions in Victoria that are likely to contain the community.**

Central Victorian Uplands (47, 175), Dundas Tablelands (67, 175), East Gippsland Lowlands (175), East Gippsland Uplands (175), Goldfields (47, 67, 70, 175), Greater Grampians (67, 175), Highlands Northern Fall (175), Highlands Southern Fall (175), Murray Fans (175), Northern Inland Slopes (47, 67, 175, 187), Otway Plain (175), Victorian Riverina (47, 67, 175).

**Ecological Vegetation Classes within Bioregions in Victoria which may contain the community.**

Dundas Tablelands (55, 71, 704, 882), Goldfields (3, 22, 55), Greater Grampians (22, 195, 282, 283, 704), Highlands Northern Fall (47, 55), Northern Inland Slopes (55, 188), Victorian Riverina (55, 187, 188), Wimmera (3, 195, 283, 803).

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# Appendix 5: Full Key/Potentially Threatening Process Listing for Introduced Animal Pest Species

- **Goats**

  "*Competition and land degradation by feral goats*" (EPBC Act)

  "*Competition and habitat degradation by feral goats,* Capris hircus*"* (TSC Act)

- **Rabbits**

  "*Competition and land degradation by feral rabbits*" (EPBC Act)

  "*Competition and grazing by the feral European rabbit*" (TSC Act)

  "*Reduction in biomass and biodiversity of native vegetation through grazing by the rabbit* Oryctolagus cuniculus" (FFG Act)

- **Bees**

  "*Competition from feral honeybees*" (TSC Act)

  *"Introduction of the Large Earth Bumblebee* Bombus terrestris" (TSC Act)

  "*The introduction and spread of the Large Earth Bumblebee* Bombus terrestris *into Victorian terrestrial environments*" (FFG Act)

  "*Threats to native flora and fauna arising from the use by the feral honeybee* Apis mellifera *of nesting hollows and floral resources"* (FFG Act)

- **Deer**

  "*Herbivory and environmental degradation caused by feral deer*" (TSC Act)

  "*Reduction in biodiversity of native vegetation by Sambar* (Cervus unicolor)" (FFG Act)

- **Pigs**

  *"Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)"* ( TSC Act)

  *"Predation, habitat degradation, competition and disease transmission by feral pigs"* (EPBC Act)

- **European Fox**

  *Predation by the European Red Fox* Vulpes vulpes (TSC Act)

  *Predation by the European Red Fox* (Vulpes vulpes) (EPBC Act)

  *Predation of native wildlife by the introduced Red Fox* (Vulpes vulpes) (FFG Act)

- **Cats**

  *"Predation by the Feral Cat* Felis catus (TSC Act).

  *"Predation by feral Cats"* (EPBC Act)

  *"Predation of native wildlife by the cat,* Felis catus" (FFG Act).

# Appendix 6: Estimated Extent and Broad Clearing Estimates of Box-Gum Grassy Woodland

| State | Current Area (ha) | Pre-1750 Area (ha) | % cleared |
|---|---|---|---|
| Queensland | 93,371 | 285,662 | 67 |
| New South Wales | 250,729 | 3,717,366 | 93 |
| Australian Capital Territory | 10,865 | 32,000 | 66 |
| Victoria | 61,360 | 976,627 | 94 |
| **TOTAL** | **416,325**[2] | **5,011,655** | **92**[3] |

Mapping Data Sources:


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

# Appendix 7: Conservation Reserves Known to Contain Box-Gum Grassy Woodland

| ACT |
|---|
| Goorooyaroo Nature Reserve |
| Gungaderra Nature Reserve |
| Mt Majura Nature Reserve |
| Mt Painter Nature Reserve |
| Mt Pinnacle Nature Reserve |
| Mugga Mugga Nature Reserve |
| Mulligans Flat Nature Reserve |
| Tuggeranong Hill Nature Reserve |
| **NEW SOUTH WALES** |
| Alma Nature Reserve |
| Bangadilly National Park |
| Barayamal National Park |
| Barton Nature Reserve |
| Benambra National Park |
| Beni Community Conservation Area Zone 3 |
| Boginderra Hills Nature Reserve |
| Border Ranges National Park |
| Borenore Karst Conservation Area |
| Breelong Community Conservation Area Zone 1National Park |
| Brindabella National Park |
| Bungonia State Conservation Area |
| Conimbla National Park |
| Copeton Waters State Park |
| Cuumbeun Nature Reserve |
| Dananbilla Nature Reserve |
| Drillwarrina Community Conservation Area Zone 1National Park |
| Ellerslie Nature Reserve |
| Flagstaff Memorial Nature Reserve |
| Goobang National Park Goonoowigall Community Conservation Area |
| Goonoowigall Community Conservation Area |
| Goulburn River National Park |
| Gunyerwarildi Community Conservation Area Zone 1 |
| Gungewalla Nature Reserve |
| Illunie Nature Reserve |
| Koorawatha Nature Reserve |
| Livingstone National Park |
| Minjary National Park |
| Mogriguy Community Conservation Area Zone 1 |
| Mount Kaputar National Park |
| Oak Creek Nature Reserve |
| Oxley Wild Rivers National Park |
| Queanbeyan Nature Reserve |
| Stony Creek Nature Reserve |
| Terry Hie Hie Community Conservation Area Zone 2 |
| Towarri National Park |

Tumblong State Conservation Area

Warrumbungle National Park

Wollemi National Park

Wongarbon Nature Reserve

Woomargama National Park

Yerranderrie State Conservation Area

**QUEENSLAND**

Arcot State Forest

Bringalily State Forest

Broadwater State Forest

Bunya Mountains National Park

Claremont State Forest

Coolmunda Conservation Park

Durikai State Forest

Gambubal State Forest

Girraween National Park

Googa State Forest

Greenup State Forest

Gunyan State Forest

Imbil State Forest 1

Lamington National Park

Leyburn State Forest

Macintyre State Forest

Main Range National Park

Mount Beau Brummell Conservation Park

Mount Binga State Forest

Passchendaele State Forest

Pidna National Park

Pidna State Forest

Sundown National Park

Sundown Resources Reserve

Talgai State Forest

Tamborine Forest Reserve

Tamborine National Park

Terrica State Forest

Texas State Forest 1

Texas State Forest 2

Texas State Forest 3

Yelarbon State Forest

Yarraman State Forest

**VICTORIA –** ***currently under review. This is not a comprehensive list but shows examples of reserves containing the community.***

Balmattum Nature Conservation Reserve

Bonegilla White Box Bushland Reserve

Broken Boosey State Park and Natural Features Reserve

Chiltern-Mt Pilot National Park

Dookie Bushland Reserve

Mt Franklin Scenic Reserve

Runnymeade Flora and Fauna Reserve

Snowy River National Park

# Appendix 8: Remnants of Box-Gum Grassy Woodland on the Register of the National Estate

| NEW SOUTH WALES |
| --- |
| Bala Travelling Stock Route Remnant Vegetation Site – Boorowa |
| Canowindra General Cemetery Woodland Remnant - Canowindra |
| Currabubula Cemetery Woodland Remnant - Currabubula, |
| Dananbilla Nature Reserve |
| Monteagle Cemetery Woodland Remnant - Monteagle |
| Oxley Park -Tamworth |
| Poplars Rutidosis Site - Jerrabomberra |
| Rutidosis Site - Queanbeyan West |
| Somerton Road Travelling Stock Route (part) - Manilla |
| Tarcutta Hills Woodland Remnant - Tarcutta |
| Tralee - Williamsdale Railway Swainsona Recta Sites - Williamsdale |
| Wallabadah Cemetery and Common Woodland Remnant - Wallabadah |
| Winton Cemetery Woodland Remnant - Tamworth |
| Woodstock Cemetery Woodland Remnant - Woodstock |
| **VICTORIA** |
| Puckapunyal Military Area |