# National Recovery Plan for the **Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia** ecological community 2012

Australian Government

Government of South Australia

Department of Environment, Water and Natural Resources

This plan was prepared by the South Australian Department of Environment, Water and Natural Resources with funding assistance from the Australian Government Department of Sustainability, Environment, Water, Population and Communities.



ISBN 978-1-921800-02-3

This recovery plan sets out the actions necessary to stop the decline, and support the recovery, of the listed threatened species or ecological community. The Australian Government is committed to acting 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, but 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.

Cite as:
Turner, J. (2012). *National Recovery Plan for the Peppermint Box (*Eucalyptus odorata) *Grassy Woodland of South Australia ecological community 2012*. Department of Environment, Water and Natural Resources, South Australia.

Copies of this plan are available at:
http://www.environment.gov.au/biodiversity/threatened/recovery-list-common.html

Enquiries:
Department of Environment, Water and Natural Resources
Nature Conservation Unit
Natural Resources Directorate
Strategy and Advice
GPO Box 1047
Adelaide SA 5001

Cover photograph: Peppermint Box Grassy Woodland, Hallett, July 2006 (by Jean Turner)

## Acknowledgments

Many individuals, stakeholder groups and organisations have contributed to development of this Recovery Plan. Their input and support is greatly appreciated and acknowledged.

Particular thanks to:

Members of the Recovery Planning Steering Committee, who generously shared their knowledge, ideas and time throughout the recovery planning process: Anne Brown (Greening Australia SA), Tim Jury (Threatened Plant Action Group), Bill New (Nature Conservation Society SA), Millie Nicholls (Grazier/Mid North Grasslands Working Group), Penny Paton (Ornithologist/Nature Conservation Society SA), Jodie Reseigh (Rural Solutions SA/Upper North Farming Systems Group/Mid North Grasslands Working Group), Vicki-Jo Russell (formerly Conservation Council of SA and Threatened Species Network SA), Jo Clarke (Greening Australia SA), Ann Prescott (Botanical Consultant; and formerly Department for Environment and Heritage), and Angela Duffy, Meg Robertson, Peter Copley, Randall Johnson, Greg Guerin, Sarah Lance and Wendy Stubbs (all Department of Environment, Water and Natural Resources).

Sonia Croft, Roman Urban and Steve Triplett (Department of Environment, Water and Natural Resources), Tony Randall (Goolwa to Wellington Local Action Planning Association Inc.) and Harry Seager (Eastern Hills and Murray Plains Catchment Group), who provided site access, mapping and GIS support.

The following individuals provided valuable comments on drafts of the plan: Alex Coombe (Trees for Life), Anita Crisp (Central Local Government Region), David Donato (Northern and Yorke Declining Woodland Birds Recovery Team), Zita Stokes (Rural Solutions SA), Andrew West, Doug Bickerton, Peter Copley, Thai Te and Mike Wouters (Department of Environment, Water and Natural Resources), Harry Seager (Eastern Hills and Murray Plains Catchment Group), Ben Simon & Tony Randall (Goolwa to Wellington Local Action Planning Association Inc.), Andrew Chalklen and other staff of the Australian Government Department of Sustainability, Environment, Water, Population and Communities.

The Department of Sustainability, Environment, Water, Population and Communities, for funding support.

The Department of Environment, Water and Natural Resources replaced the Department for Environment and Natural Resources on 1 July 2012.

## Contents

## List of Tables



## List of Figures



## Appendices

## Abbreviations

| | |
|---|---|
| AMLR | Adelaide and Mt Lofty Ranges (NRM Board/Region) |
| CITES | Convention on International Trade in Endangered Species |
| DEH | Former Department for Environment and Heritage (South Australian Government) |
| DENR | Former Department of Environment and Natural resources (South Australian Government) |
| DEWNR | Department of Environment, Water and Natural Resources (South Australian Government) (formerly DENR and DEH) |
| DSEWPaC | Department of Sustainability, Environment, Water, Population and Communities (Australian Government) |
| EP | Eyre Peninsula (NRM Board/Region) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) |
| GIS | Geographic Information System |
| IBRA | Interim Biogeographic Regionalisation of Australia |
| INTG | Iron-grass Natural Temperate Grassland |
| IUCN | International Union for the Conservation of Nature and Natural Resources |
| N&Y | Northern and Yorke (NRM Board/Region) |
| NC | Non-current taxonomic name - reflects the name used when data were collected |
| NRM | Natural Resources Management |
| NRM Act | *Natural Resources Management Act 2004* |
| NPW Act | *National Parks and Wildlife Act 1972* |
| NV Act | *Native Vegetation Act 1991* |
| NVC | Native Vegetation Council |
| PBGW | Peppermint Box Grassy Woodland |
| PBT | Pygmy Bluetongue Lizard |
| SA MDB | South Australian Murray Darling Basin (NRM Board/Region) |
| WWF | World Wide Fund for Nature |

## Glossary

| | |
|---|---|
| **Annual** | referring to plant species, a plant species that completes its life cycle from germination to seeding in one year and then dies |
| **Area of occupancy** | the area within the 'extent of occurrence' which is occupied by the ecological community |
| **Broad-leaved (plant)** | referring to plant species in the dicotyledonous group of plants; i.e. plants which have a pair of seed leaves or cotyledons |
| **Broad-leaved herbaceous species** | an attribute used in Condition Class assessment of PBGW remnants, referring to plant species which are "broad-leaved" plants with a herbaceous growth form |
| **Condition Class** | a state of the PBGW defined in the EPBC Act Listing Advice and based on native plant species diversity, composition and minimum patch size. Three Condition Class categories have been defined, representing high quality remnants (A), moderate quality remnants (B) and degraded remnants with potential for restoration (C) |
| **Cover/abundance** | a scaled estimate of the total canopy cover or abundance of a plant species in a survey quadrat, based on a visual estimate; cover categories are <5% (with 3 abundance categories - up to 10 plants; sparsely present; or plentiful), 5-25%, 25-50%, 50-75% and 75-100% |
| **Dominant species** | in general, the species which make up a large proportion of biomass, or numbers of organisms, in a community; in vegetation, the most common and characteristic species in the uppermost stratum of the plant community, excluding emergent species; hence in a woodland, the species contributing the greatest proportion of canopy cover in the tree stratum |
| **Ecological community** | a naturally occurring assemblage of inter-dependent plant and animal species, characterised by a unique combination of species composition, structure and habitats, and determined by or associated with physical factors such as soil type, position in the landscape, climate and water availability |
| **Emergent species** | plants that rise up above the dominant upper stratum of the plant community, generally widely spaced and with total canopy cover less than 5% |
| **Extent of occurrence** | the area contained within the shortest imaginary boundary that can be drawn to encompass all the known 'sub populations' of the ecological community |
| **Floristic** | pertaining to the types, numbers and distribution of plant species in a particular area |
| **Forb** | a herbaceous (non-woody) plant other than grasses, sedges and rushes |
| **Grass-like (herb)** | a herbaceous plant in the monocotyledonous group of plants; i.e. plants which have a single seed leaf or cotyledon |

| | |
|---|---|
| **Herb** | a plant which does not develop a woody stem |
| **Herbaceous** | referring to the growth form of plant species; species which do not develop a woody stem |
| **Indicator species** | from floristic analysis of vegetation survey sites; a native plant species that occurs relatively commonly in a floristic group, is relatively uncommon in other groups and its occurrence in the floristic group is statistically significant |
| **Integrity** | (of the ecological community) the capacity of PBGW remnants to support and maintain species diversity and composition, woodland structure and functional organisation similar to undisturbed examples of the ecological community |
| **Long term** | in the context of recovery of the ecological community, 50 years or more |
| **Medium term** | in the context of recovery of the ecological community, in the next 10 to 50 years |
| **Microphytic crust** | a natural protective crust on the soil surface formed by lichens, mosses and algae; generally present in undisturbed and less disturbed sites |
| **Perennial** | referring to plant species, a plant that lives for more than two years before completing its life cycle from germination to seeding; may be short-lived, or long-lived with repeated annual cycles of flowering and seeding |
| **Polygon** | in GIS, an area bounded by a closed line, used to represent a feature on a map (e.g. a PBGW remnant or a continuous area of a floristic vegetation group) and linked to a data reference point inside the boundary |
| **Priority remnants** | PBGW remnants and habitat areas that are significant and critical for the long-term persistence of the ecological community |
| **Savannah woodland** | Synonymous with grassy woodland, referring to open woodland types with an understorey dominated by native grasses and herbs; used mainly in earlier publications on native vegetation of South Australia |
| **Short term** | in the context of recovery of the ecological community, over the next 10 years; the period of this recovery plan |
| **Stratum** | in relation to vegetation, a distinct layer of plants – i.e. trees, shrubs and herbaceous understorey each form a different stratum in the woodland |
| **Understorey** | Vegetation layers beneath the dominant upper canopy layer; in PBGW the main understorey layer is low, herbaceous vegetation of annual and perennial grasses, herbs and forbs |

## Summary

This *National Recovery Plan for the Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia* has been prepared in accordance with the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The intended life-span of this recovery plan is ten years. Its effectiveness will be reviewed after five years and further recovery goals and actions may be identified.

### Conservation Status

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community is listed as Critically Endangered under the EPBC Act.

### The Ecological Community

Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community has the woodland form of *Eucalyptus odorata* as the characteristic and dominant tree species. Peppermint Box Grassy Woodland is endemic to South Australia. The ecological community occurs in areas of winter-dominant rainfall, with the main distribution in the Flinders-Lofty Block Bioregion and smaller occurrences in the Kanmantoo, Eyre-Yorke Block, Murray Darling Depression and Gawler Bioregions. It occurs mainly on loam to clay loam soils, on gentle to steep slopes of hills and ridgelines.

Peppermint Box Grassy Woodland has a tree canopy cover varying from sparse to dense (in the range of 5-70%), over an open understorey dominated by native grasses and herbs, with scattered shrubs. Mosses, lichens, leaf litter and bare ground are common and important features of the ground layer. Many plants and animals of the ecological community are grassy habitat specialists or woodland-dependent species. The presence of mature *E. odorata* trees with hollows, large old fallen logs and intact native understorey generally indicate areas not previously disturbed by ploughing and crop production. Such areas are important refuges for species sensitive to cultivation and fertilizers, such as orchids and soil-dwelling invertebrates, reptiles and amphibians.

Peppermint Box Grassy Woodland once extended over an estimated 900,000 ha (Davies 2000; Threatened Species Scientific Committee 2007), but the ecological community has declined dramatically in area and integrity across its natural range, to the point where it is now considered critically endangered. Knowledge of the remaining area, species composition and condition of the ecological community is incomplete. The present area of occupancy of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia is thought to be less than 15,000 ha (Davies 2000; Threatened Species Scientific Committee 2007). The area that meets the EPBC condition criteria is unknown but is likely to be much less.

### Land Uses

Most remaining areas of Peppermint Box Grassy Woodland are on privately owned and managed land. In many cases these areas are used for stock shelter and grazing. There has been a trend for change in land ownership and land uses in peri-urban areas, and livestock grazing no longer occurs in some Peppermint Box Grassy Woodland remnants. There are also mining, energy infrastructure, housing and transport developments in and adjoining Peppermint Box Grassy Woodland in localised areas. At least 345 ha of the ecological community are protected in national parks, conservation parks and NPW Act reserves, and at least 28 Heritage Agreements protect areas of Peppermint Box Grassy Woodland on private land. The ecological community also occurs in various Crown Land reserves, including road and rail reserves and in parcels owned and managed by Local Governments.

### Key Threats

The Peppermint Box Grassy Woodland ecological community is at risk from a range of threats. Key existing and potential threats include:

- incompatible agricultural practices including cultivation, fertiliser application or detrimental grazing regimes;
- changes in the use and management of Peppermint Box Grassy Woodland remnants or adjoining areas;
- clearance associated with new developments such as urban and peri-urban expansion, wind farms, mining, transport and other activities;
- ongoing decline and degradation due to existing weed infestations, feral predators, past fragmentation and small patch size of remnants;
- impacts of recreational activities such as 4WD and trail bikes;
- inappropriate or altered fire management regimes; and
- ecological impacts of climate change.

### Knowledge Gaps

Key knowledge gaps to address for recovery of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia include the total area remaining and the composition, condition and integrity of remnants. Other critical gaps include knowledge about the fauna of the ecological community, particularly species that are functionally important or depend on the community for their survival; structure and dynamics of the ecological community; 'best practice' management strategies for conservation outcomes in different land uses (including grazing) and condition states; effective restoration techniques; the role and management of fire; and potential impacts of climate change.

### Recovery Opportunities

Opportunities exist to improve the long term viability of the Peppermint Box Grassy Woodland ecological community. These centre on working in partnership with private and public land owners and managers, to improve the condition and integrity of existing remnants, halt any further decline in extent, and restore recoverable areas to meet the condition criteria for the listed ecological community. The Australian Government's *Environmental Stewardship Program* and other market-based incentive programs enable greater participation of private land owners and managers in recovery of the ecological community, by providing incentives for long-term protection and management of Peppermint Box Grassy Woodland remnants. Surveys, condition assessments and monitoring undertaken by these programs and from existing support programs, could be an important part of the recovery process, potentially contributing knowledge on the extent, condition, management and restoration of the ecological community.

### Recovery Objectives

The overall objective of this recovery plan is to ensure the survival of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and promote its recovery by maintaining or improving the area, condition and integrity of the ecological community.

Specific objectives to be achieved within the intended life of this recovery plan are:

1. To maintain or improve the condition of remnant Peppermint Box Grassy Woodland.
2. To increase the area of Peppermint Box Grassy Woodland secured and managed for conservation.

3. To increase the area of occupancy of Peppermint Box Grassy Woodland across its natural range.

The achievement of these objectives will be measured by the performance criteria that are listed for each strategy.

**Recovery Strategies**

The key strategies to achieve this objective are to:-

1. Increase awareness of PBGW to ensure protection of the ecological community.
2. Improve baseline information on the location, extent, condition and management of PBGW remnants.
3. Increase the area of EPBC listed PBGW secured and managed for conservation.
4. Maintain or improve the condition and integrity of the EPBC-listed PBGW remnants using 'best practice' strategies.
5. Increase the area of occupancy of the EPBC listed PBGW ecological community across its natural range.
6. Address critical knowledge gaps about the ecological community.
7. Actively manage the recovery process through an effective recovery team.

23 recovery actions have been developed to implement these strategies and meet the objective over the next ten years. These actions have been prioritised and performance criteria identified to help set tasks and measure the achievement of actions.

**Costs and Evaluation**

The total funding required to implement this plan over the ten-year period is estimated at $6,221,000. This is likely to be an underestimate due to difficulty in comprehensively costing many ongoing activities, including in-kind contributions of partners. Funds to implement this plan will be sought from a range of sources, including South Australian and Australian Governments and private investors. Progress towards achieving the recovery objectives will be reported against the performance criteria and as required by funding and management arrangements.

# Part A Introduction

Peppermint Box (*Eucalyptus odorata*) is found mainly in South Australia (Ross and Walsh 2003; Barker *et al*. 2005) with a small occurrence in Victoria near Bordertown (Nicolle 1997, O'Leary pers. com.). The species occurs in two main woodland types: savannah or grassy woodlands with an open understorey of perennial tussock grasses, herbs and shrubs; and mallee woodlands with a well-developed shrubby understorey dominated by sclerophyll heath species or chenopods (Boomsma 1946; Smith 1963; Specht 1972). Peppermint Box Grassy Woodland is usually on relatively fertile, well drained soils, including red-brown earths, brown loams and transitional soils, whereas Peppermint Box mallee woodlands with sclerophyll heath understorey occur in higher rainfall areas, on nutrient-poor skeletal, podsolic or seasonally water-logged soils; and the woodlands with chenopod understorey are associated with solonized mallee soils in lower rainfall areas (Boomsma 1946; Jessup 1946 & 1948; Smith 1963; Specht 1972).

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community is a typical 'savannah' or grassy woodland community. The canopy is dominated by the woodland tree form of *E. odorata*, and the understorey is dominated by grasses and other herbaceous plants, with scattered shrubs. Other woodland eucalypts, including Inland South Australian Blue Gum (*E. leucoxylon* subsp. *leucoxylon* and *E. leucoxylon* subsp. *pruinosa*), Eyre Peninsula Blue Gum (*E. petiolaris*), Grey Box (*E. microcarpa*) and Mallee Box (*E. porosa*), often occur as co-dominants. The ecological community occurs on loam to clay loam soils in areas of winter-dominant rainfall, generally on gentle to steep slopes of hills and ridgelines. It is regarded as endemic to South Australia. Examples of Peppermint Box Grassy Woodland are shown in Figures 1 and 2.

Peppermint Box Grassy Woodland once extended over an estimated 900,000 hectares (Davies 2000; Threatened Species Scientific Committee 2007). These woodlands were initially used for livestock grazing during pastoral settlement; less rocky sites were then progressively cleared for agricultural development. The ecological community has declined dramatically both in area and integrity across its natural range, and is now considered critically endangered. Knowledge of its remaining area, species composition and condition is incomplete, but at the time of listing under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) it was estimated less than 15,000 ha of the Peppermint Box Grassy Woodland ecological community remained in good condition (Threatened Species Scientific Committee 2007). Most remnants are small, highly modified and highly fragmented across the landscape. The area in which Peppermint Box Grassy Woodland may occur is shown in Figure 3.

The ecological community includes many woodland-dependent species, and flora and fauna regarded as grassy habitat specialists. While most remnants of the ecological community have been modified by grazing, weed invasion and feral animals, there are still remnants of mature Peppermint Box trees with well-developed hollows and old fallen timber, indicative of areas not previously disturbed by ploughing, cropping or broad-scale timber removal. Such areas are important habitat refuges for hollow-dependent species of birds, mammals and reptiles, and species sensitive to cultivation and fertilizers, including orchids and soil-dwelling invertebrates, reptiles and amphibians.

Prior to this recovery plan there has been no formal, coordinated recovery program for the Peppermint Box Grassy Woodland ecological community. Priority recovery actions undertaken during the recovery planning process include awareness raising, training in recognition and assessment of the ecological community, and field surveys to fill gaps in knowledge of the distribution and condition of Peppermint Box Grassy Woodland. Native grasslands extension programs, management trials, stewardship funding and on-ground works programs have supported adoption of 'best practice' management in some Peppermint Box Grassy Woodland in the past 12 years.

**Figure 1: *Eucalyptus odorata* grassy woodland with sparse understorey of grasses and herbs, bare soil and surface stones. Near Mt Bryan, November 2008.** (Photo: J Turner)

**Figure 2: *Eucalyptus odorata* grassy woodland with shrub cover near 30%, over grasses, forbs and litter. Barossa Valley, July 2008.** (Photo: J Turner)

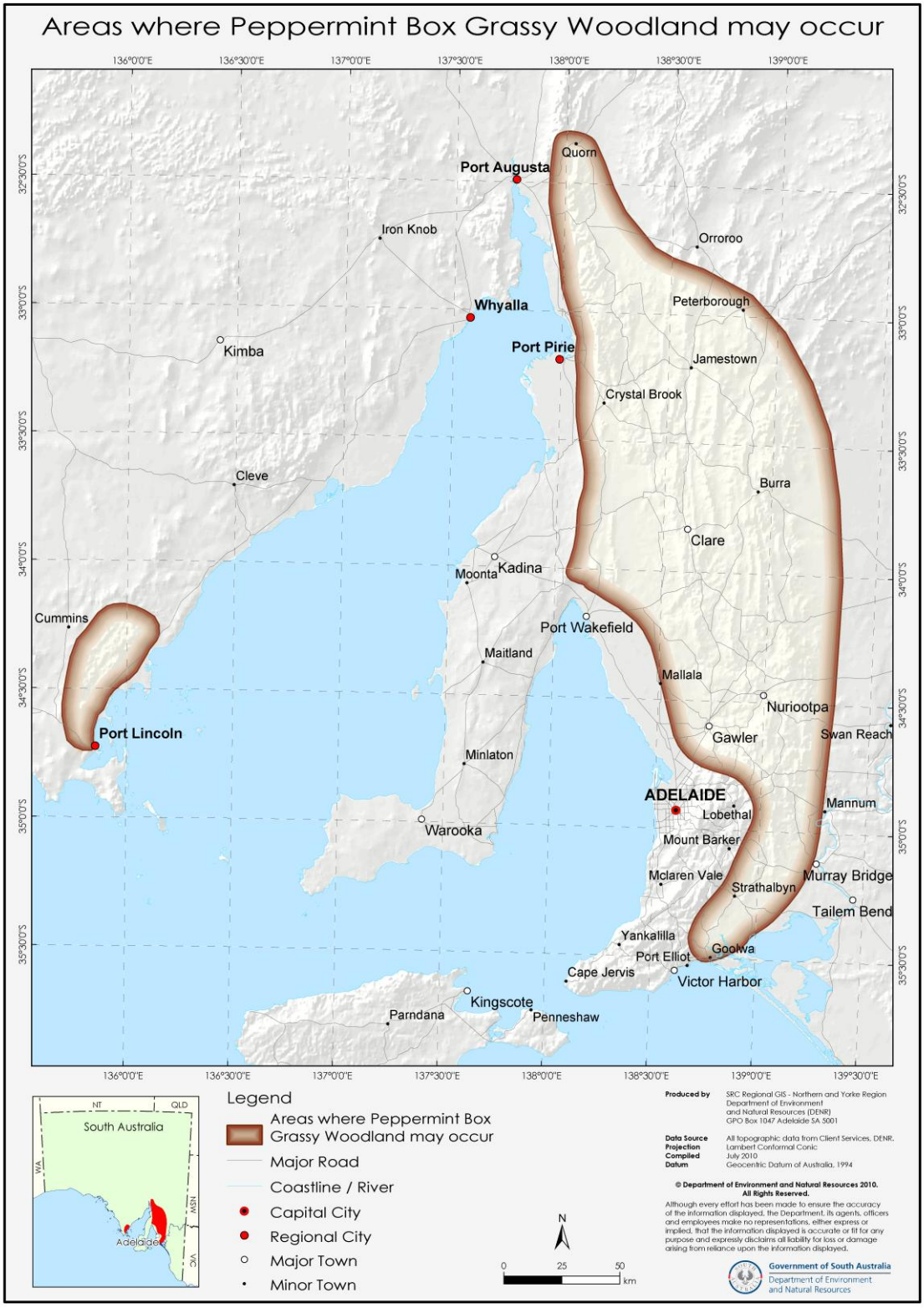


**Figure 3: Areas where Peppermint Box Grassy (*Eucalyptus odorata*) Woodland of South Australia may occur.**

## Conservation Status and Protection

Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia is listed as a threatened ecological community under Commonwealth legislation. In South Australia, *Eucalyptus odorata +/- E. leucoxylon* Grassy Low Woodland is recognised as a threatened ecosystem (DEH 2005a) and the vegetation community is protected under provisions of the *Native Vegetation Act 1991* and associated Regulations.

Commonwealth Legislation:

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community is listed nationally as Critically Endangered, under the EPBC Act. The listing applies to woodlands dominated by the woodland tree form of *E. odorata*, in which the understorey consists mainly of native grasses, forbs and other herbs, with shrub cover of 30% or less.

Under the provisions of the EPBC Act, any action likely to have a significant impact on the nationally listed ecological community, or a nationally listed plant or animal species occurring in the ecological community, must be referred to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities for assessment and approval before the proposed action is taken.

South Australian Government Legislation:

South Australian legislation has no provision for officially rating and listing threatened ecological communities. However, *Eucalyptus odorata +/- E. leucoxylon* Grassy Low Woodland ecosystem is recognised as Endangered in a provisional list of threatened ecosystems of South Australia (DEH 2005a).

South Australian Acts of Parliament most relevant to the protection and management of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia are the *National Parks and Wildlife Act 1972* and the *Native Vegetation Act 1991*.

The ***Native Vegetation Act 1991*** (NV Act) regulates the removal of native vegetation and prohibits broad-scale clearance. It also provides for 'in perpetuity' protection of native vegetation and associated wildlife, through conservation covenants called Heritage Agreements.

'Clearance' as defined under the NV Act includes ploughing, establishing exotic pastures in native vegetation, changes in livestock species or increased grazing intensity, as well as deliberate removal of native plants by cutting, digging or burning. Native vegetation can only be cleared with approval of the Native Vegetation Council (NVC), or in accordance with permitted activities defined in the Regulations under the Act. Clearance applications are assessed against a set of Principles defined in Schedule 1 of the NV Act (Appendix 1) which take into account the conservation status and remnancy of the vegetation community, presence of threatened species and the condition and habitat values of the remnant. These Principles can be used to protect areas of Peppermint Box Grassy Woodland remnants from clearance.

Private land owners and managers of Crown lands can voluntarily enter into Heritage Agreements to formally protect Peppermint Box Grassy Woodland remnants. Heritage Agreements may also be negotiated as Significant Environmental Benefit (SEB) off-sets for vegetation clearance approved by the NVC. A Heritage Agreement protects all indigenous plants and animals within an area of vegetation defined and registered on the land title or parcel details.

Activities permitted by the *Native Vegetation Regulations 2003* under the NV Act could impact on the Peppermint Box Grassy Woodland ecological community and therefore should still be assessed under the provisions of the EPBC Act. Conversely, Peppermint

Box Grassy Woodland remnants that do not meet the criteria for the nationally listed ecological community may still be protected from clearance under the NV Act and require NVC approval.

The ***National Parks and Wildlife Act 1972*** (NPW Act) provides for protection and management of natural habitats and wildlife species, through establishment of parks and reserves, development of plans for their management, protection of native plant and animal species within protected areas, and listing of State protected and threatened species.

Areas of Peppermint Box Grassy Woodland in NPW Act parks and reserves are protected by the NPW Act. Peppermint Box Grassy Woodland remnants outside of NPW Act reserves can be voluntarily protected under the Act, through declaration as a Sanctuary for conservation of natural habitat and protection of native animals and plants. Unlike Heritage Agreements, sanctuaries are not binding 'in perpetuity' agreements and are not part of the Protected Areas network.

Some plant and animal species that occur within Peppermint Box Grassy Woodland are listed as threatened species under the NPW Act. Nationally and State threatened species associated with this ecological community are listed in Table 1.

Other South Australian legislation relevant to the conservation, management and protection of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia is outlined in Appendix 2.

## International Obligations

International conventions and agreements relevant to this plan include the Convention on International Trade in Endangered Species (CITES) and the Convention on Biological Diversity. While grassy woodland ecosystems are not specifically the subject of international agreements, the Peppermint Box Grassy Woodland ecological community may include species and associated habitat that are subject to these agreements Recovery actions identified in this plan are consistent with Australia's obligations under these conventions and agreements, and aim to enhance the conservation of threatened species occurring in them, including species subject to international agreements.

**Table 1: Threatened species occurring in, or associated with, Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.**

| Species | Common Name | EPBC Act | SA NPW Act | Existing Recovery Plan |
|---|---|---|---|---|
| **Flora** | | | | |
| *Acacia gracilifolia* | Graceful Wattle | | R | |
| *Acacia iteaphylla* | Flinders Ranges Wattle | | R | |
| *Acacia menzelii* | Menzel's Wattle | V | V | Part range only (AMLR[1] & SA MDB[2]) |
| *Acacia rhetinocarpa* | Resin Wattle | V | V | Part range only (AMLR[1] & EP[4] ) |
| *Asperula syrticola* | Southern Flinders Woodruff | | R | |
| *Rytidosperma tenuius* (formerly *Austrodanthonia tenuior*) | Short-awn Wallaby-grass | | R | |
| *Austrostipa breviglumis* | Cane Spear-grass | | R | |
| *Austrostipa densiflora* | Fox-tail Spear-grass | | R | |
| *Austrostipa gibbosa* | Swollen Spear-grass | | R | |
| *Austrostipa multispiculis* | Small-seed Spear-grass | | R | |
| *Austrostipa pilata* | Prickly Spear-grass | | V | |
| *Austrostipa tenuifolia* | | | R | |
| *Bothriochloa macra* | Red-leg Grass | | R | |
| *Brachyscome ciliaris* var. *subintegrifolia* | | | R | |
| *Choretrum glomeratum* | Yellow-flower Sour-bush | | R | |
| *Cryptandra campanulata* (syn. *C. sp. Long hypanthium*) | Long-flower Cryptandra | | R | |
| *Daviesia benthamii* subsp. *humilis* | Mallee Bitter-pea | | R | |
| *Daviesia pectinata* | Zig-zag Bitter-pea | | R | Part range only (AMLR[1]) |
| *Dianella longifolia* var. *grandis* | Pale Flax-lily | | R | Part range only (AMLR[1]) |
| *Diuris behrii* | Behr's Cowslip Orchid | | V | Part range only (AMLR[1]) |
| *Eryngium ovinum* (syn. *E. rostratum*) | Blue Devil | | V | |
| *Euphrasia collina* subsp. *osbornii* | Osborn's Eyebright | E | E | EPBC Act[3] |
| *Maireana excavata* | Bottle Fissure-plant | | V | |
| *Olearia pannosa* subsp. *pannosa* | Silver Daisy-bush | V | V | Part range only (AMLR[1]; EP[4] & SA MDB[2]) |
| *Ozothamnus scaber* | Rough Bush-everlasting | | V | |
| *Poa drummondiana* | Knotted Poa | | R | |
| *Pterostylis despectans* | Lowly Greenhood | E | E | LB Orchids[5]; & EPBC Act conservation advice |
| *Ptilotus erubescens* | Hairy-tails | | R | |
| *Pycnosorus globosus* | Drumsticks | | V | |
| *Rumex dumosus* | Wiry Dock | | R | |
| *Swainsona behriana* | Behr's Swainson-pea | | V | |
| *Thysanotus tenellus* | Grassy Fringe-lily | | R | |
| *Wurmbea latifolia* subsp. | Broad-leaf Nancy | | V | |

| Species | Common Name | EPBC Act | SA NPW Act | Existing Recovery Plan |
|---|---|---|---|---|
| *latifolia* | | | | |
| **Fauna** | | | | |
| *Aprasia pseudopulchella* | Flinders Ranges Worm-lizard | V | De-listed | Part range only (AMLR[1]); & EPBC Act conservation advice |
| *Corcorax melanorhamphos* | White-winged Chough | | R | Part range only (AMLR[1]) |
| *Falco peregrinus* | Peregrine Falcon | | R | Part range only (AMLR[1]) |
| *Microeca fascinans fascinans* | Jacky Winter (south eastern subspecies) | | R | Part range only (AMLR[1]) |
| *Pseudophryne bibronii* | Brown Toadlet | | R | Part range only (AMLR[1]) |
| *Stagonopleura guttata* | Diamond Firetail | | V | Part range only (AMLR[1]) |
| *Trichosurus vulpecula* | Common Brushtail Possum | | R | |

Notes
1 AMLR refers to the Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia (Willson and Bignall 2009)
2 SA MDB refers to the SA Murray Darling Basin Threatened Flora Recovery Plan (Obst 2005)
3 EPBC refers to the Recovery Plan for Osborn's Eyebright, *Euphrasia collina* subp. *osbornii* (Moritz and Bickerton 2010)
4 EP refers to the Draft Recovery Plan for 23 Threatened Flora on Eyre Peninsula SA (Pobke 2007)
5 LB Orchids refers to the Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia (Quarmby 2010)
E = Endangered, V = Vulnerable, R = Rare (in descending order of threat status)

## The National Recovery Plan

This *National Recovery Plan for Peppermint* Box (*Eucalyptus odorata*) *Grassy Woodland of South Australia* has been prepared in accordance with the provisions of the Commonwealth EPBC Act. The Objects of the EPBC Act, as set out in Section 3 of that Act, have been considered in the development of this plan.

The recovery plan describes and documents current knowledge of Peppermint Box Grassy Woodland in South Australia. It identifies the major issues currently threatening and impacting on the ecological community, emerging issues, and potential threats which may impact in the near future. The long-term goal for the ecological community is to stabilise existing areas, prevent their decline and if possible, improve their condition and status through appropriate management.

The plan sets objectives and actions to protect, manage and recover the Peppermint Box Grassy Woodland ecological community, including actions to address knowledge gaps and to engage stakeholders. Landholders are key partners in the recovery of the ecological community, and their active involvement through adoption of best practice management combining conservation with production outcomes will be encouraged and supported.

This recovery plan is consistent with existing national recovery plans for threatened species within the ecological community and does not replace those plans. It takes a multi-species approach, seeking to retain, re-establish and protect common species integral to the persistence and function of the ecological community, as well as rare and threatened species occurring within it. The ecological community occurs over a wide geographic range with natural variations in the biological and physical

environment. Maintenance and management of these variations is integral to recovery actions identified in the plan.

It is also consistent with South Australian state plans including the South Australian Strategic Plan, the No Species Loss conservation strategy, NatureLinks, the State Natural Resources Management (NRM) Plan, regional NRM plans and the Adelaide and Mount Lofty Ranges Regional Recovery Plan. Details of these plans are summarised in Appendix 3. The recovery plan for Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia expands on targets in these state plans and policies, identifying specific strategies and actions for restoration and conservation of the ecological community across its natural range. The recovery of the Peppermint Box Grassy Woodland will also link into other threatened species and ecological community recovery plans and programs.

This recovery plan will be reviewed periodically, and may be updated to include additional information from future surveys, research, applied adaptive management and monitoring, or other outcomes of recovery actions.

## Affected Interests

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community occurs on private and public lands, across a range of land tenures, uses and management regimes.

Nearly 98% of the remaining Peppermint Box Grassy Woodland is on privately owned land. Most of these remnants are in areas used for agricultural production, either non-arable grazing land, or non-arable patches in cropping land. Some remnants are on smaller rural 'lifestyle' properties where larger commercial farms have been subdivided and are no longer used for conventional broad-acre agriculture. Some private landowners, including individuals, non-government organisations and conservation companies have set aside Peppermint Box Grassy Woodland remnants as private reserves, either through 'in perpetuity' Heritage Agreements, stewardship management agreements or as informal conservation areas on their properties.

Remnants also occur on undeveloped house blocks in rural townships, and in or adjoining industrial, infrastructure and development sites, including mines, wind farms, transport corridors and peri-urban areas targeted for future urban expansion.

Peppermint Box Grassy Woodland also occurs on Crown lands, including National Parks and Conservation Parks, Forest Reserves, Local Government reserves, road and railway reserves, and special purpose infrastructure sites including Education Department land, waste management sites and water reserves.

Peppermint Box Grassy Woodland, as defined in the EPBC listing, is currently known to occur in four NRM Board regions, the Adelaide Mt Lofty Ranges (AMLR), Northern and Yorke (N&Y), SA Murray-Darling Basin (SA MDB) and Eyre Peninsula (EP). This recovery plan links to programs, priorities and targets identified in the Boards' Regional NRM Plans.

Peppermint Box Grassy Woodland may have once occurred in the South East NRM region, but has probably all been cleared (B. Haywood, pers. comm.). Grassy woodlands with *E. odorata* do occur in the South East, but these generally do not meet the criteria for the EPBC listing as *E. odorata* is a sub-dominant species.

Both private land owners and public land management authorities will be affected by implementation of this recovery plan, and a wide range of stakeholders and supporting partners will need to be engaged and involved in the recovery process. Voluntary participation by graziers and other private land owners and managers will be critical to achieving the aim and objectives of this plan. Specific recovery actions have been

developed to raise awareness and knowledge of different stakeholder groups and to support their participation in recovery actions. . Representatives of affected interests were consulted during the development of this recovery plan, with their views taken into consideration in finalising the plan.

## Role and Interests of Aboriginal People

The natural distribution of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community extends through several Aboriginal Nations, including traditional lands of the Ngarrindjeri, Peramangk, Kaurna, Narrunga, Nukunu, Ngadjuri, Barngala and Nauo Barngala people. Extensive areas of Peppermint Box Grassy Woodland existed prior to European settlement, and these woodlands and the native plants and animals inhabiting them may have social, cultural and spiritual significance to the Aboriginal people. Ngadjuri were known as the 'peppermint gum people', a reference to the *E. odorata* trees that occurred throughout their land (Warrior *et al*. 2005).

This plan aims to ensure that the role and interests of Aboriginal people are considered in implementing recovery actions. To this end, the Aboriginal Partnerships Section of the South Australian Department of Environment, Water and Natural Resources (DEWNR) consulted with the relevant Aboriginal nations and communities about their interests in the ecological community and their involvement in recovery planning and implementation. The standard process adopted by Aboriginal Partnerships is to contact each community, inform them of the plan and provide fact sheets with information on the relevant species or ecological community. Comments are requested by a set date and if no comment is forthcoming a personal follow-up reminder is made. For this recovery plan no comments had been received by the time of publication. However, as and when actions of this plan are implemented, relevant Aboriginal interests will be engaged with.

This recovery plan will be adopted and released subject to any Native Title rights and interests that may continue in relation to the land and/or waters. Nothing in the plan is intended to affect Native Title. The Commonwealth *Native Title Act 1993* should be considered before undertaking any future acts that might affect Native Title.

## Social and Economic Benefits and Impacts

Implementation of this recovery plan is likely to provide a number of social and economic benefits, as well as having some impacts. Recommended recovery actions are compatible with continuation of many existing land uses, with a focus on increased knowledge, adoption of 'best practice' adaptive management, and improved planning and development of areas with Peppermint Box Grassy Woodland.

Potential social and economic benefits include:

- Improved awareness, knowledge, skills and capacity of land owners and managers to manage PBGW remnants for conservation and production;
- Increased productivity, economic benefits and sustainability of grazing enterprises through adoption of 'best practice' management;
- Local peer support networks developed and maintained for land owners and managers developed and maintained;
- Opportunities for coordinated brokering of livestock grazing services to land owners without stock;
- Greater general knowledge, awareness and understanding of the ecological community and its management;

- Increased community skills and capacity to participate in management of biodiversity and natural resource assets (e.g. increased weed and pest animal management);
- Improved development assessment and planning processes for sites with Peppermint Box Grassy Woodland remnants;
- Targeting of available funding resources to high priority activities and sites;
- Improved access to funding for individual land owners and managers, community groups and Local Government, for conservation and management of Peppermint Box Grassy Woodland;
- Research effort focussed on addressing knowledge gaps for the ecological community; and
- Increased aesthetic and tourism values associated with improved condition and native species diversity of Peppermint Box Grassy Woodland remnants.

Potential social and economic impacts may include:

- Additional infrastructure costs associated with changing to 'best practice' grazing management (Bishop 2009);
- Time and effort to learn about new management techniques (Bishop 2009);
- Management costs for Peppermint Box Grassy Woodland remnants currently not actively managed;
- Reduced stock access for grazing and shelter at ecological restoration sites;
- Limitations or conditions placed on urban and peri-urban developments, new infrastructure developments and mineral exploration or extraction;
- Additional costs associated with improved site management and protection of PBGW remnants at industrial, infrastructure and development sites; and
- Costs of implementing 'best practice' restoration of degraded sites.

Recovery actions in this plan provide a framework to help minimise significant adverse social and economic impacts. These include provision of targeted training and support to land owners and managers, planners, developers and other stakeholders; development of improved 'best practice' adaptive management and restoration techniques for different land uses; and targeted funding, peer support and advice to assist adoption of 'best practice' adaptive management and restoration techniques at Peppermint Box Grassy Woodland sites.

## Benefits to Species and other Ecological Communities

Individual native plant and animal species of the Peppermint Box Grassy Woodland ecological community will also benefit from implementation of this recovery plan. Some of the benefits to species and the environment are outlined below.

Increased knowledge about the location, native species composition and condition of Peppermint Box Grassy Woodland remnants will enhance:

- Conservation, management and protection of rare and threatened species, particularly species listed under the EPBC Act and the NPW Act (Table 1);
- Protection and management of habitat for a range of woodland-dependent species and grassy habitat specialist species;
- Targeted threat abatement and site restoration work in priority areas; and
- Improved planning and assessment of development proposals in or near Peppermint Box Grassy Woodland remnants.

Increased adoption of 'best practice' adaptive grazing management will help:

- Shift the biomass balance in the understorey from exotic annual plants to native perennial plants;
- Reduce grazing pressure on palatable native herbs and forbs, such as native legumes, lilies and daisies;
- Provide habitat for a wide range of invertebrates including butterflies and spiders;
- Reinstate and maintain the microphytic crust which protects the soil surface layer; and
- Reduce surface water run-off, soil erosion and compaction, and their associated impacts on native species.

Conservation outcomes will be enhanced by aligning with relevant State and regional planning documents, including;

- No Species Loss, A Nature Conservation Strategy for South Australia 2007-2017 (Department for Environment and Heritage, undated);
- Cape Borda to Barossa Naturelink (DENR, undated);
- Regional recovery plan for threatened species and ecological communities of Adelaide and the Mount Lofty Ranges, South Australia – 2009-2014 (Wilson & Bignall 2009);
- Para Woodland Restoration Project
- The SA Urban Forests - Million Trees Program (Urban Biodiversity Unit 2012)
- SA Murray Darling Basin Threatened Flora Recovery Plan (Obst 2005);
- Natural Resource Management Plan for the Northern and Yorke, SA Murray-Darling Basin, Adelaide and Mount Lofty Ranges and Eyre NRM;
- Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia (Quarmby 2010);
- Recovery Plan for the Endangered Osborn's Eyebright *Euphrasia collina* subsp. *osbornii* (Moritz & Bickerton 2010); and
- National Recovery Plan for the Iron-grass Natural Temperate Grassland of South Australia 2012 (Turner 2012)

Adjoining areas of other ecological communities may also benefit from recovery actions in Peppermint Box Grassy Woodland remnants. For example, improved site management and protection measures in Peppermint Box Grassy Woodland may provide important seasonal feeding or breeding habitat for native fauna species, enhancing their ability to maintain viable populations, provide ecosystem services or move through the landscape between different ecological communities. The restoration and re-establishment of Peppermint Box Grassy Woodland may also improve landscape connectivity, reduce weed and pest animal abundance and assist in the maintenance of important ecological processes.

# Part B The Ecological Community

## Description of the Listed Community

The EPBC Listing Advice defines the ecological community by characteristic features of its vegetation structure and composition, distribution range, climate, soil type and position in the landscape (Threatened Species Scientific Committee 2007). Key features of the ecological community are as follows:

- The vegetation structure of the ecological community is an open to dense woodland dominated by *Eucalyptus odorata*. The *E. odorata* trees are the woodland tree form, generally with a single trunk at the base and often with low branching. Trees are usually in the range of 5 to 10 m high, but may be up to 15 m. Canopy cover is typically 5 to 40% but can reach 70%. Other tree species may be present but they contribute less to the canopy cover and generally are not as abundant as *E. odorata*. The understorey consists mainly of native grasses and other perennial and annual native herbs. Medium to tall shrubs (0.5 m to 2.0 m or more) are sparse, but can have up to 30% canopy cover.
- The ecological community is restricted to South Australia and occurs primarily in the Flinders-Lofty Block Bioregion, with patches extending into the Murray-Darling Depression, Kanmantoo, Eyre-Yorke Block and Gawler Bioregions. The main distribution extends from Mount Brown in the southern Flinders Ranges, south to Lake Alexandrina. A smaller isolated area occurs in the Koppio Hills and surrounding areas of southern Eyre Peninsula.
- The climate is typically 'Mediterranean', with hot, dry summers and cool, wet winters. The winter-dominant rainfall averages 310-610 mm/year across the distribution range. Frosts are common in some areas. Most remaining patches are on gentle to moderate hill slopes, foot slopes, ridgelines and adjacent plains, often at altitudes above 300 metres. Soil types vary from sandy loam to clay loam. Scattered surface stones occur at many sites.

Examples of Peppermint Box Grassy Woodland are shown in Figures 1 and 2.

## Condition Classes and Timing of Assessments

The EPBC Listing Advice distinguishes better quality remnants of Peppermint Box Grassy Woodland that are protected by the listing, from remnants with low native species diversity that are not considered part of the ecological community and not protected under the EPBC Act (Threatened Species Scientific Committee 2007). Three different condition classes are defined on the basis of remnant patch size, native species diversity and composition (Table 2).

Condition Classes A and B make up the listed ecological community, with Condition Class A representing the areas of best condition. Condition Class C represents Peppermint Box Grassy Woodland remnants considered too degraded to be part of the listed community, but of sufficient biodiversity value to target for restoration.

**Table 2: Condition Classes defined under the EPBC Act for the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia**

| Condition Class | Minimum Patch Size (hectares) | Native Species Diversity[1,2] | No. of Native Broad-leaved Herbaceous Species[1] (excluding disturbance resistant species[3]) | No. of Native Perennial Grass species[1] |
|---|---|---|---|---|
| **Listed ecological community** | | | | |
| **A** | ≥ 0.1 ha | > 30 | ≥ 10 | ≥ 5 |
| **B** | ≥1.0 ha | > 15 | ≥ 3 | ≥ 2 |
| **Degraded patches amenable to rehabilitation** | | | | |
| **C** | | > 5 | No minimum | ≥ 1 |

Notes
[1] As measured in a 50m x 50m quadrat (or equivalent to make 2,500m$^2$ if patch is narrower – e.g. roadside corridor).
[2] *Eucalyptus odorata* should be one of the species recorded in the quadrat.
[3] Disturbance resistant species:- *Ptilotus spathulatus*; *Sida corrugata*; *Oxalis perennans*; *Convolvulus erubescens*[4]; *Euphorbia drummondii* (syn. *Chamaesyce drummondii*); *Maireana enchylaenoides.*
[4]NB *Convolvulus erubescens* is no longer considered to occur in South Australia (Barker *et al*. 2005) and specimens previously named as this species are now ascribed to eight other taxa in the genus with *C. angustissimus* subsp. *angustissimus, C. angustissimus* subsp. *peninsularum* and *C. remotus* possibly occurring in the PBGW ecological community.

Condition Class ratings of Peppermint Box Grassy Woodland remnants are based on surveys of 50 m x 50 m quadrats, or an equivalent area. While surveys could in theory be done at any time of the year, accurate rating relies on determining the total native plant species diversity, the number of broad-leaved herbaceous species and the number of perennial native grass species. This may only be possible at certain times of the year or in certain phases of management (e.g. after rest and re-growth following grazing).

Some commonly occurring native forbs and 'grass-like' herbs of the ecological community are annuals or herbaceous perennials which germinate or re-sprout after rain in autumn or early winter, then die off again in late spring to early summer. They are most easily identified when flowering or setting seeds, generally in late winter or spring, but can be difficult to identify or even detect at other times of the year. Many of the characteristic native grass species, particularly Wallaby Grasses (*Rytidosperma* (formerly *Austrodanthonia*) species), Spear-grasses (*Austrostipa* species) and Native Wheat-grass (*Elymus scaber*) are difficult to distinguish in vegetative growth and may only be positively identified by their flowers or mature seeds, generally in late spring to early summer. In grazed areas, palatable species may need to regrow and flower before they can be identified.

Condition Class ratings help inform decisions about the likelihood of significant impact on the listed Peppermint Box Grassy Woodland ecological community. However, ratings for a site can vary depending on the season the assessment is done; climatic conditions such as drought; time elapsed since grazing or other disturbances; presence of weed (including introduced pasture grasses) biomass obscuring small native plants; whether the 50m x 50m survey quadrat is representative of average diversity in that remnant; and interpretation of which native plant species to include in the 'broad-leaved herbaceous' category.

Ideally site surveys for Condition Class ratings should be:

- undertaken in mid to late spring, and if necessary over multiple visits, to ensure accurate plant identification;
- assessed in good seasonal conditions or within two months of effective rain;
- done at least two months after a disturbance (e.g. fire, grazing, slashing);
- located in the most intact (least modified) vegetation in the remnant; and
- based on multiple quadrats.

If site surveys are undertaken in poor seasonal conditions, during or soon after stock grazing or other disturbances, or at a sub-optimal time for plant identification, the precautionary principle should be applied to Condition Class ratings, especially if a remnant fails to meet the criteria for Condition Class A or B by a small margin.

Potential site assessors require more specific guidance on assessing the Condition Class of remnants. It is recommended that this be addressed in the short-term through field testing and clarification of survey methods, followed up with information and training for site assessors (Action 1.1 & 1.2).

Thresholds for condition classes of the ecological community may be reviewed by the Australian Government from time to time. Any change in thresholds will need to be incorporated into site assessor training and the GIS database and mapping of the ecological community updated.

## Structure and Floristic Composition

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community includes both woodlands where *E. odorata* is the only tree species present, and mixed species woodlands where it is the dominant canopy species. Peppermint Box (*E. odorata*) is one of four woodland eucalypts regarded as an indicator of grassy woodland communities in the Lofty Block region (Robertson 1998). Peppermint Box Grassy Woodland often inter-grades with other eucalypt grassy woodland communities, including those dominated by SA Blue Gum (*E. leucoxylon* subspecies), Eyre Peninsula Blue Gum (*E. petiolaris*) or Mallee Box (*E. porosa*).

Broad structural criteria distinguishing grassy woodlands from other woodland ecosystems include the absence of a well developed medium height (0.5 – 2.0 m) native shrub layer; and a high cover/abundance of low growing species such as native grasses, *Lomandra* species, native forbs, sedges, and mosses or lichens in the ground-cover layer (Robertson 1998).

Many native herbaceous species of Peppermint Box Grassy Woodland are common to, and characteristic of, other grassy woodland and grassland communities in South Australia (Robertson 1998) and elsewhere in south-eastern Australia (Eddy *et al*. 1998; Lunt *et al*. 1998; Carter *et al*. 2003). Some of these herbaceous species occur predominantly or exclusively in grassy ecosystems and are regarded as 'grassy ecosystem specialists' (Appendix 4; Specht 1972; Davies 1997; Robertson 1998).

Grazing pressure from livestock, feral animals or kangaroos can influence the composition and structure of Peppermint Box Grassy Woodland remnants. Moderate to high intensity grazing suppresses regeneration of palatable trees, shrubs and herbaceous plants, resulting in an absence of different age classes of these plants. It also affects fauna habitat in the understorey, by removing leaf litter and suppressing the growth and structural development of shrubs, perennial tussocks and mat-forming plants.

Complete removal of grazing can also impact on woodland composition and structure. Invasive annual and perennial weeds (including introduced pasture species) previously kept in check by grazing can increase in abundance and cover, dominating the

natural open spaces and suppressing or out-competing native grasses, forbs and shrubs (Lenz *et al.* 2003).

In general, woodlands with the 'mallee form' of *E. odorata* over a heath understorey, and *E. odorata* woodlands with a continuous shrubby understorey of greater than 30% cover, are not considered to be Peppermint Box Grassy Woodland. However, variations from the typical structural composition of Peppermint Box Grassy Woodland may be observed under particular transitional states. For example, following fire or the removal of grazing, there may be prolific shrub regeneration in some remnants, resulting in greater than 30% shrub cover. 'Woodland form' *E. odorata* trees, which characterise this ecological community, typically have a single main trunk at the base, but may have multiple trunks and resemble mallees after fire, wood-cutting, grazing or other tissue damage, due to regrowth from the base.

Further information on the structure and floristic composition of Peppermint Box Grassy Woodland is presented in Appendix 5.

The native plants most commonly recorded in Biological Surveys of Peppermint Box Grassy Woodland are listed in Appendix 4. Grassy ecosystem specialists are designated by species coding from Davies (1997), Robertson (1998) and Specht (1972).

### *Characteristic Flora*

The native plant species composition of Peppermint Box Grassy Woodland is very similar to other grassy woodland communities throughout the region (Robertson 1998). Species which characterise different grassland and grassy woodland communities in this bioregion may have become rare or locally extinct (Robertson 1998) as a result of selective grazing, trampling, suppressed regeneration or depletion of the soil seed bank, making it difficult to identify characteristic flora of the ecological community.

Indicator species with a statistically significant occurrence in the *Eucalyptus odorata* Low Woodland group include Peppermint Box (*E. odorata*), Box Mistletoe (*Amyema miquelii*), Common Woodruff (*Asperula conferta*), Small-flower Wallaby-grass (*Rytidosperma setaceum*, formerly *Austrodanthonia setacea*), Crested Spear-grass (*Austrostipa blackii*), Feather Spear-grass (*Austrostipa elegantissima*), Rough Spear-grass (*Austrostipa scabra* subsp. *scabra*), Climbing Saltbush (*Einadia nutans* subsp. *nutans*), Native Wheat-grass (*Elymus scaber* var. *scaber*), Common Eutaxia (*Eutaxia microphylla*), Coarse Bottle-daisy (*Lagenophora huegelii*), Wingless Fissure-plant (*Maireana enchylaenoides*) and Native Plantain (*Plantago varia*) complex (Robertson 1998).

## Fauna

Native fauna are an integral component of the Peppermint Box Grassy Woodland ecological community. Fauna drive or influence many essential ecological processes such as biomass management, nutrient recycling, soil structure and fertility, water infiltration and run-off, pollination, plant dispersal, flora and fauna species composition, habitat availability, and distribution of species within and between remnants. Mammals, birds, reptiles, amphibians, insects, spiders and other invertebrates occur in the ecological community, making use of and relying on a variety of habitats. Important fauna habitats available in Peppermint Box Grassy Woodland include tree trunks, limbs and small branches, foliage, flowers, bark, hollows, leaf litter, understorey plants, shaded areas, open spaces, rock outcrops, fallen logs and loose surface stones, microphytic crusts, bare ground and the sub-surface soil profile.

Relatively few comprehensive fauna surveys have been undertaken in Peppermint Box Grassy Woodland and some fauna groups, such as the invertebrates, are difficult to observe, sample and identify.

Kangaroos (*Macropus* spp.) are the most abundant mammals recorded in Peppermint Box Grassy Woodland (Herbert 2000; Johnson 2003; Neagle 2008), with Common Brushtail Possums (*Trichosurus vulpecula*) also frequently recorded (Neagle 2008; Johnson 2003) despite being considered endangered and declining in the Northern and Yorke and Eyre Peninsula regions (Gillam and Urban 2008; Gillam and Urban 2009) and rare in South Australia (NPW Act).

Over 60 native bird species have been recorded at Peppermint Box Grassy Woodland survey sites in the Mid North and Eastern Mount Lofty Ranges, with the most frequently recorded species including the Australian Magpie (*Cracticus tibicen*), Galah *(Eolophus roseicapillus*, syn. *Cacatua roseicapilla*), Grey Shrike-thrush (*Colluricincla harmonica*), Little Raven (*Corvus mellori*), Striated Pardalote (*Pardalotus striatus*), Red Wattlebird (*Anthochaera carunculata*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*), Mistletoe Bird (*Dicaeum hirundinaceum*), Crimson Rosella (*Platycercus elegans*), Red-rumped Parrot (*Psephotus haematonotus*) and Weebill (*Smicrornis brevirostris*) (Johnson 2003; Neagle 2008).

While at least 20 reptile species have been recorded at Peppermint Box Grassy Woodland sites in the Mid North and Eastern Mount Lofty Ranges (Johnson 2003; Neagle 2008), the limited number of systematic surveys undertaken makes it difficult to draw conclusions about characteristic species.

Information on frog species occurring in Peppermint Box Grassy Woodland is very limited, though evidence of the Brown Toadlet (*Pseudophryne bibronii*), Common Eastern Froglet (*Crinia signifera*) and Spotted Grass Frog (*Limnodynastes tasmaniensis*) has been recorded (Neagle 2008; Hutchinson *et al*. 1999).

Invertebrates are a major faunal component of temperate grassy woodland communities (Martin and Green 2002). However, no systematic surveys of the invertebrates of Peppermint Box Grassy Woodland have been undertaken and limited information is available. Targeted surveys and monitoring are needed to find out more.

Further work is needed to identify characteristic and functionally important fauna species of Peppermint Box Grassy Woodland. Information on the macro-fauna of the ecological community is summarised in Appendix 6.

## Threatened Species

### *Threatened Flora*

At least 33 native plant species recorded in surveys of Peppermint Box Grassy Woodland have National or State conservation ratings (DEH 2009). Five species, Menzel's Wattle (*Acacia menzelii*), Resin Wattle (*Acacia rhetinocarpa*), Osborn's Eyebright (*Euphrasia collina* subsp. *osbornii*), Silver Daisy-bush (*Olearia pannosa* subsp. *pannosa*) and Lowly Greenhood *(Pterostylis despectans*), are listed as threatened under the EPBC Act (Table 1). The remaining 28 species are listed in the threatened species schedules of the NPW Act. Vegetation surveys in the Mid North also found at least 51 plant taxa of regional conservation significance in Peppermint Box Grassy Woodland sites (Neagle 2008).

### *Threatened Fauna*

The Flinders Worm Lizard (*Aprasia pseudopulchella*) is the only nationally threatened fauna species currently associated with the ecological community. This species is no longer listed in the NPW Act schedules. Six state threatened fauna species have been recorded in the ecological community, including one mammal, four bird species and an amphibian (Table 1). Peppermint Box Grassy Woodland is an important habitat for woodland birds, and several species recorded in the ecological community are thought to be in decline nationally or in regions where the ecological community

occurs (DEH 2005b; Gillam and Urban 2008, 2009 & 2010; Olsen 2008; Willson and Bignall 2009).

***Regionally Threatened Species***

For information on the status, trends and prioritisation of flora and fauna species at the regional scale, see Gillam (2009a, 2009b & 2010); Gillam and Urban (2008, 2009 & 2010); and Willson and Bignall (2009).

## Other Communities Resembling the Listed Ecological Community

Several other grassy woodland communities in South Australia resemble the Peppermint Box Grassy Woodland ecological community, with *E. odorata* present as a sub-dominant species at some sites. These include:

- *Eucalyptus leucoxylon* +/- *E. odorata* Low Woodland and Woodland (Robertson 1998);
- *Eucalyptus leucoxylon* +/- *E. odorata* +/- *Allocasuarina verticillata* Woodland over *Acacia pycnantha*, *A. paradoxa* (Neagle 2008);
- *Callitris glaucophylla* +/- *Eucalyptus odorata* Low Open Forest (Neagle 2008);
- *Allocasuarina verticillata* Low Woodland (Neagle 2008).

Floristic analysis of these communities (Robertson 1998; Neagle 2008) identified some different indicator species and variations in the dominant native understorey species, but they also have many species in common with *Eucalyptus odorata* Low Woodland. However, patches within these other floristic vegetation communities may have a higher proportion of *E. odorata* and therefore meet the criteria for the listed Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community. Hence assessments of grassy woodland remnants with *E. odorata* should not be deduced from broad-scale floristic vegetation maps, but should still be done on a site basis and against the EPBC criteria.

Examples of mallee woodland communities with *E. odorata* that do not fit the criteria for the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community include:

- *Eucalyptus odorata*, +/- *E. fasciculosa* Low Open Forest over *Acacia pycnantha*, *Melaleuca uncinata*, *A. paradoxa* and *Astroloma humifusum*;
- *Eucalyptus odorata* +/- *E. phenax* subsp. phenax Mid Mallee Woodland over *Melaleuca uncinata*, *Lasiopetalum baueri*, tussock grasses and *Gonocarpus mezianus*;
- *Eucalyptus odorata* Mid Open Mallee Woodland over *Senna artemisioides* subsp. *petiolaris*, *Acacia ligulata*, *Alyxia buxifolia*, *Rytidosperma setaceum* and *Westringia rigida*.

## Recovery Opportunities

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community is currently listed as Critically Endangered, based on the following criteria:

- The ecological community has undergone a decline in extent of greater than 95%, based on estimates of the pre-European extent and current extent; and
- The change in community integrity makes regeneration of the ecological community unlikely in the medium-term future without active intervention.

Many Peppermint Box Grassy Woodland remnants are small and isolated, and most are subject to ongoing impacts from a range of threats. Given the modified agricultural landscape in which these remnants occur, it is unlikely that the severe decline in extent and integrity of the ecological community could be substantially reversed by recovery actions. Even if all patches rated as 'high confidence' of being Peppermint Box Grassy Woodland (Table 3) met the criteria for the EPBC Act listed ecological community, the area remaining would need to be doubled to raise the area of occupancy above 5% and change the national threat rating from Critically Endangered to Endangered.

Broad-scale re-establishment of the ecological community where it once occurred is not feasible or practical, due to changed conditions at cleared sites, including altered soil structure, nutrients and chemistry, depletion of native soil seed banks, and loss of soil-dwelling native invertebrates, fungi and micro-organisms. However, opportunities exist to improve the long-term viability of the Peppermint Box Grassy Woodland ecological community. Priorities centre on halting any further decline in the extent and integrity of Peppermint Box Grassy Woodland remnants; improving the condition and integrity of these remnants; and restoring degraded areas with potential for recovery so they meet the condition criteria for the listed ecological community. Opportunities also exist to increase conservation outcomes for the Peppermint Box Grassy Woodland ecological community by linking with other threatened species and ecological community recovery plans and programs including Cape Borda to Barossa NatureLinks and the recovery programs for the Iron-grass Natural Temperate Grassland, Pygmy Bluetongue Lizard, Twelve Threatened Orchids in the Lofty Block Region and the Osborn's Eyebright.

Most remaining areas of Peppermint Box Grassy Woodland are on private agricultural land and have a long history of use for livestock grazing. These areas are often highly modified and many are likely to fit within Condition Class C of the ecological community (A. Brown, pers. comm.). Condition Class C remnants and scattered paddock trees still provide important habitat for many woodland-dependent fauna of the ecological community, such as possums, bats, woodland birds, reptiles and invertebrates. They also support or provide potential habitat for many grassy ecosystem plants. These lower condition remnants offer the best opportunity to increase the area of occupancy of the listed ecological community but are not formally protected by the EPBC Act. Long-term recovery of the ecological community will depend on ensuring that patches of Condition Class C Peppermint Box Grassy Woodland are retained, and that interested and willing land owners and managers are supported in adopting management practices that protect and restore these areas.

Monitoring programs will need to be established to detect changes in the condition and viability of remnants, determine the impacts of threats and their abatement, and the contribution of restoration projects and management changes to the recovery of the ecological community.

# Part C Distribution and Location

## Current Distribution

The Peppermint Box (*Eucalyptus odorata*) Grassy Woodland ecological community occurs only in South Australia. Its distribution is a sub-set of the distribution of *E. odorata*, which also occurs in a range of other native vegetation communities, including shrublands, mallee and woodlands with a dense shrub understorey.

The main distribution of the ecological community extends from Quorn in the southern Flinders Ranges to Victor Harbor, with an outlying area on eastern Eyre Peninsula (Figure 3). It occurs in a variety of positions in the landscape, including the crests, slopes and foot slopes of hills, on plains and flats, in gullies and on ridges (Robertson 1998; Neagle 2008). Peppermint Box Grassy Woodland has been heavily cleared, fragmented and modified since European settlement and the current area of occupancy may be as little as 2% of the original cover (TSSC 2007).

Knowledge of the location, area and condition of Peppermint Box Grassy Woodland remnants is incomplete. Broad-scale mapping of treed vegetation is available for most of the distribution of the ecological community (excluding the Southern Flinders region), but where mapping is available, it is subject to limitations including scale (smaller remnants are excluded) and accuracy (much of the mapping is based on interpretation of aerial imagery and extrapolation of point-based survey data, and therefore the dominant tree species is often uncertain). Identification of eucalypt species at survey sites has also been problematic in the past, particularly confusion of Grey Box (*E. microcarpa*) or Mallee Box (*E. porosa*) with Peppermint Box (Hyde 1996). Furthermore, the floristic vegetation units assigned in South Australian Vegetation Mapping do not align directly with the definition of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia. Furthermore, condition information is unavailable for most sites, and it is not clear what proportion of the community meets the EPBC Act condition class criteria.

A desktop assessment of available mapping and survey data has been undertaken to identify sites likely to support Peppermint Box Grassy Woodland (DEH 2010). Based on this assessment, there are thought to be around 58,000 hectares of grassy woodland remnants where *E. odorata* is a dominant or subdominant canopy species (Table 3). The area likely to fit the EPBC Act definition of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia (Threatened Species Scientific Committee 2007) is much less and probably closer to 24,000 ha (Table 3), and only a subset of this area would meet the condition class criteria for the listed community.

The distribution of mapped Peppermint Box Grassy Woodland remnants across different land tenures is summarised in Table 3. Nearly 98% of the area rated as high confidence of being the Peppermint Box Grassy Woodland ecological community is on private land. The proportion of privately owned Peppermint Box Grassy Woodland with formal protection of a Heritage Agreement is likely to be less than 4.5%.

Less than 2.5% of the area rated as high confidence of being the Peppermint Box Grassy Woodland ecological community is on public land, but more than half of this (58%) is protected in NPW Act reserves. The remaining unprotected public land areas are in roadside reserves, Crown Land parcels or land owned and managed by Local Governments and various Government agencies (DEH 2009). Many of these unprotected remnants are small and/or isolated.

**Table 3: Estimated areas of Peppermint Box Grassy Woodland under different land tenure and protection[1].**

| Confidence Level[2] | Protected Areas | | Areas not formally protected | |
|---|---|---|---|---|
| | Public Land[3] | Private Land[4] | Public Land[5] | Private Land[6] |
| High | 344 ha | 1092 ha | 246 ha | 22,199 ha |
| Medium | 128 ha | 189 ha | 324 ha | 15,341 ha |
| Low | 305 ha | 998 ha | 7,491 ha | 9,516 ha |

Notes
1 Based on the desk-top assessment of existing survey sites and floristic vegetation mapping polygons. Includes grassy woodland remnants rated as High, Medium or Low confidence of fitting the definition for the EPBC Act listed ecological community, within the general distribution area for the ecological community.
2 Confidence that the vegetation at a survey site meets the general definition for Peppermint Box Grassy Woodland as in EPBC Act Policy Statement 3.7 (Australian Government 2007), irrespective of current Condition Class. See Appendix 4 for definition of confidence categories.
3 Protected as a park or reserve under the NPW Act.
4 Protected in perpetuity by a Heritage Agreement covenant under the NV Act.
5 Includes Crown Land assigned to various State or Australian Government Departments, Corporations, and Local Governments, not protected under the NPW Act or by a Heritage Agreement covenant under the NV Act.
6 Private freehold and leasehold land, including private Sanctuaries under the NPW Act not formally protected by a Heritage Agreement covenant under the NV Act.

***Furthering Knowledge of Distribution and Condition***

Improved knowledge of the location, area and condition of Peppermint Box Grassy Woodland will be important to guide recovery actions and priorities, assess and manage threats and potential impacts, and evaluate the effectiveness of the recovery effort. Ground-truthing of mapped woodland polygons is a priority, to confirm the presence and extent of this ecological community. In addition to targeted surveys, information on the location, extent, and condition of Peppermint Box Grassy Woodland remnants should be collated from a range of sources, including land owners and managers, NGOs, community groups, local experts, and site assessment data from development proposals, environmental stewardship programs, NGOs, community groups and NRM on-ground works programs. Priority for targeted surveys should be given to areas at risk of development and land use change.

Predictive vegetation mapping which models the expected occurrence of the ecological community can help inform site selection and target future survey effort. DEWNR has developed a predictive vegetation model for the Northern and Yorke, and Adelaide and Mount Lofty Ranges NRM regions, based on floristic associations and physical parameters (Rogers in prep.). Field surveys are needed to test and further develop the model.

To make best use of future survey effort, new information and existing data, it is recommended that:

- site assessors use a consistent, agreed survey methodology;
- data are recorded in a form compatible with the GIS database already developed by DEWNR for Peppermint Box Grassy Woodland;
- adequate resources are available to maintain and regularly update the GIS database;
- polygons requiring ground-truthing are targeted for field assessment;
- site surveys are used to ground-truth the predictive model; and
- updated information on the distribution and condition of remnants is provided to land owners and managers, site assessors and other stakeholders, including the Australian Government.

## Protected Areas

Analysis of vegetation survey data and floristic vegetation mapping identified nine NPW Act reserves and 118 private Heritage Agreements in the Protected Areas Network containing grassy woodland vegetation with *E. odorata*. Some of these protected areas also have woodland vegetation with the mallee form of *E. odorata* and/or a shrubby understorey dominated by sclerophyll (heath) or chenopod species: these are not considered part of the ecological community and were excluded from the analysis.

At least 345 ha of Peppermint Box Grassy Woodland is protected in NPW Act reserves, and 1,091 ha in Heritage Agreement parcels. However, this area could be larger, if remnants currently not rated as high confidence of meeting the listed community's criteria are found to contain patches that do meet the criteria. Generally the Peppermint Box Grassy Woodland remnants in protected areas were surveyed and mapped long before the ecological community was listed under the EPBC Act. Their current condition and integrity is unknown, and the proportion of these areas meeting the EPBC Condition Class criteria needs to be assessed and mapped in the field.

### *Parks and Reserves*

One National Park, five Conservation Parks and three other NPW Act reserves protect areas of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community (Appendix 7).

### *Heritage Agreements*

At least 118 private Heritage Agreement parcels, totalling 2,280 ha, contain grassy woodland vegetation with *E. odorata* over herbaceous and shrub understorey. More than half of these Heritage Agreements (64%) are less than one hundred hectares. Some have been included in formal vegetation surveys (e.g. in Robertson 1998; Neagle 2008), and many have been evaluated for presence of the Peppermint Box Grassy Woodland ecological community based on Heritage Agreement site assessment data, floristic vegetation mapping and local expert knowledge. Most of these Heritage Agreements require further field assessment to determine their current species composition, structure and ecological integrity, Condition Class rating and the proportion of their area which meets the criteria for listing under the EPBC Act.

## Past Distribution

The Peppermint Box Grassy Woodland ecological community is estimated to have once extended over 900,000 hectares (Davies 2000; Threatened Species Scientific Committee 2007), across the Southern Flinders Ranges, Mid North, eastern Mount Lofty Ranges, near-coastal areas of the Fleurieu Peninsula, and parts of the Eyre Peninsula.

At the southern limit of its distribution, Peppermint Box Grassy Woodland was previously recorded on heavier textured grey-brown podsols adjacent to the coast around Port Elliott, Encounter Bay, Cape Jervis, Normanville and Sellick's Hill (Boomsma 1948). It also occurred on red brown earths on undulating to hilly terrain on the eastern slopes of the Mount Lofty Ranges between Harrogate, Callington and Lake Alexandrina (Jessup 1946). In the central Mount Lofty Ranges north of the Torrens River, Specht *et al.* (1961) described the community as being common along the Para scarp on reasonably fertile soils. In the Northern Mount Lofty Ranges, the community occurred on brown solonized soils on the foothill plains and skeletal soils in the hills (Jessup 1948).

Throughout the Mid North region of South Australia, Peppermint Box Grassy Woodland occurred on hilly country, growing in red-brown earths, podzolic soils, and skeletal soils over limestone (Todd 1965). On the lower slopes, the vegetation graded into

*Eucalyptus leucoxylon subsp. pruinosa* Woodland in the vicinity of drainage lines (Croft 2008).

In the Southern Flinders Ranges, Peppermint Box woodlands were recorded on small hills of red-brown soils, and plains with solonized brown soils (Boomsma 1946).

On Eyre Peninsula, Smith (1963) described Peppermint Box woodlands as occurring on the most fertile soils (red brown earths, chocolate skeletal soils of the upper slopes and a wide belt of fertile transitional red-brown earths from Lipson through Stokes to the railway line at Cockaleechie). Outliers were recorded at Mt Isabella, north-east of Yeelanna, surrounding an outcrop of Archaean rock, near Mt Hope and near the Marble Range.

***Historical factors influencing current distribution***

Many Peppermint Box Grassy Woodland remnants have been used for sheep grazing since the early days of European settlement and their botanical composition has been substantially altered, with perennial native grasses and forbs largely replaced by introduced annual grasses and other weeds (Specht 1972). The naturally fertile soils of savannah woodlands and increased concentration of nutrients by livestock have favoured introduced annual pasture plants and weed species, dramatically changing the understorey species composition in some areas. The tendency for sheep to congregate under shade in paddocks with traditional set-stocking grazing regimes means that many of the woodland areas in paddocks are lacking younger age-classes of trees and no longer support the natural understorey of the Peppermint Box Grassy Woodland ecological community.

While livestock grazing has impacted mainly on the condition of Peppermint Box Grassy Woodland, the progressive development of land for cropping has substantially reduced the area of the ecological community. Tree cutting and ploughing on the arable gentle and lower slopes and plains cleared the ecological community from the deeper soils and less rocky areas. Once cleared, these areas have generally been maintained for cropping and sown pastures, and the trees and understorey have been prevented from regenerating. Some patches of Peppermint Box trees were deliberately retained for stock shelter, generally on the soils less suitable for cropping.

Hence, while Peppermint Box Grassy Woodland was once widespread in the landscape, it is now confined mainly to the shallower, rockier soils within its former distribution range. Remnants in the Lofty Block region generally follow the north-south pattern of alignment of the hills and ranges. Floristic types of the ecological community associated with deeper and more fertile soils of the lower slopes and plains in particular are under-represented. Remnants vary in size from less than one hectare to large blocks of 100 ha or more, but generally are fragmented and isolated from each other by areas of arable cropping land and pasture dominated by introduced species. The ecological integrity and condition of remnants can vary considerably.

## Habitat Critical to Survival

In broad terms, habitat critical to the survival of Peppermint Box Grassy Woodland is on the loam to clay loam soils in areas of winter-dominant rainfall, within the range of its distribution (see Figure 3). Current knowledge indicates that approximately 2% of the Peppermint Box Grassy Woodland that existed at the time of European settlement remains. These remnants are highly fragmented and isolated across the natural distribution range; many remnants are degraded and in lower condition states. It is likely that less than one per cent of the original area has a moderate to high level of ecological integrity.

Given the relatively small area that remains of this critically endangered ecological community, all sites that meet the criteria for the listed community and provide habitat for component flora and fauna species should be considered habitat critical to the survival of the ecological community.

From an ecological perspective, remnants of lower condition (Condition Class C) may also be critical to survival of the ecological community because they adjoin, buffer or connect high integrity remnants, provide critical habitat for functionally important or threatened species, are essential habitat for mobile species (e.g. woodland birds), increase the potential habitat for some species, or have good potential for restoration.

Actions related to Objectives 2, 5, 6 and 7 of this recovery plan (Table 5) provide the basis for surveying and assessing the condition of remnants and ranking sites for their value and priority for conservation or restoration.

In addition to the Condition Class criteria, the following attributes should be considered when assessing the significance of remnants and assigning priorities for their protection. They will be useful in evaluating habitat critical to survival of the ecological community, including Condition Class C remnants.

- moderate to high native plant species diversity in the remnant as a whole;
- presence of different age cohorts of *E. odorata*, including on-going regeneration and recruitment;
- presence of different vegetation strata within the woodland;
- native fauna species diversity;
- presence and diversity of woodland fauna habitats;
- presence and condition of the microphytic crust;
- variations in woodland structure, including open spaces and bare patches;
- presence of one or more national- or state-listed threatened species;
- presence of grazing-sensitive species;
- remnant size and shape;
- functional connectivity with other remnants of the ecological community and/or remnants of other ecological communities;
- low weed density, species diversity and/or limited distribution in remnants; and
- potential for restoration (including willingness of the land owner to participate).

The following habitat features are considered critical to influencing animal diversity and distribution in grassy woodlands (Martin and Green 2002) and their presence should be incorporated into assessments of remnant integrity and habitat value:-

- a herb and tussock understorey;
- a shrub layer;
- mature trees;
- a diversity of tree species and ages;
- tree hollows;
- standing and fallen dead timber; and
- sources of water nearby, including natural watercourses and dams.

Benchmarks for these features and attributes should be determined for the Peppermint Box Grassy Woodland ecological community, to ensure that all critical habitats are protected.

## Important Populations

All Peppermint Box Grassy Woodland remnant patches are considered important populations. The ecological community has been heavily cleared, fragmented and modified since European settlement and the current area of occupancy may be as little as 2% of the original cover (TSSC 2007) and is now confined mainly to the shallower, rockier soils within its former distribution range. Given the small area that remains, all sites that meet the criteria for the listed ecological community and provide habitat for component flora and fauna species should be considered populations important to the survival of the ecological community.

# Part D Land Use History and Management

## Current Land Use and Management

Most of the remaining areas of Peppermint Box Grassy Woodland are on private land managed for agricultural production. Historical clearance for agriculture significantly reduced the extent of the ecological community, particularly on arable lower slopes and flats. Remnants are generally confined to rocky areas or steeper slopes unsuitable for cultivation and most have a history of regular stock grazing dating back to pastoral and agricultural settlement in the 1850s to 1870s. Native species composition, structure and condition of these remnants have been modified to varying degrees, depending on the stock type, grazing intensity and the introduction of exotic pasture species.

Many landholders value these woodland areas for stock shelter, particularly summer shade and protection from cold weather, as well as grazing. Peppermint Box Grassy Woodland remnants are grazed mainly by sheep and cattle; horses and other stock species are also used on some properties. The predominant grazing regime in these remnants is set-stocking, although some landholders have recently changed to time-managed rotational grazing (H. Neal, pers. comm.). Set-stocking for long periods generally results in the loss of palatable native species and development of degraded 'camps' where repeated grazing, trampling, soil compaction and high nutrient loads suppress the regeneration of native trees and understorey plants. These conditions favour exotic annual species including Wild Oats (*Avena barbata*), Salvation Jane (*Echium plantagineum*), Clovers (*Trifolium* species), Cape Weed (*Arctotheca calendula*) and Brome grasses (*Bromus* species).

Some remnants have been set aside for conservation and regeneration, with stock grazing permanently excluded. These still require active management to maintain or improve their condition, but are often neglected due to lack of knowledge, time and resources. Complete stock exclusion after a long history of grazing can lead to dominance of the understorey by introduced annual grasses, pasture species and other weeds. Weed biomass and seed set need to be managed to reduce their competition with, and impacts on, the native species, but this can be difficult to achieve, especially in larger remnants. Total grazing pressure in some set-aside areas is still high due to other herbivores such as rabbits and kangaroos. These also need to be actively managed to reduce their impact on the native plants.

While land owners and managers generally recognise trees and shrubs as native vegetation, they generally have much less awareness and knowledge of native grasses, herbs and forbs. They may not recognise the natural understorey of the ecological community as native vegetation, or may be unable to distinguish herbaceous weeds from native species. This lack of knowledge also influences current decisions on land use, management and protection of Peppermint Box Grassy Woodland remnants.

Appropriate livestock grazing is an important tool for long-term management, maintenance and protection of the ecological community. Studies of grazing management in grassy woodlands indicate that practices such as low intensity grazing and time-managed rotational grazing with long rest periods can help maintain or improve condition, structure and habitat values of remnants while also allowing some agricultural production (Dorrough *et al*. 2004; Earl and Kahn 2006; Fischer *et al*. 2009).

As Peppermint Box Grassy Woodland occurs mainly on agricultural land, incompatible agricultural uses or inappropriate management practices also have potential for significant impact on survival and persistence of the ecological community. Management practices or changes in land use which may have a detrimental impact on the ecological community include high intensity set-stocked grazing regimes; cultivation and cropping in the woodland; introduction of new pasture species; soil

disturbance for weed or vertebrate pest control; application of fertilizers, soil ameliorants and agricultural chemicals; incompatible new agricultural industries; and other intensified activities (Table 4). In peri-urban areas, land use change from agricultural to urban, infrastructure developments and recreational pursuits (e.g. 4WD and trail bikes) may also impact on the ecological community.

## Best Practice Management

Active, adaptive management will be a key strategy for long-term persistence and conservation of the Peppermint Box Grassy Woodland ecological community, regardless of land tenure, land uses or protection mechanisms in place at individual sites. Existing 'best practice' guidelines for grassy ecosystems in south-eastern Australia provide general information relevant to conservation and management of Peppermint Box Grassy Woodland remnants (e.g. Eddy 2002; Sharp *et al*. 2005; Dorrough *et al*. 2008), but site-based research, trials and monitoring are needed to develop specific strategies for recovering the ecological community.

Management tools such as livestock grazing, slashing, fire, herbicides and pest control all influence, and can be used to manage, native and exotic plant biomass, vegetation structure, habitat features and diversity of native plants and animals in Peppermint Box Grassy Woodland.

Livestock grazing has been identified as a vital tool for restoration of degraded grazed grasslands (Papanastasis 2009), and may also be important in grassy woodlands. Field trials in grassy woodlands and grasslands in south-eastern Australia have found that different grazing strategies can be used to manipulate the perennial native grass component of native pastures (Earl and Kahn 2006; Dorrough *et al.* 2008), and variations such as rest periods in grazing regimes can benefit native invertebrate diversity and soil processes (Dorrough *et al*. 2004). There is some evidence that switching from a set-stock regime to a rotational grazing regime benefits grassy woodland communities (Fischer *et al*. 2009), with the tree component of woodlands more likely to regenerate under high-intensity rotational grazing than conventional continuous grazing. Grazing trials in a Peppermint Box Grassy Woodland in the Mid North have also found that a change to rotational grazing allowed regeneration of *E. odorata* trees and the native grass understorey (H. Neal, pers. comm.).

Fire is sometimes suggested to regenerate native understorey. In previously grazed grassy ecosystems fire sometimes results in rapid invasion by exotic plant species (Lunt and Morgan 1999). However, a combination of fire and livestock grazing may be more effective than grazing alone, in reducing weed cover and enhancing native plant cover (Dorrough *et al*. 2004), and restoring natural disturbance patterns, structural heterogeneity and species diversity. Grass-specific herbicides also show potential in broad-acre control of exotic annual grasses in native grassy ecosystems (Davies 1997) and carefully timed slashing can significantly reduce the cover of exotic annual grasses and some exotic perennial forbs (Davies 1997), but the value of these approaches in Peppermint Box Grassy Woodland needs further testing.

Use of these management tools, separately or in combination, in Peppermint Box Grassy Woodland requires further investigation. Management requirements at the site level will vary depending on current land use, management history, species composition, site condition, disturbances and threats, management goals, climate and the physical environment. Strategies for maintaining and improving condition and integrity of Peppermint Box Grassy Woodland remnants need to be tested and monitored against suitable benchmarks for the ecological community.

Development of 'best practice' management guidelines for the ecological community should be based on co-ordinated research and monitoring across a range of sites with

different land uses, site histories and management regimes. This research and monitoring should:

- be funded and run over longer time-frames (10+ years) so that long-term trends and changes due to management can be detected;
- be undertaken in close collaboration with private and public land owners and managers, utilising their local knowledge and experience as well as their land and time resources;
- incorporate sites funded through environmental stewardship programs and other NRM and community programs;
- include partnerships between researchers, NRM Boards, funding bodies, agricultural production advisers, communications and extension specialists;
- provide funding for infrastructure and management changes which impact on production and economic outcomes of participating land owners and managers;
- identify indicators and long-term monitoring strategies for the ecological community which land owners/managers and others can use; and
- link with and have input into GIS databases for site surveys, Condition Class assessments and mapping of the ecological community.

## Recovery Action to Date

Prior to this recovery plan there has been no formal, coordinated recovery program for the Peppermint Box Grassy Woodland ecological community.

An initial workshop of stakeholder group representatives held in November 2007 identified known threats to the ecological community, potential recovery actions, mapping needs and communication and engagement issues. A workshop of field experts in 2009 identified important ecological attributes and habitat features of the ecological community, and areas at risk of land-use change and development. Ideas and information from both workshops have been incorporated into this recovery plan.

Since the listing of this ecological community under the EPBC Act in 2007, the following recovery actions have been implemented:

- awareness raising with land owners, land managers and the general public;
- training workshops and information kits for extension advisors, native vegetation assessors and consultants in recognising the ecological community, understanding the EPBC Act implications and Condition Class assessment of remnants;
- Condition Class assessment conducted to establish reference sites for training, bench-marking and long-term monitoring;
- GIS database and mapping layers developed for Peppermint Box Grassy Woodland; distribution maps revised; data collection sheets developed for surveys and site assessments of the ecological community; and initial field surveys to help fill knowledge gaps on the distribution and condition of the ecological community.

Recovery of Peppermint Box Grassy Woodland has also been supported through the Heritage Agreement scheme (since 1981), and through extension programs, on-ground works programs and environmental stewardship funding over the past 12 years. The range of activities includes:

- awareness raising with land owners and managers and the general public;
- development and distribution of extension materials;
- training in plant identification, weed and pest animal management techniques and improved grazing management;

- financial support for adoption of conservation management practices, including fencing, rotational grazing, environmental weed management and pest control, revegetation and infill plantings; and
- long-term protection of high quality remnants through management agreements.

In 2011, Greening Australia commenced a series of Conservation Action Planning (CAP) workshops for the Mid-North of South Australia, in consultation with interested organisations and agencies. The assets within, and threats to, Peppermint Box Grassy Woodlands and other ecosystems within the region are being discussed, and strategies for integrated conservation are being devised.

Organisations and groups involved in these earlier and current activities include DEWNR, the World Wide Fund for Nature, the former Threatened Species Network, Mid North Grasslands Working Group, Native Grass Resources Group, Nature Conservation Society of SA, Eastern Hills and Murray Plains Catchment Group, Goolwa to Wellington Local Action Planning Association, Bremer Barker Catchment Group, Angas River Catchment Group, Greening Australia SA, Rural Solutions SA, the Northern and Yorke, SA Murray-Darling Basin and Adelaide-Mt Lofty Ranges NRM Boards, the Native Vegetation Council and local landholders.

While the above activities have increased general awareness, knowledge and protection of Peppermint Box Grassy Woodland and supported management change in some remnants, it is not yet possible to tell how much they have contributed to recovery of the ecological community.

## Environmental Stewardship Program

The Environmental Stewardship Program (ESP), part of the Australian Government's Caring for our Country initiative, aims to "maintain and improve the condition and extent of targeted high public value environmental assets on private land" (Australian Government 2008). Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia is one of two nationally threatened South Australian endemic ecological communities targeted by the ESP's *Multiple Ecological Communities Project* in South Australia. Implementation of the project commenced in 2010 – 2011 and continued through 2011-2012, and provides market-based incentives for individuals and organisations that own or manage private land to undertake long-term protection and improvement of eligible Peppermint Box Grassy Woodland remnants. The ESP is working with SA-based delivery agents and land managers to implement management changes for long-term protection and recovery of the ecological community. Tender bids are assessed on the basis of conservation value and value for money. Funding contracts of up to 15 years duration provide the opportunity for longer term management to be undertaken.

The ESP is a major source of funding for implementing many of the on-ground recovery actions identified in this plan for private land. It will also contribute more broadly to the long-term recovery of the ecological community by improving knowledge of the location, size, condition and management of remnants. Monitoring the management changes and their outcomes at funded sites will help inform the development of 'best practice' adaptive management guidelines for Peppermint Box Grassy Woodland. It is recommended there be two-way sharing of survey, mapping and monitoring data between DEWNR, the ESP and other organisations involved in the delivery and implementation of recovery actions, to avoid duplication of effort and make best use of available resources.

# Part E Known and Potential Threats

A wide range of threats currently affect, or have potential to impact on, the Peppermint Box Grassy Woodland ecological community. The main threatening processes and their risks to the ecological community are summarized in Table 4. The main weeds of concern in Peppermint Box Grassy Woodland are outlined in Appendix 8.

Sources of threats with potential for major impacts on Peppermint Box Grassy Woodland in the short to medium term are outlined below. Impediments to recovery include general lack of awareness, recognition and understanding of grassy woodland ecosystems and how they function. These may reduce the effectiveness of efforts to manage impacts of the listed threats to Peppermint Box Grassy Woodland.

**Changes in land use:**

- Change of livestock species/breeds and stocking rates resulting in inappropriate grazing levels and disturbance;
- Intensification of activities (cropping in new areas, pasture improvement, hand-feeding or establishment of feed-lots, new water supply/dams for irrigation);
- New industries displacing the ecological community (horticulture, agroforestry, apiary, carbon sequestration programs, revegetation);
- Inappropriate chemical application (herbicides, fertilizers, soil ameliorants);
- Tree thinning and removal of fallen timber;
- Land sub-division.

**Weed invasion:**

- Competition for resources (space, nutrient, water);
- Increased dominance of existing weeds species;
- Introduction of new weed species;
- Incompatible weed control techniques (cultivation, chemical, off target damage);
- Inappropriate choice of species composition and density for revegetation.

**Exotic animals and overabundant native species:**

- Overgrazing of native flora by exotic and native herbivores;
- Predation of native fauna by exotic carnivores (foxes, cats);
- Spread of exotic weeds by animal vectors (foxes, starlings);
- Soil disturbance and poisoning of native fauna from inappropriate exotic animal control (rabbit warren destruction).

**New infrastructures and developments:**

- Land sub-division and development;
- Infrastructures for energy and water supplies (building, wind generator networks, transmission line poles, underground power cables, pipelines, dams, bores);
- Mineral exploration and extraction;
- New roads or upgrading of existing roads (widening, re-surfacing);
- Infrastructure development in non-arable areas (sheds, roads, storage facilities).

**Fire:**

- Impropriate or altered fire regimes;
- Lack of investigation/knowledge about species response to fire;

- Inappropriate biomass management for fire prevention (slashing, understorey vegetation removal);
- Damage to vegetation and soils from fire suppression activities (grading or fire breaks, vehicle access through remnants, application of chemical foam).

**Recreational activities:**

- Damage to vegetation and soils from inappropriate recreational pursuits (4WD vehicles, trail bikes);
- Introduction of weeds and other pathogens (e.g. horse manure);
- Disturbance to fauna.

**Ongoing ecological stresses due to past clearance, fragmentation and changes in management:**

- Incremental decline in condition of remnants, leading to further habitat loss;
- Isolation of remnant populations (barriers to dispersal, inbreeding, edge effects);
- Increased competition in remnant populations (resources, mortality, loss of pollinators, loss of host plants or animals, disruption of critical life stages, vulnerability to stochastic events);
- Competition with new and existing weeds (see Appendix 8); and
- Over-harvesting of biological resources (seeds, nectar, rocks, timber).

**Climate change**:

- Potential reduction in biomass production;
- Reduction in species diversity and age classes;
- Possible escalation of species stresses associated with a drying climate, (increased competition for water and other resources, increased mortality, loss of pollinators, loss of host plants or animals, disruption to critical life stages);
- Reduction in management effort in Peppermint Box Grassy Woodland remnants resulting from changes in land management cost and priorities due to climate change;
- Planting of non-local indigenous species more adapted to changing climate conditions;
- Increased grazing intensity due to the failure to adapt grazing management to reduced biomass production; and
- Increase in fire frequency and intensity.

Threat abatement work and adaptive management of remnants are important short-term steps and strategies land managers can take to help eliminate or significantly reduce the impact of some of these threats. Land manager guidelines based on extensive, recent research in grassy woodlands and grasslands of south eastern Australia provide general principles for action (e.g. Eddy 2002; Sharp *et al*. 2005; Dorrough *et al*. 2008).

Strategies are also needed to minimise the risks and potential impacts of future threats to Peppermint Box Grassy Woodland. Addressing key knowledge gaps (including information on condition, extent and landscape configuration; ecological processes; fauna species; habitat structure; 'best practice' management; restoration strategies; and the role of fire) will assist in managing the threats to this ecological community.

## Key Areas Affected by Threats

Most of the threats identified are not limited to specific locations or districts in which the ecological community occurs, and have potential to impact on Peppermint Box Grassy Woodland throughout its distribution range. The main areas where the ecological community may occur are shown in Figure 3.

Wind farms, urban developments and other new infrastructure developments have more localised impacts. The ridgelines and higher slopes of hills and ranges in the Lofty Block region are target areas for wind energy generation. Some wind farms are already being developed in areas with grassy woodland remnants in the Mid North Region, and further wind farms are in the planning phases. Urban and peri-urban developments are most likely to occur and affect the ecological community in identified population growth areas including smaller towns and adjoining areas in the Barossa Valley, Gawler and Murray Bridge districts.

The impacts of climate change on the ecological community are likely to be more pronounced in lower rainfall areas of the distribution range. Climate change is also more likely to impact on agricultural production, economics and options for land owners/managers in these areas. However, the potential effects of climate change on the ecological community are poorly known and need to be investigated, along with strategies to minimise their potential impacts across the distribution range.

**Table 4: Summary of threatening processes, associated issues and activities, risk to the ecological community and threat abatement options.**

| Threatening process | Associated issues and activities | Risk to ecological community | Threat abatement options |
|---|---|---|---|
| 1. Agricultural land use | • Incompatible grazing levels and disturbance by stock<br>• Change of livestock species or breeds (to species/breeds with different grazing behaviours from historical use)<br>• Intensification of activities (pasture sowing or cropping between trees, increased stocking rates, hand-feeding or establishment of feed-lots, new water supply systems/dams for irrigation, new paddock sub-division fencing)<br>• Soil disturbance - cultivation (e.g. for pasture establishment or renovation, or cropping between trees); or pest control (e.g. warren ripping)<br>• New industries displacing the ecological community (horticulture, agroforestry)<br>• Inappropriate chemical applications – herbicides, fertilizer & soil ameliorants | • Defoliation and stem damage of understorey plants or tree seedlings, reduced capacity of plants to re-sprout, gradual decline leading to death of plants<br>• Bark damage and ring-barking of young trees<br>• Loss or damage to native perennial plant root systems<br>• Trampling of small herbaceous plants and seedlings<br>• Selective removal of palatable species and replacement by unpalatable species including weeds<br>• Depletion of the soil seed bank<br>• Reduced flowering, seed set and regeneration<br>• Depletion of the soil seed bank<br>• Destruction of the soil surface crust<br>• Vegetation clearance and incremental clearance<br>• Decline in condition of remnants<br>• Loss of native fauna habitat<br>• Indirect effects on the soil - compaction, erosion, reduced water infiltration or pugging, nutrient enrichment favouring introduced annual species | • Promote 'best practice' adaptive grazing management strategies<br>• Use fencing to delineate land class / land use, to manage PBGW remnants with low intensity or rotational grazing<br>• Increase awareness about the potential occurrence and significance of PBGW amongst new land owners / managers and people entering new agricultural industries<br>• Encourage conservation land-use through existing Heritage Agreements and programs<br>(Addressed in Strategies 1, 3, 4, 5 & 7) |
| 2. Weed invasion and management | • Understorey dominance by exotic annual grasses & forbs<br>• Perennial grass weeds<br>• Perennial herbaceous weeds<br>• Woody weeds<br>• Mechanical or chemical weed control techniques, including inappropriate cultivation, inappropriate slashing, off target herbicide damage or broad-scale over-spraying<br>• Weed invasion and dominance exacerbated by soil disturbance, | • Decline in available bare ground and open spaces between plants for crust formation and annual herbs<br>• Smothering and suppression of native plants by increased weed biomass<br>• Increased competition for nutrients and water<br>• Increased shrub density and shading due to woody weeds (change in structural integrity)<br>• Change or loss of floristic structure due to competition and exclusion of native plants<br>• Decline in condition of remnants<br>• Physical damage to native plants (cultivation, machinery, off-target herbicide damage) | • Provide information on native plant and weed identification and weed control methods including 'minimum disturbance' techniques for high priority sites<br>• Provide information and training for NRM Officers and other advisors in appropriate weed control methods<br>• Develop 'best practice' guidelines to manage annual and perennial grass weeds in PBGW<br>• Prepare and implement site- |

| Threatening process | Associated issues and activities | Risk to ecological community | Threat abatement options |
|---|---|---|---|
| | inappropriate grazing regimes, nutrient enrichment, inappropriate and altered fire regimes, or altered drainage and surface flows | • Impacts on native fauna e.g. loss of bare ground and open spaces used by ground-foraging species | specific action plans for weed management<br>• Provide information, training and resources to assist adoption of best practice weed management in PBGW remnants<br>(Addressed in Strategies 1, 3, 4, 5, 6 & 7) |
| 3. Pest animals, including exotic species and overabundant native species | • Feral carnivores – foxes, cats<br>• Feral herbivores – rabbits, hares, goats, deer, agricultural pest snails<br>• Native herbivores - kangaroos in high numbers; native locusts and grasshoppers in plague numbers<br>• Weed vectors (e.g. foxes; starlings)<br>• Feral honey bees<br>• Rabbit warren destruction - ripping or explosives<br>• Increase of aggressive native bird species in degraded woodlands – noisy miners | • Predation of native birds, reptiles, invertebrates and small mammals by foxes and cats<br>• Physical damage to native plants and ongoing stresses causing decline in vigour and condition<br>• Suppressed flowering, seed set and regeneration of native plants<br>• Selective grazing and removal of palatable plants, changing species composition and structure<br>• Total grazing pressure underestimated and poorly managed<br>• Reduced availability of essential food sources and habitats for native fauna - plants, leaf litter, hollows<br>• Physical damage to plants, fauna and habitats by pest control e.g. ripping of rabbit warrens<br>• Weed spread by vector animals - soft-fruited woody weeds (olives, boxthorn, briar roses) in droppings; dry seeds with spines/awns on fur; seed gathering by ants<br>• Off-target impact of pesticides on native fauna, including birds, reptiles, invertebrates and their natural predators in the ecological community<br>• Loss of small woodland bird species in remnants due to harassment by more aggressive birds | • Undertake planned and coordinated local action for pest control<br>• Provide information and training for NRM Officers and other advisors on appropriate 'minimum disturbance' pest control and management<br>• Improve availability of information to land managers on appropriate pest control and management<br>• Provide training and resources to assist adoption of best practice pest animal management in and adjoining PBGW remnants<br>(Addressed in Strategies 1, 2, 4, 5, 6 & 7) |
| 4. Revegetation | • Lack of recognition and understanding of natural grassy woodland composition and structure, especially the understorey<br>• Inappropriate plantings of trees and | • Physical damage to native plants and fauna habitat, from ripping, cultivating and spraying associated with plant establishment and site preparation<br>• Increased potential for weed invasion due to soil disturbance | • Increase awareness, knowledge and recognition of grassy woodlands by land owners/managers, advisors and the wider community |

| Threatening process | Associated issues and activities | Risk to ecological community | Threat abatement options |
|---|---|---|---|
| | shrubs for amenity/aesthetics, landscape restoration or carbon sequestration programs<br>• Inappropriate planting density, species selection or proportions of plant types in restoration plantings (including indigenous species, non-indigenous native species and exotic species) | • Competition for water and soil nutrients with existing native vegetation<br>• Introduction of potential woody weeds (non-indigenous and exotic trees and shrubs)<br>• Increased density of trees or shrubs above the natural level and site capacity of remnants<br>• Altered fauna species composition through loss of habitat requirements or changes in structure – e.g. increased shrub density and loss of open spaces favouring different woodland bird species<br>• Altered floristic composition, vegetation structure and ecological processes due to increased shading<br>• PBGW remnants no longer protected by the EPBC listing if plantings increase shrub cover above 30% | • Improve spatial definition of PBGW remnants to inform revegetation works<br>• Provide information and training to NRM Officers and other advisors on appropriate species and strategies to restore PBGW remnants<br>• Develop stricter guidelines for Carbon sequestration plantings in areas of native vegetation<br>(Addressed in Strategies 1, 2, 5, 6 & 7) |
| 5. Infrastructure development and maintenance, including industrial and urban development, transport, mining and energy infrastructures | • Development of existing surveyed allotments for housing<br>• Re-zoning and subdivision of land in urban fringe areas for housing, commercial and industrial developments<br>• Other inappropriately sited new buildings (sheds, schools) & industrial developments<br>• New roads /upgrading of existing roads (widening, sealing, bituminising)<br>• New water supplies (dams, pipelines, bores etc)<br>• Energy supplies (infrastructure buildings, wind generator networks, transmission line poles, underground power cables, access road)<br>• Mining exploration and extraction<br>• Wind farm developments<br>• New installation of transmission lines and underground pipes and cables | • Clearance of PBGW remnants for approved house and infrastructure development<br>• Partial clearance and fragmentation of patches for fire risk management around houses or other infrastructure adjoining or in remnants<br>• Woodland habitat degradation by removal of dead trees, fallen logs and branches, bark, leaf litter and dry herbaceous understorey for fire risk management<br>• Construction of new roads or upgrading of existing roads encroaching into PBGW remnants<br>• Clearance of PBGW remnants for approved mining, wind farms, or other industrial developments and associated infrastructure<br>• Weeds introduced by machinery associated with maintenance of existing infrastructure or construction and operational phases of new infrastructure<br>• Smothering of PBGW understorey by road aggregate, earthmoving or over-burden stock-piles<br>• Ongoing vegetation damage, soil compaction and impacts on fauna by vehicles accessing development and infrastructure sites | • Improve spatial definition of PBGW remnants to inform development assessments and applications to clear native vegetation<br>• Increase awareness of planning authorities, project developers and development assessors about PBGW and their significance<br>• Train native vegetation officers, environmental consultants, local government and NRM staff in recognition and condition assessment of PBGW remnants<br>• Adopt and enforce weed hygiene strategies during construction and operational phases of mining and infrastructure developments<br>• Promote appropriate site management practices for development sites<br>(Addressed in Strategies 1, 2 & 7) |

| Threatening process | Associated issues and activities | Risk to ecological community | Threat abatement options |
|---|---|---|---|
| | • Road development and borrow pits | | |
| 6. Fire management | • Inappropriate fire regimes - e.g. too frequent, too infrequent, wrong season for particular native fauna/flora or biodiversity outcomes<br>• Increase fire intensity facilitated by over abundance of introduced annual grasses<br>• Lack of knowledge and experience of fire responses at different sites – e.g. timing and conditions to favour native vs. weed species<br>• Inappropriate fire risk / fire prevention activities, such as excessive reduction of native perennial plant biomass or management that promotes annual weed biomass<br>• Fire suppression activities (grading, slashing, clearing fire breaks, vehicular access through remnant)<br>• Limited refuge areas caused by fragmentation of habitat | • Loss of fire sensitive species due to frequent burning<br>• Decline in soil seed bank and recruitment of fire-dependent and fire-stimulated species due to infrequent burning<br>• Increase in fire stimulated species altering floristic structure and ecological functions of the woodland (e.g. transitions to increased *Acacia* shrub cover)<br>• Increased susceptibility to weed invasion and growth, including annual weed biomass<br>• Suppressed recruitment of native grasses and forbs, by excessive biomass of annual weeds and grass thatch<br>• Damage to native plants and habitat structures by slashing, grazing or burning for biomass reduction either too frequently or too low<br>• Loss of fauna species not able to escape to a refuge area<br>• Loss of essential fauna habitat, e.g. bark, leaf litter, dead trees, fallen logs and branches | • Undertake research into fire ecology of PBGW and trial appropriate fire regimes for remnants of varying species composition and condition states<br>• Develop 'best practice' guidelines for managing fuel loads in PBGW remnants (slashing, grazing, burning) for ecological benefits and asset protection<br>• Actively manage PBGW remnants to maintain and promote native plant diversity and habitat structure<br>(Addressed in Strategies 3, 4, 5 & 6) |
| 7. Recreational activities | • Inappropriate placement and construction of recreational trails<br>• Inappropriate use of 4WD vehicles and trail bikes | • Damage to native vegetation<br>• Damage to soil structure (disturbance and compaction)<br>• Spread of weeds and other pathogens<br>• Disturbance to fauna species | • Increase awareness about the potential occurrence and significance of PBGW amongst land owners / managers and recreational groups.<br>(Addressed in Strategies 1, 2, 3) |
| 8. Ecological stresses | • Fragmentation & isolation of patches<br>• Small population sizes of some component species<br>• Reduction and loss of habitat areas for component species<br>• Negative impacts from surrounding | • Altered patterns of genetic diversity and gene flow<br>• Inbreeding leading to reduced vigour and resilience of species populations<br>• Loss of key species and species diversity generally<br>• Loss of ecological functions such as pollination and recruitment | • Identify and monitor indicators of ecological stress in PBGW<br>• Develop restoration strategies to help reverse the impacts of ecological stresses<br>• Identify and monitor functionally |

| Threatening process | Associated issues and activities | Risk to ecological community | Threat abatement options |
|---|---|---|---|
| | land use – pesticide/herbicide/nutrient drift or residues/ pasture species<br>• Decline in native pollinator species (native wasps and bees etc) | • Incremental loss of habitat<br>• Decline in condition of remnants | important species of the ecological community<br>• Identify and monitor important habitat features and indicators of ecological integrity<br>(Addressed in Strategies 3, 4, 5 & 6) |
| 9. Climatic factors | • Water stress and drought effects<br>• Increased incidence of frosts & frost damage to plants, associated with spring drying trends<br>• Climate change impacting on species survival and timing of ecological functions<br>• Social changes in land use and management resulting from climate change<br>• reduced management effort in Peppermint Box Grassy Woodland remnants<br>• planting of non-local indigenous species more adapted to changing climate conditions | • Increased grazing pressure on plants in PBGW remnants, including grazing of less preferred plants ('prey shifting')<br>• Loss of individual plants and animals or species from PBGW remnants or surrounding areas within the distribution range, due to varying levels of susceptibility to climate change impacts<br>• Increased water demand and stress from mistletoe over-abundance on individual trees or in some remnants (e.g. lower rainfall areas)<br>• Reduced availability of plant resources for fauna – e.g. reduced nectar for insects; lower seed-set and quality of native grass seeds for seed-eating birds<br>• Reduced opportunity or commitment to managing remnants for biodiversity conservation outcomes | • Investigate the potential impacts of climate change on the PBGW ecological community<br>• Trial management strategies to minimise climate change impacts<br>(Addressed in Strategy 6) |
| 10. Land Use Changes | • Reduced or altered land management<br>• Intensified activities (economic pressures, new industries)<br>• Inappropriate management by new owners (e.g. "Tree Change")<br>• Re-zoning for different land uses<br>• Exclusion of grazing or other biomass management (fence and forget) | • Increased grazing pressure in response to poor economic or seasonal conditions<br>• Lack of awareness by new landholders about the ecological community and its management needs resulting in degradation to floristic structure and composition (e.g. "Tree Change")<br>• Increased pressure to clear or modify remnants (e.g. land for urban development, fire risk management adjoining new developments, misguided 'restoration' of understorey shrub cover) | • Provide key information through local advisors to reach new landholders<br>• Provide training for land owners and managers in 'best practice' adaptive management for PBGW<br>(Addressed in Strategies 1, 4, 5 & 7) |
| 11. Use of biological and other resources | • Apiary industry (bees taking nectar & pollen)<br>• Illegal hunting or collection of | • Competition with native insects for nectar and pollen<br>• Displacement of native fauna from tree hollows by bee swarms | • Raise awareness about the component species of PBGWs and their habitat needs |

| Threatening process | Associated issues and activities | Risk to ecological community | Threat abatement options |
|---|---|---|---|
| | plants/animals<br>• Tree cutting and collection of fallen timber for firewood<br>• Over-harvesting of native seeds (permitted uses with inappropriate limits)<br>• Rock collection for landscaping (especially in the eastern Mount Lofty Ranges area) | • Reduced capacity for regeneration of native plants from seed<br>• Loss of native seeds as a food resource for seed-dependent fauna (e.g. birds, invertebrates)<br>• Loss of rock habitat and protection for reptiles, frogs and invertebrates, palatable plants and plants requiring moist sheltered micro-habitats<br>• Loss of essential habitats – trees, hollows and fallen timber – for woodland-dependent fauna, including mammals, birds, reptiles, frogs and invertebrates<br>• Changes to surface water flow, infiltration and availability to fauna (from removal of rocks) | • Monitor impacts of resource harvesting on functionally important species in PBGWs<br>• Relinquish approvals for fire wood harvesting (tree cutting and collection of fallen timber) in PBGW, including private landowner use<br>• Restrict and manage rock harvesting from PBGW remnants<br>(Addressed in Strategies 1, 4, 5, 6 & 7) |

# Part F Planning for Recovery

## Recovery Objectives

The overall objective of this Recovery Plan is to ensure survival of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and promote its recovery, by maintaining or improving the area, condition and integrity of the ecological community.

Specific objectives to be achieved within the intended life of this recovery plan are:

1. To maintain or improve the condition of remnant Peppermint Box Grassy Woodland.
2. To increase the area of Peppermint Box Grassy Woodland secured and managed for conservation.
3. To increase the area of occupancy of Peppermint Box Grassy Woodland across its natural range.

The achievement of these objectives will be measured by the performance criteria that are listed for each strategy.

## Recovery Strategies

Seven broad strategies and associated recovery actions critical to achieving the recovery plan objectives are outlined in Table 5, with performance criteria to measure their success. Specific responsibility for recovery actions has not been assigned, due to the wide geographic spread of the ecological community, the large number of land owners and managers, the variety of land tenures and the number of other stakeholders and partner organisations needed to be involved.

The objectives will only be met by working in close collaboration with key stakeholders, particularly private land owners and managers, throughout the natural range of the Peppermint Box Grassy Woodland. Awareness raising and training activities, realistic incentives, local peer support and access to technical advice are essential to encourage landholder participation and adoption of management changes on the scale necessary to benefit the ecological community.

Successful implementation of recovery actions will rely on coordination and active involvement of the various stakeholder groups. An adequately resourced, representative team is needed to facilitate and coordinate the recovery program. This will provide a central reference point for the recovery program, helping to avoid duplication of effort and ensure that priority actions are implemented, monitored and reviewed. It will also establish a mechanism for communication and partnership building between stakeholders on issues such as funding, priorities and responsibility for recovery actions.

While this plan aims to build on actions already underway and use knowledge from existing grassy ecosystems research, restoration and extension programs in South Australia and elsewhere, some critical knowledge gaps must be addressed for the recovery plan objective to be achieved. These include knowledge about the location, extent, condition and current management of Peppermint Box Grassy Woodland remnants; native species composition, ecological functions and essential habitat requirements, especially of native fauna; 'best practice' adaptive management strategies for different land uses; and the most effective strategies to restore degraded remnants. Further field surveys, mapping, research and monitoring programs are essential to overcome these knowledge gaps.

**Table 5: Recovery actions and performance criteria to meet the recovery plan objectives.**

| **Strategy 1: Increase awareness of PBGW to ensure protection of the ecological community**<br>*Run targeted awareness campaigns and training activities for different stakeholder groups, to promote wider recognition and protection of PBGW, their conservation significance, management and connections with primary production.* | | | |
|---|---|---|---|
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **1.1** | Develop a recovery plan communication strategy identifying how key stakeholder groups will be engaged, informed and communicated with and produce extension materials on recognition of PBGW, 'best practice' adaptive management guidelines and Condition Class assessment. | • Recovery plan communication strategy developed and implementation commenced by Year 1.<br>• Fact sheet to assist recognition of PBGW updated if required and distributed by Year 1.<br>• Existing 'best practice' guidelines for management of grassy ecosystems in south-eastern Australia (e.g. Eddy 2002; Sharp *et al*. 2005; Dorrough *et al*. 2008) distributed initially, with an aim to develop 'best practice' adaptive management guidelines for PBGW at a later date (Action 4.3).<br>• Site-based Condition Class assessment guidelines distributed by Year 1 and updated as new information is gathered.<br>• Existing networks are engaged to support communication and information sharing including establishing a network of local mentors and champions - ongoing. | **High** |
| **1.2** | Run coordinated, local training and extension programs for stakeholders and interest groups on the recognition, protection and management of PBGW and understanding of the implications of EPBC listing. | • At least two training activities conducted per year for stakeholders and other industry providers about PBGW.<br>• At least two field day events per year attended to provide information and talk about PBGW to the wider communities.<br>• At least one information session organised with each of the eight identified Aboriginal Nations to identify their interests in PBGW, incorporate their knowledge and facilitate their involvement (if requested) by Year 5.<br>• At least 10% of known landowners with PBGW targeted, engaged and provided with information, training, advice or incentives to protect and manage the grassland annually.<br>• At least 20% of targeted landowners (from above), become involved in some form, with protecting the PBGW on their property annually. | **Medium to High** |
| **1.3** | Collaborate with landowners, planning authorities and developers to identify, protect and implement appropriate management strategy for PBGW remnants. | • GIS layers on PBGW distribution/conditions updated annually and provided to relevant landholders, planning agencies and authorities - ongoing.<br>• Landholders, local government planners and developers provided with advice on appropriate management of PBGW remnants - ongoing.<br>• No avoidable decline in condition of PBGW remnants due to lack of | **High** |

| | | | |
|---|---|---|---|
| | | awareness of locations or of inappropriate management practices known or observed to occur. | |
| **1.4** | Opportunities for interested community volunteers to become involved in on-ground recovery activities. | • Opportunities for interested volunteers to participate in on-ground recovery activities identified and promoted through networks including links with other threatened species activities such as declining birds, Lofty Block orchid recovery and Iron-grass Natural Temperate Grassland recovery - ongoing.<br>• Aboriginal people involved in recovery planning and activities where appropriate – ongoing. | **Medium** |
| **Strategy 2: Improve baseline information on location, extent, condition and management of PBGW remnants.**<br>*Survey and map the location, extent and condition of PBGW remnants to support monitoring, management, planning and recovery activities.* | | | |
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **2.1** | Identify and undertake targeted surveys to fill gaps in our knowledge on location, extent, management and condition of PBGW remnants.<br>*(Desktop assessment using existing survey data and floristic vegetation mapping identified approx. 58,000 ha of grassy woodland with 24,000 ha of high confidence, 16,000 ha medium confidence and 3,325 ha low confidence. The EPBC Act listed community could be as low as 15,000 ha.)* | • Desktop assessment of mapped PBGW used to identify gaps in survey effort, Condition Class assessment and ground-truthing of remnant PBGW sites determined and prioritised by Year 2.<br>• 50 person days of surveys conducted at priority sites to gather information on extent, baseline condition data, current management and threats completed annually.<br>• Survey data lodged with DEWNR entered and reported to Recovery Team annually. | **High** |
| **2.2** | Review and update the guidelines for assessing the Condition Class rating, based on research and field surveys of PBGW remnants in varying seasons, climatic conditions, land uses and management across the distribution range. | • Condition Class criteria and assessment methods (from Recovery Plan) evaluated in at least 20 representative PBGW sites by Year 2.<br>• Condition Class criteria assessed by field based (site assessment) experts, and updated guidelines for Condition Class assessment developed by Year 2.<br>• Updated guidelines distributed to site assessors – ongoing. | **Medium** |
| **2.3** | Maintain and update the GIS database with survey data and Condition Class assessments, to reflect new information. | • GIS database maintained and updated, with survey data collated and entered annually including from consultants, Stewardship Agreements, Heritage Agreements and other private conservation areas.<br>• Land owners and managers, the Australian Government and other stakeholders provided with updated information from surveys, mapping and data analysis - ongoing. | **Medium** |

| **Strategy 3: Increase the area of the EPBC listed PBGW secured and managed for conservation**<br>*Develop a network of PBGW conservation areas, with a variety of conservation management and protection mechanisms suited to different land owners, land managers and land use, including land management and stewardship agreements, covenants, planning mechanisms and land acquisition for reserves.* | | | |
|---|---|---|---|
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **3.1** | Identify priority PBGW sites (Class A & B) to target for formal and informal conservation management agreements ensuring representation of distinct PBGW types and connectivity across the geographic and ecological range of the community.<br>*(As little as 15,000 ha of the EPBC Act listed community may be available for formal or informal protection)* | • Criteria developed and used to select and prioritise PBGW sites (identified from Action 2.1) to increase the area of PBGW secured and managed for conservation by Year 2.<br>• Appropriate conservation mechanisms (e.g. Stewardship Agreement, Heritage Agreement, public and private reserve system) determined for the top 50 sites by Year 2.<br>• Prioritised PBGW sites to secure mapped, with maps and associated conservation mechanisms provided to NRM Boards, on-ground work coordinators and coordinators of environmental stewardship programs and management incentives schemes by Year 2. | **High** |
| **3.2** | Increase the area of PBGW secured and managed for conservation using a variety of protection mechanisms. | • Total area of PBGW secured and management for conservation increased from 2,481 ha (2011) to at least 3,600 ha by Year 10 based on priority sites identified in Action 3.1 and consisting of:<br>– Management agreements (e.g. Stewardship Agreement) where landholders enter into new, secure land agreement increased from 1,045 ha (2011) to at least 1,500 ha by Year 10.<br>– SA Heritage Agreements entered into for PBGW remnants increased from 1,091 ha (2011) to at least 1,500 ha by Year 10.<br>– Public & private protected area reserves established for PBGW increased from 345 ha (2011) to at least 600 ha by Year 10. | **High** |
| **Strategy 4: Maintain or improve the condition and integrity* of the EPBC listed PBGW remnants using 'best practices' strategies**<br>*Encourage and support private and public land owners and managers to manage PBGW remnants to maintain or improve the integrity and Condition Class rating.*<br>(* Integrity refers to the capacity of PBGW remnants to support and maintain native species composition, diversity, functional organisation and natural ecological processes similar to undisturbed examples of the ecological community) | | | |
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **4.1** | Identify and prioritise known PBGW remnants (Class A & B) to maintain or improve the condition and integrity* ensuring representation of distinct PBGW types and connectivity across the geographic and ecological range of the community.<br>*(As little as 15,000 ha of the EPBC Act listed* | • Criteria developed and used to select and prioritise PBGW sites (identified from Action 2.1) to maintain or improve the condition and integrity of PBGW remnants by Year 2.<br>• Prioritised PBGW sites to maintain or improve mapped, with maps and associated management requirements provided to NRM Boards and field coordinators by Year 2. | **High** |

| | | | |
|---|---|---|---|
| | *community may be available to maintain or improve the condition and integrity)* | | |
| **4.2** | Support landowners and land managers to maintain or improve the condition and integrity* of PBGW remnants and establish a process for monitoring condition over time. | • Total area with active management increased by 1,000 ha by Year 10 with 100% maintained at pre-management condition (Class A or Class B) and at least 20% of areas with improved condition (Class B to Class A).<br>• Baseline condition collected and management plans using 'best practice' adaptive management guidelines developed and being implemented for 100 ha of priority PBGW remnants (identified from Action 4.1) annually.<br>• Long-term condition monitoring established at all sites with active management and monitored biannually to evaluate the effectiveness of management activities to maintain or improve the condition of PBGW.<br>• Monitoring data on the effectiveness of management activities used to improve the management at that site and of other PBGW sites – ongoing.<br>• Survey data (baseline and monitoring) lodged with DEWNR and reported to Recovery Team annually.<br>• Report on management practices, cost-benefit and condition, published and used to inform future management practices by Year 10. | **High** |
| **4.3** | Develop 'best practice' adaptive management guidelines for PBGW from gathered information to better maintain & improve the integrity* of PBGW remnants. | • 'Best practice' adaptive management guidelines for PBGW developed by Year 5 and updated as new information is gathered by Year 10.<br>• 'Best practice' adaptive management guidelines for PBGW distributed to relevant people – ongoing. | **Medium** |
| **Strategy 5: Increase the area of occupancy of the EPBC listed PBGW ecological community across its natural range**<br>*Identify, map and promote the best locations for restoration (Class C patched rather than broad-acre planting of Peppermint Box) to increase the area and integrity of PBGW remnants; and ensure this information is available to support planning processes at the national, state, regional and local levels.*<br>(** Key areas and sites for restoration may include buffer zones around significant small remnants, connectivity between priority remnants, large recoverable PBGW remnants of Condition Class C or past revegetation sites with opportunities to improve its condition, or important habitat areas for key species of the PBGW ecological community) | | | |
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **5.1** | Identify priority PBGW sites (Class C) for restoration** throughout the geographic range that will contribute to the increase in area of occupancy and to the long-term recovery and viability of the EPBC listed ecological community.<br>*(Based on desk-top assessment of mapped grassland, of the 24,000 ha with high* | • Criteria developed and used to select and prioritise PBGW sites (identified from Action 2.1) for potential restoration to increase the area of PBGW by Year 2.<br>• Prioritised PBGW restoration sites mapped, with maps and associated information provided to NRM Boards, on-ground work coordinators, and coordinators of environmental stewardship programs and management incentives schemes by Year 2. | **High** |

| | | | |
|---|---|---|---|
| | *confidence of being PBGW, minus 15,000 ha of possible EPBC Act listed community, there maybe 9,000 ha of Class C remnant for possible restoration)* | | |
| **5.2** | Support landowners and land managers to increase the area of occupancy of the PBGW through active restoration**. Link restoration activities with other threatened species recovery projects including NatureLinks, INTG, Lofty Block orchids, declining woodland birds. | • 5% (approx. 500 ha) of the total area of Class C improved to Class B by Year 10.<br>• Baseline data collected and management plans using current 'best practice' restoration guidelines developed and being implemented for at least 50 ha of priority PBGW remnants (identified from Action 5.1) annually.<br>• Long-term condition monitoring established at all PBGW sites with active restoration and conducted biannually to evaluate the effectiveness of restoration activities to restore and improve the condition of PBGW.<br>• Monitoring data on the effectiveness of restoration activities used to improve current and future restoration of other PBGW sites – ongoing.<br>• Survey data (baseline and monitoring) lodged with DEWNR and reported to Recovery Team annually.<br>• Report on effectiveness of restoration and cost-benefits published and used to inform future restoration practices by Year 10. | **High** |
| **5.3** | Develop'best practice' restoration guidelines for PBGW from consultation with land managers and expert groups and analysis of existing knowledge, experience and research. | • 'Best practice' restoration guidelines for PBGW developed by Year 5 & updated as new information is gathered, by Year 10.<br>• 'Best practice' restoration guidelines for PBGW distributed to relevant people – ongoing. | **High** |
| **Strategy 6: Address critical knowledge gaps about the ecological community**<br>*Identify and facilitate projects, collaborative partnerships and funding to address key knowledge gaps influencing or impacting on conservation, management and restoration of PBGW.* | | | |
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **6.1** | Identify, assess and monitor the status of species in PBGW that are functionally important, threatened, or dependent on the ecosystem for their persistence including declining woodland birds. | • Functionally important, threatened, and ecosystem-dependent species of PBGW identified, their status assessed and included in monitoring of key sites by Year 5. | **High** |
| **6.2** | Identify ecological attributes and habitat features which are indicators of condition and ecological integrity of PBGW remnants and ensure these are incorporated into | • Indicators of condition and ecological integrity in PBGW remnants identified and included in survey, research and monitoring programs by Year 3.<br>• Information gathered used to update the Condition Classes Assessment guideline. | **High** |

| | | | |
|---|---|---|---|
| | survey, research and monitoring programs. | | |
| **6.3** | Identify indicators for measuring detrimental changes in the PBGW ecological community and ensure these indicators are incorporated into survey, research and monitoring programs. | • Indicators of detrimental changes in PBGW identified and included in survey, research and monitoring programs by Year 5. | **High** |
| **6.4** | Investigate the potential impacts of, and management strategies for, significant threatening processes on the PBGW ecological community including impacts of ecological barriers (small patch size, fragmentation & isolation of remnants), grazing, fire and climate change. | • Impacts of, and management strategies for, significant threatening processes investigated and incorporated into 'best practice' adaptive management and restoration guidelines by Year 10.<br>• Strategies to overcome ecological barriers (small patch size, fragmentation and isolation of remnants) investigated and 'best practice' restoration guidelines revised to include these strategies by Year 10.<br>• Base-line monitoring and investigation of habitat management for declining woodland birds in PBGW commenced by Year 5.<br>• Research on role and management of fire in PBGW remnants undertaken by Year 7. Results incorporated into 'best practice' adaptive management and 'best practice' restoration guidelines by Year 9.<br>• Research on role and management of 'best practice' grazing in PBGW remnants of different ecological conditions undertaken and incorporated into 'best practice' adaptive management and 'best practice' restoration guidelines by Year 10.<br>• Likely climate change impacts on PBGW identified and trials of management strategies to minimise these impacts set up at 4 representative sites across its range by Year 10. | **Medium** |
| **6.5** | Foster partnerships with public and private institutions to conduct research to improve management and restoration practices in PBGW. | • Key stakeholders involved in partnerships to develop and conduct research into knowledge gaps by Year 2.<br>• Potential funding sources for research projects identified by Year 2.<br>• Links made with other research projects for INTG, Lofty Block Orchids, Declining Birds. | **Medium** |
| **Strategy 7: Actively manage the recovery process through an effective recovery team.**<br>*Manage and review the recovery process through a Recovery Team* | | | |
| **Action** | **Description** | **Performance Criteria** | **Priority** |
| **7.1** | Establish a representative state Recovery Team to coordinate key recovery actions and monitor, evaluate, review and report on implementation of the recovery plan. | • A National Recovery Team for PBGW established by Year 1.<br>• Membership of the National PBGW Recovery Team representative of key stakeholder and community groups (from Table 7).<br>• Recovery Team membership, relevance, effectiveness reviewed annually. | **High** |

| | | | |
|---|---|---|---|
| **7.2** | Engage a Recovery Team Coordinator and Project Officer to manage day-to-day business of Recovery Team (liaise with stakeholders, help coordinate & implement recovery plan). Coordinator to have part-time role for PBGW, INTG, PBT and Lofty Block Orchids recovery programs | • Recovery Team Coordinator role funded and appointed by Year 2.<br>• Full time Project Officer for INTG & PBGW funded and appointed by Year 2. | **High** |
| **7.3** | Actively monitor the status of the ecological community, evaluate and review the effectiveness of recovery actions, and identify and prioritise future actions for ongoing recovery of PBGW. | • Status and recovery of the ecological community reviewed every 3 years and summary reports submitted to the State and Australian governments with review of the Recovery Plan at the end of Year 5 and Year 10.<br>• Future actions necessary for the recovery of PBGW identified and prioritised, by Year 10 based on new information gathered from recovery actions. | **Medium** |

## Costs and Duration of Recovery

The intended life-span of this recovery plan is ten years. It will be reviewed after five years and further recovery goals and actions may be identified. Estimated indicative costs and timing of the recovery actions outlined in Table 5 are summarized in Table 6.

**Table 6: Estimated costs of implementing the recovery plan over 10 years.**

| Action | Summary Description | Priority | [1]Timeframe | [2]Cost Estimate ($K) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| 1.1 | Develop communication strategy & extension material | High | Short - Ongoing | 40 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | **130** |
| 1.2 | Run local training & extension programs | Medium - High | Short - Ongoing | 30 | 30 | 30 | 30 | 30 | 25 | 25 | 25 | 25 | 25 | **275** |
| 1.3 | Identify, protect & implement management strategy for PBGW remnants | High | Ongoing | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | **100** |
| 1.4 | Identify opportunities to involve volunteers in on ground activities. | Medium | Ongoing | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | **20** |
| 2.1 | Identify & undertake targeted survey of gaps on location, extent, condition | High | Short - Ongoing | 50 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | **410** |
| 2.2 | Review & update Condition Class assessment guideline | Medium | Short | 10 | 10 | | | | | | | | | **20** |
| 2.3 | Maintain & update GIS Database | Medium | Short - Ongoing | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | **150** |
| 3.1 | Identify priority PBGW sites for formal & informal conservation | High | Short | | 10 | | | | | | | | | **10** |
| 3.2 | Increase the area of PBGW secured using a variety of mechanisms | High | Short - Ongoing | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | **2,000** |
| 4.1 | Identify & prioritise known PBGW remnants to maintain or improve condition | High | Short | | 10 | | | | | | | | | **10** |
| 4.2 | Maintain/mprove the condition & integrity of PBGW remnants | High | Short - Ongoing | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | **600** |
| 4.3 | Develop 'best practice' adaptive management guidelines | High | Medium - Long | | | | | 10 | | | | | 10 | **20** |
| 5.1 | Identify priority PBGW sites for restoration | High | Short | | 10 | | | | | | | | | **10** |

| Action | Summary Description | Priority | [1]Timeframe | [2]Cost Estimate ($K) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| 5.2 | Support landowners/managers to increase area of occupancy | High | Short - Ongoing | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | **600** |
| 5.3 | Develop 'best practice' restoration guidelines | High | Medium - Long | | | | | 10 | | | | | 10 | **20** |
| 6.1 - 6.5 | Foster partnerships, research projects | Medium - High | Short - Ongoing | | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | **1,080** |
| 7.1 | Establish a representative Recovery Team | High | Short - Ongoing | 3 | 3 | 3 | 5 | 3 | 3 | 3 | 3 | 5 | 3 | **34** |
| 7.2 | Engage a Recovery Team Coordinator and Project Officer | High | Short - Ongoing | | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | **720** |
| 7.3 | Evaluate & review recovery actions | Medium | Medium - Long | | | 2 | | | 4 | | | | 6 | **12** |
| **TOTAL** | | | | **480** | **670** | **632** | **632** | **650** | **629** | **625** | **625** | **627** | **651** | **6,221** |

Notes
1 For the implementation time frame: Short term = 1 to 2 years; Medium term = 3 to 5 years; Long term = 5 to 10 years; Ongoing = recurrent from year of commencement to the end of recovery plan period
2 Costs calculated at 2012 rates.

## Evaluation

Performance criteria have been identified to evaluate the effectiveness of each recovery action. A key strategy for the recovery plan is to establish a recovery team to facilitate and coordinate recovery plan implementation, evaluate the effectiveness of recovery actions and report on progress with recovering the ecological community. Representation on this recovery team is yet to be determined but should include key stakeholder groups and organisations.

The Grassy Ecosystems Recovery Planning Steering Committee is an advisory group established to support development of this recovery plan. The committee is not a representative group for key stakeholders, but may be able to take an interim role until the recovery team is established. Organisations and stakeholder interests represented on the steering committee include:

- Department of Environment, Water and Natural Resources
- Mid North Grasslands Working Group
- Rural Solutions SA
- Greening Australia SA
- Threatened Plant Action Group
- Nature Conservation Society of SA
- Conservation Council of SA
- Northern & Yorke NRM Board
- SA Murray-Darling Basin NRM Board
- Community members, including graziers
- Upper North Farming Systems Group
- Eastern Hills and Murray Plains Catchment Group
- Goolwa to Wellington Local Action Planning Association Inc.

The outcomes of the plan and future directions for recovery will be reviewed after five years and at the end of the ten-year period. In addition, the Recovery Team will review and report on the status and recovery of the ecological community every three years. However it is recognised that many of the desired ecological outcomes for the Peppermint Box Grassy Woodland ecological community will need to be measured over a much longer time-frame than the intended duration of this plan.

# Part G Communication and Participation

A communication strategy is being developed to support the recovery program (Action 1.1). The strategy will identify options for engaging with key stakeholder groups and strategies for implementing recovery actions related to awareness raising, knowledge and skills development and capacity building of those stakeholders. It will also identify opportunities for engaging partner organisations and gaining their support and involvement in recovery actions.

Private land owners and managers are key stakeholders in the recovery of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia, as they currently own, manage and have influence over most of the remaining area of the ecological community. The greatest gains for the ecological community will be achieved by working in partnership with private land owners and managers, to raise their interest and understanding of grassy woodland remnants on their properties, develop their knowledge and skills to manage those areas and build their capacity to implement 'best practice' adaptive management for conservation with production outcomes.

Other sectors including industry and community groups, non-government organisations, local government, NRM Boards, other statutory organisations, research institutions, government agencies and indigenous groups and organisation will be significant and essential partners in the recovery program.

Effective communication and liaison will be needed between these various stakeholders and partners, to ensure a common understanding of the recovery aims, objectives and priorities, to build and maintain collaborative partnerships and to avoid duplication and make best use of resources in implementing recovery actions. The proposed recovery team (Action 7.1), supported by a project officer (Action 7.2) will be essential to facilitate and coordinate the involvement of stakeholders and partners in implementing this recovery plan.

Current and potential stakeholders and partners in the management and recovery of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia are listed in Table 7.

**Table 7: Current and potential stakeholders and partners in the management and recovery of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.**

| |
|---|
| **National Stakeholders and Partners:** |
| Department of Sustainability, Environment, Water, Population and Communities |
| National non-government organisations (e.g. WWF Australia) |
| National Farmers' Federation |
| General public |
| **State Stakeholders and Partners:** |
| Department of Environment, Water and Natural Resources |
| Primary Industries and Resources SA |
| Native Vegetation Council |
| Department for Planning, Transport and Infrastructure |
| Department of Planning and Local Government |
| Natural Resources Management Council |
| Advisory Board of Agriculture |
| South Australian Farmers Federation |
| Greening Australia SA |
| Conservation Council of South Australia |
| Nature Conservation Society of SA |
| Threatened Plant Action Group |
| Trees for Life |
| Specialist non-government organisations and groups (e.g. Birds SA; Field Naturalists Society of SA, SA Herpetology Group; Butterfly Conservation SA; Native Orchid Society of SA; Native Grass Resources Group) |
| Mining and wind energy industries |
| Universities (Flinders University, University of Adelaide, University of South Australia) |
| General public |
| **Regional Stakeholders and Partners:** |
| Land owners and managers, including private landholders and local councils |
| Local Governments: Alexandrina Council, The Barossa Council, District Council of Barunga West, Clare and Gilbert Valleys Council, Coorong District Council, Goyder Regional Council, Light Regional Council, District Council of Mallala, Mid Murray Council, District Council of Mount Remarkable, The Rural City of Murray Bridge, Northern Areas Council, District Council of Orroroo-Carrieton, District Council of Peterborough, Wakefield Regional Council, Flinders Ranges Council, District Council of Tumby Bay, District Council of Lower Eyre Peninsula |
| NRM Boards: Northern and Yorke, SA Murray Darling Basin, Adelaide Mount Lofty Ranges, Eyre Peninsula |
| Agricultural Bureau Branches (Men's and Women's) |
| Mid North Grasslands Working Group |
| Northern and Yorke Grassy Habitats Recovery Team |
| Central Local Government Region of SA |
| Regional Threatened Species Recovery Teams (e.g. Northern &Yorke Declining Woodland Birds, SAMDB Threatened Flora) |
| Friends of Parks Groups |
| Eastern Hills and Murray Plains Catchment Group |
| Goolwa to Wellington Local Action Planning Association Inc. |
| Kanmantoo/Callington Landcare Group |

## References

Australian Government (2007), *EPBC Act Policy Statement 3.7 Nationally Threatened Species and Ecological Communities: Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia,* Australian Government Department of the Environment and Water Resources, Canberra. (Also available at: http://www.environment.gov.au/epbc/publications/peppermint-box-iron-grass-policy.html).

Australian Government (2008), *Environmental Stewardship Strategic Framework*, Department of the Environment, Water, Heritage and the Arts, and Department of Agriculture, Fisheries and Forestry, Canberra. (also available at http://www.nrm.gov.au/publications/frameworks/pubs/stewardship-strategic-framework.pdf).

Barker, W.R., Barker, R.M., Jessop, J.P. & Vonow, H.P., (eds.), (2005), 'Census of South Australian Vascular Plants, 5th edition'*, J. Adelaide Bot. Gard Supplement 1*, Botanic Gardens of Adelaide & State Herbarium, Adelaide.

Bishop, G. (2009), *Management of Native Grasses and Grassy Ecosystems Case Study 2: Cell grazing of native grasses: Improving grazing management in low rainfall areas,* Rural Solutions SA, Adelaide. (also available at http://www.ruralsolutions.sa.gov.au/publications/native_grasses_factsheets)

Boomsma, C.D. (1946), 'The vegetation of the Southern Flinders Ranges, South Australia', *Trans. Roy. Soc. S. Aust.* **70**, pp. 259-276.

Boomsma, C.D. (1948), 'The ecology of the western Clare hills, South Australia', *Trans. Roy. Soc. S. Aust.* **72**, pp. 216-230.

Carter, O., Murphy, A.M. and Cheal, D. (2003), *Natural Temperate Grassland*, Flora Ecology Research Section, Arthur Rylah Institute for Environmental Research, Department of Natural Resources and Environment, Victoria.

Croft, T. (2008), 'Pre-European Vegetation', in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*, ed N. Neagle, Department for Environment and Heritage, South Australia.

Davies, R.J.-P. (1997), *Weed Management in Temperate Native Grasslands and Box Grassy Woodlands in South Australia*, Black Hill Flora Centre, Botanic Gardens of Adelaide, Adelaide.

Davies, R, (2000), 'Nomination for Listing of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland as a Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*', Report prepared for the WWF Australia.

Department for Environment and Heritage (2005a), *Provisional List of Threatened Ecosystems of South Australia: 2005 Update*, unpublished and provisional list, Department for Environment and Heritage SA, Adelaide.

Department for Environment and Heritage (2005b), *Woodland birds need your help!*, Threatened Species Information Sheet, Department for Environment and Heritage, South Australia.

Department for Environment and Heritage (2009), Flora and fauna species queries from the Biological Data Base of South Australia, Department for Environment and Heritage, South Australia.

Department for Environment and Heritage (2010), Flora species queries from the Biological Data Base of South Australia, Department for Environment and Heritage, South Australia.

Dorrough, J., Stol, J. and McIntyre, S. (2008), *Biodiversity in the Paddock: a Land Managers Guide*, Future Farm Industries CRC.

Dorrough, J., Yen, A., Turner, V., Clark, S.G., Crosthwaite, J. and Hirth, J.R. (2004), 'Livestock management and biodiversity conservation in Australian temperate grassy landscapes', *Australian Journal of Agricultural Research*, **55**, pp. 279-295.

Earl, J. and Kahn, L. (2006), *Impact of Grazing Management on Native Grasses of Non-arable Pastures in the Mid-North of South Australia,* Mid North Grasslands Working Group Project Final Report, February 2006.

Eddy, D.A. (2002), *Managing Native Grassland: A guide to management for conservation, production and landscape protection*, WWF Australia, Sydney.

Eddy, D., Mallinson, D., Rehwinkel, R. and Sharp, S. (1998), *Grassland Flora: a field guide for the Southern Tablelands (NSW & ACT)*, Canberra, ACT.

Fischer J., Stott, J., Zerger, A., Warren, G., Sherren, K. and Forrester, R.I. (2009), Reversing a tree regeneration crisis in an endangered ecoregion. *Proceedings of the National Academy of Sciences* **106**, pp. 10386-10391.

Hyde, M.K. (1996), Eucalyptus odorata *Woodlands in South Australia*, Wallowa Mallee Research, Blackwood, South Australia.

Gillam, S. (2009a), *A Regional Species Conservation Assessment Process for South Australia – Phase 2 Report: Species Prioritisation*, Department for Environment and Heritage, South Australia.

Gillam, S. (2009b), *A Regional Species Conservation Assessment Process for South Australia – Phase 2: Species Prioritisation, Northern & Yorke Results*, Department for Environment and Heritage, South Australia.

Gillam, S. (2010), *Regional Species Conservation Assessment Project – Phase 2: Species Prioritisation, West Region*, Department for Environment and Heritage, South Australia.

Gillam, S. and Urban, R. (2008), *Species Risk Assessment Pilot Project Phase 1 Report: Regional Species Conservation Assessments, Northern and Yorke Region*, Department for Environment and Heritage, South Australia.

Gillam, S. and Urban, R. (2009), *Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, West Region*, Department for Environment and Heritage, South Australia.

Gillam, S. and Urban, R. (2010), *Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, Murraylands Region*, Department of Environment and Natural Resources, South Australia.

Jessup, R.W. (1946), 'The ecology of the area adjacent to Lakes Alexandrina and Albert'. *Trans. R. Soc. S. Aust*. **70**, pp. 3-34.

Jessup, R.W. (1948), 'A vegetation and pasture survey of Counties Eyre, Burra and Kimberley, South Australia', *Trans. R. Soc. S. Aust.*, **72**, pp. 33-68.

Lenz, T.I., Moyle-Croft, J.L. and Facelli, J.M. (2003), 'Direct and indirect effects of exotic annual grasses on species composition of a South Australian grassland', *Austral Ecology*, **28**, pp. 23-32.

Lunt, I., Barlow, T. and Ross, J. (1998), *Plains Wandering: Exploring the Grassy Plains of South-eastern Australia*, Victorian National Parks Association and the Trust for Nature (Victoria), Melbourne.

Lunt, I.D. and Morgan, J.W. (1999), 'Vegetation Changes after 10 years of Grazing Exclusion and Intermittent Burning in a *Themeda triandra* (Poaceae) Grassland Reserve in South-eastern Australia', *Australian Journal of Botany*, **47**, pp. 537-552.

Martin, T.G. and Green, J.L. (2002), 'Wildlife and core conservation areas', in *Managing & Conserving Grassy Woodlands*, eds S. McIntyre, J.G. McIvor and K.M. Heard, CSIRO Publishing, Collingwood.

Moritz, K. and Bickerton, D. (2010), *Recovery Plan for the Endangered Osborn's Eyebright* Euphrasia collina *subsp.* osbornii, Department for Environment and Heritage, South Australia.

Neagle, N. (2008), 'Vegetation', in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*, ed N. Neagle, Department for Environment and Heritage, South Australia.

Nicolle, D. (1997), *Eucalypts of South Australia*, Lane Print Group, South Australia.

Obst, C. (2005), *South Australian Murray Darling Basin Threatened Flora Recovery Plan*, Report to the Threatened Species and Communities Section, Australian Government Department of the Environment and Heritage, Canberra.

Olsen, P. (Ed.) (2008), *The State of Australia's Birds 2008,* Supplement to Wingspan, Dec 2008, Birds Australia, Carlton.

Papanastasis, V.P. (2009), 'Restoration of Degraded Grazing Lands through Grazing Management: Can It Work?', *Restoration Ecology*, **17**, No. 4, pp. 441-445.

Paton, D.C., Carpenter, G. and Sinclair, R.G. (1994), 'A second bird atlas of the Adelaide region. Part 1: changes in the distribution of birds: 1974-75 vs 1984-85', *South Australian Ornithologist,* **31**, pp. 151-193.

Pobke, K. (2007), *Draft recovery plan for 23 threatened flora taxa on Eyre Peninsula, South Australia 2007-2012*, Department for Environment and Heritage , South Australia.

Pruett-Jones, S.G., White, C.M. and Devine, W.R. (1981), Breeding of the Peregrine Falcon in Victoria, Australia, *Emu*, **80**, Supplement, pp. 253-269.

Quarmby, J.P. (2010), *Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of South Australia 2010,* Department for Environment and Heritage, South Australia.

Queale, L. and Neagle, N. (2008), 'Terrestrial Macro-invertebrates', in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*, ed N. Neagle, Department for Environment and Heritage, South Australia.

Robertson, M. (1998), *A Biological Survey of Grasslands and Grassy Woodlands of the Lofty Block Bioregion of South Australia 1995-1996*, Department for Environment, Heritage and Aboriginal Affairs, South Australia.

Ross, J.H. and Walsh, N.G. (2003), A *Census of the Vascular Plants of Victoria Seventh Edition*, Royal Botanic Gardens, Melbourne.

Sharp, S., Dorrough, J., Eddy, D., and Breckwoldt, A. (2005), Grassy *Ecosystem Management Kit for Landholders*, Environment ACT, Canberra.

Smith, D.F. (1963), 'The Plant Ecology of Lower Eyre Peninsula, South Australia', *Trans. Roy. Soc. S. Aust*, **87**, pp. 93-118.

Specht, R.L, Brownell, P.F. and Hewitt, P.N. (1961) 'The plant ecology of the Mount Lofty Ranges (2): The distribution of Eucalyptus elaeophora', Trans. R. Soc. S. Aust., vol. 85, pp. 155-176.

Specht, R.L. (1972), *The Vegetation of South Australia* (2nd Edition), Government Printer, Adelaide.

Threatened Species Scientific Committee (2007), *Commonwealth Listing Advice on Peppermint Box (*Eucalyptus odorata) *Grassy Woodland of South Australia*, Threatened Species Scientific Committee (2007i), website viewed 17 August 2009, http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=36&status=Critically+Endangered

Todd, M.A. (1965), 'The Distribution of Eucalyptus Species in portion of County Stanley, South Australia' *Trans. Roy. Soc. S. Aust*, **89**, pp. 24-39.

Turner, J. (2011), *Draft National Recovery Plan for the Iron-grass Natural Temperate Grassland of South Australia ecological community 2011*. Department of Environment and Natural Resources, South Australia.

Urban Biodiversity Unit (2012). Website http://www.milliontrees.com.au/ viewed in April 2012,

Warrior, F., Knight, F., Anderson, S. and Pring, A. (2005), N*gadjuri: Aboriginal People of the Mid North Region of South Australia*, SASOSE Council Inc., Prospect Hill.

Willson, A. and Bignall, J. (2009), *Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia*, Department for Environment and Heritage, South Australia (also available at http://www.environment.gov.au/biodiversity/threatened/publications/recovery/adelaide-and-mount-lofty-ranges.htm

## Personal Communications

Ms Anne Brown, Greening Australia SA

Mr Bryan Haywood, Forestry SA

Mr Harvey Neal (Landowner and grazier)

Mr Martin O'Leary (Botanist, State Herbarium of South Australia, DEWNR)

Mr David Potter (Ornithologist)

Ms Meg Robertson (Botanist)

## Appendix 1: Principles under Schedule 1 of the *Native Vegetation Act 1991* that protect Peppermint Box Grassy Woodland remnants in South Australia

### Native Vegetation Act 1991: Schedule 1—Principles of native vegetation clearance

Native vegetation should not be cleared if, in the opinion of the (Native Vegetation) Council —

(a) it comprises a high level of diversity of plant species; or

(b) it has significance as a habitat for wildlife; or

(c) it includes plants of a rare, vulnerable or endangered species or

(d) the vegetation comprises the whole, or a part, of a plant community that is rare, vulnerable or endangered; or

(e) it is significant as a remnant of vegetation in an area which has been extensively cleared; or

(g) it contributes significantly to the amenity of the area in which it is growing or is situated; or

(h) the clearance of the vegetation is likely to contribute to soil erosion or salinity in an area in which appreciable erosion or salinisation has already occurred or, where such erosion or salinisation has not yet occurred, the clearance of the vegetation is likely to cause appreciable soil erosion or salinity; or

(i) the clearance of the vegetation is likely to cause deterioration in the quality of surface or underground water; or

(j) the clearance of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding; or

(k) (i) after clearance the land will be used for a particular purpose; and

(ii) the regional NRM board for the NRM region where the land is situated has as part of its NRM plan under the Natural Resources Management Act 2004, assessed —

(A) the capability and preferred uses of the land; and

(B) the condition of the land; and

(iii) according to that assessment the use of the land for that purpose cannot be sustained;

Additional Principles of native vegetation clearance not relevant to protection of Peppermint Box Grassy Woodland —

(f) it is growing in, or in association with, a wetland environment; or

(l) the clearance of the vegetation would cause significant harm to the River Murray within the meaning of the *River Murray Act 2003*; or

(m) the clearance of vegetation would cause significant harm to the Adelaide Dolphin Sanctuary.

### Interpretation

In this Schedule, unless the contrary intention appears—

***endangered species*** means a species of plant for the time being appearing in Part 2 of Schedule 7 of the *National Parks and Wildlife Act 1972*;

***plant community*** means plants of a species indigenous to South Australia growing in association with one another and forming a group that is distinct from other plant communities;

***rare species*** means a species of plant for the time being appearing in Part 2 of Schedule 9 of the *National Parks and Wildlife Act 1972*;

***vulnerable species*** means a species of plant for the time being appearing in Part 2 of Schedule 8 of the *National Parks and Wildlife Act 1972*;

***wildlife*** has the same meaning as in the *National Parks and Wildlife Act 1972*.

## Appendix 2: South Australian Government legislation relevant to the conservation, protection and management of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia

**Development Act 1993**
*An Act to provide for planning and regulate development in the State; to regulate the use and management of land and buildings, and the design and construction of buildings; to make provision for the maintenance and conservation of land and buildings where appropriate; and for other purposes*.

Under the *Development Act 1993*, local Councils and the state Development Assessment Commission (DAC) seek advice from the Native Vegetation Council (NVC) regarding applications for land sub-division and where development may impact on native vegetation. Decisions made by local Councils and the DAC may go against the advice of the NVC. An approved development within an area of intact native vegetation is subject to the Regulations under the NV Act.

**Crown lands Act 1929**
*An Act relating to Crown lands.*

The *Crown Lands Act 1929* (CL Act) regulates the use of Crown land under the care of Local Government, such as cemetery reserves, water reserves, stone reserves and parklands. Crown land under the care of Local Government can be proclaimed as Conservation Reserves under the CL Act and managed for biodiversity purposes.

**Forestry Act 1950**
*An Act to provide for the creation and management of State forests and other related matters,*

The *Forestry Act 1950* (FA Act) regulates the use of land gazetted for the purpose of Forestry. Forestry SA manages areas of native vegetation including land with Peppermint Box Grassy Woodland remnants. Native Forest Reserves can be proclaimed under the FA Act for purposes relating to the conservation and management of land supporting native flora and fauna.

**National Parks and Wildlife Act 1972**
*An Act to provide for the establishment and management of reserves for public benefit and enjoyment; to provide for the conservation of wildlife in a natural environment; and for other purposes.*

For more details refer to the outline in the main body of this plan.

**Native Vegetation Act 1991**
*An Act to provide incentives and assistance to landowners in relation to the preservation and enhancement of native vegetation; to control the clearance of native vegetation; and for other purposes.*

For more details refer to the outline in the main body of this plan.

**Natural Resources Management Act 2004**
*An Act to promote sustainable and integrated management of the State's natural resources; to make provision for the protection of the State's natural resources; to repeal the* Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986*, the* Soil Conservation and Land Care Act 1989 *and the* Water Resources Act 1997*; and for other purposes.*

Under the *Natural Resources Management Act 2004* (NRM Act) the state NRM Council and regional NRM Boards identify the range and condition of natural resources, including biodiversity assets, throughout the state; plan and set targets for the protection and management of natural resources; and encourage landholders to adopt appropriate conservation and management practices. NRM Boards run programs targeting high priority pest plants and animals impacting on natural resources. Boards may also fund on-ground works and environmental stewardship programs for management and protection of natural resource assets, including threatened ecological communities.

**Native Title (South Australia) Act 1994**
*An Act relating to native title in South Australia.*

Recognises the rights and interests of communities, groups and individual Aboriginal peoples in relation to land (and waters), where rights are possessed by traditional laws and traditional customs are observed. Native title rights may exist in some areas of Peppermint Box Grassy Woodland where native title has not been extinguished, allowing people to hunt and gather and carry out other traditional practices on the land.

## Appendix 3: State and regional plans relevant to the recovery of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community

The following current South Australian planning strategies address biodiversity decline and are relevant to recovery of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community:

### South Australia's Strategic Plan

South Australia's Strategic Plan 2007 (Government of South Australia undated) includes sustainability targets to 'lose no native species as a result of human impacts' (Target 69) and to 'increase participation in nature conservation activities by 25% by 2015 (Target 72). These targets became the benchmark for establishment of the *No Species Loss* conservation strategy.

### No Species Loss – A Nature Conservation Strategy for South Australia 2007 – 2017

The vision of the *No Species Loss* conservation strategy (DEH 2007) is for *the people of South Australia actively supporting their native plants, animals and ecosystems to survive, evolve and adapt to environmental change*. With this view, the aim of *No Species Loss* is to halt and where possible reverse the decline in the State's terrestrial, aquatic and marine biodiversity over the next 10 years. The Strategy forms a framework with timelines for achievement. This recovery plan addresses objectives and targets under the five main goals of the *No Species Loss* conservation strategy.

### NatureLinks

*NatureLinks* is part of the *No Species Loss* conservation strategy, relating specifically to establishment of five landscape scale biodiversity corridors in South Australia (Department of Environment and Natural Resources undated). The purpose of these corridors is to manage and restore large areas of native species habitat, enabling native wildlife to survive and adapt to environmental change. The Peppermint Box Grassy Woodland ecological community may be a component of landscape restoration activities in the Cape Borda to Barossa NatureLink. The Cape Borda to Barossa NatureLink aims to increase landscape connectivity to build resilience in ecosystems, particularly in the face of climate change.

### State NRM Plan

The *State Natural Resources Management Plan* (Department of Water, Land and Biodiversity Conservation 2006) provides a framework for sustainable, long-term use of natural resources in South Australia. It promotes a landscape scale approach to managing and maintaining natural ecosystems and dealing with critical risks to biodiversity. Biodiversity conservation strategies identified in the Plan include protection, maintenance and expansion of native vegetation and natural habitats, increased functional connectivity, threat abatement and recovery of threatened species and ecological communities. The State's eight Regional NRM Boards support and deliver natural resources management in the regions. Their NRM Plans identify targets and strategies for biodiversity conservation.

### Regional NRM Plans

The Adelaide and Mount Lofty Ranges, Eyre Peninsula, Northern and Yorke, and SA Murray-Darling Basin NRM Boards have Regional NRM Plans which include targets to retain native species and ecological communities, improve native vegetation cover and maintain or improve the viability and conservation status of threatened species and ecological communities. All four NRM Plans identify the Peppermint Box Grassy Woodland ecological community as a significant biodiversity conservation target in their region.

### AMLR Regional Recovery Plan (2009 – 2014)

The *Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia* (Willson and Bignall 2009) identifies and prioritises the native species and ecological communities most at risk in the region. The plan highlights the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia as a very high priority for recovery. The ecological community occurs in the Barossa and Eastern Hills district of the AMLR region. A threat analysis for the AMLR region rated grassy woodlands as being at very high threat of weed invasion; high threat of grazing and disturbance by stock; grazing and disturbance by kangaroos; and/or inappropriate fire regimes; and medium threat from drought, climate change, severe weather; firewood and rock removal; agricultural intensification; problematic native species; and/or pollution and poisoning (chemical and solid waste).

### Regional Biodiversity Plans

Regional Biodiversity Plans describe the biodiversity assets of a region, including major plant community groups, and the ecology, distribution, threats and management of threatened plant communities. They also describe selected threatened native flora and fauna and special habitats in the region.

Biodiversity Plans were prepared for the Northern Agricultural Districts (Graham *et al*. 2001), the SA Murray-Darling Basin (Kahrimanis *et al*. 2001) and Eyre Peninsula (Matthews *et al.* 2001). While these plans pre-date the EPBC Act listing of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia, they did identify *Eucalyptus odorata* Woodland as a threatened community and a high priority for conservation. They also outlined the issues impacting on these woodlands, their management requirements and priorities for conservation.

A Biodiversity Strategy for Adelaide and the Mount Lofty Ranges region is currently in draft form.

### References

Adelaide and Mount Lofty Ranges Natural Resources Management Board (2008), *Creating a Sustainable Future: An Integrated Natural Resources Management Plan for Adelaide and the Mount Lofty Ranges Region: Volumes A-D*, website viewed 7 July 2010, http://www.amlrnrm.sa.gov.au/Plans/RegionalNRMPlan/ThePlan.aspx

Department for Environment and Heritage (2007), *No Species Loss – A Nature Conservation Strategy for South Australia 2007-2017*, website, viewed 6 July 2010, http://www.environment.sa.gov.au/Conservation/Ecosystem_conservation/No_species_loss

Department of Environment and Natural Resources (undated), *NatureLinks*, website, viewed on 6 July 2010, http://www.environment.sa.gov.au/naturelinks/

Department of Water, Land and Biodiversity Conservation 2006, *State Natural Resources Management Plan 2006*, website viewed 6 July 2010, http://www.nrm.sa.gov.au/Portals/1/NRM_StateNRMPlan2006.pdf

Eyre Peninsula Natural Resources Management Board (2009), *Regional NRM Plan*, website viewed 7 July 2010, http://www.epnrm.sa.gov.au/PolicyPlanning/OurPlan.aspx

Government of South Australia, *South Australia's Strategic Plan 2007*, website, viewed 6 July 2010, www.SAplan.org.au

Graham, A, Oppermann, A., and Inns, R.W. (2001), *Biodiversity Plan for the Northern Agricultural Districts,* Department for Environment and Heritage, South Australia.

Kahrimanis, M.J., Carruthers, S., Oppermann, A., and Inns, R. (2001), *Biodiversity Plan for the South Australian Murray-Darling Basin*, Department for Environment and Heritage, South Australia.

Matthews, E., Oppermann, A. and Inns, R.W., (2001*), Biodiversity Plan for Eyre Peninsula*, Department for Environment and Heritage, South Australia.

Northern and Yorke Natural Resources Management Board (2009), *Northern and Yorke Regional NRM Plan*, website, viewed 7 July 2010, http://www.nynrm.sa.gov.au/PolicyPlanning/StrategicPlans/RegionalNRMPlan.aspx

South Australian Murray-Darling Basin Natural Resources Management Board (2009), *Regional NRM Plan: Volumes 1-4*, website viewed 7 July 2010, http://www.samdbnrm.sa.gov.au/NRMPlan.aspx

Willson, A. and Bignall, J. (2009), *Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia*, Department for Environment and Heritage, South Australia.

## Appendix 4: Native plant species commonly recorded in the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community

Species frequency in Biological Survey sites classified as Peppermint Box Grassy Woodland in the Mt Lofty Ranges, Flinders Ranges and adjacent areas. Compiled from the Biological Survey Data Base of SA, May 2009

| | | Sites | Records in Sites according to EPBC Confidence rating | | | Previous species coding | | |
|---|---|---|---|---|---|---|---|---|
| ***Species*** | **Common name** | **Total** | **High** | **Med** | **Low** | **Davies 1997** | **Robertson 1998** | **Specht 1972** |
| *Eucalyptus odorata* | Peppermint Box | 180 | 120 | 29 | 31 | | | X |
| *Oxalis perennans* | Native Sorrel | *101 | 70 | 12 | 19 | | | X |
| *Arthropodium strictum* | Common Vanilla-lily | 99 | 70 | 8 | 21 | | | X |
| *Acacia pycnantha* | Golden Wattle | 95 | 66 | 13 | 16 | | | X |
| *Bursaria spinosa* subsp. *spinosa* | Sweet Bursaria | 87 | 54 | 18 | 15 | | | X |
| *Rytidosperma caespitosum* (formerly *Austrodanthonia caespitosa*) | Common Wallaby-grass | 77 | 58 | 8 | 11 | | | X |
| *Lomandra multiflora* subsp. *dura* | Stiff Iron-grass | *76 | 46 | 13 | 17 | | 2 | X |
| *Austrostipa elegantissima* | Feather Spear-grass | 75 | 52 | 12 | 11 | | | |
| *Maireana enchylaenoides* | Wingless Fissure-plant | 69 | 56 | 8 | 5 | A | | |
| *Allocasuarina verticillata* | Drooping Sheoak | 69 | 41 | 13 | 15 | | | X |
| *Austrostipa blackii* | Crested Spear-grass | 66 | 48 | 8 | 10 | A | 2 | X |
| *Cheilanthes austrotenuifolia* | Annual Rock-fern | 66 | 39 | 7 | 20 | | | X |
| *Gonocarpus elatus* | Hill Raspwort | 59 | 35 | 8 | 16 | | | |
| *Lomandra densiflora* | Soft Tussock Mat-rush | 58 | 37 | 10 | 11 | | 2 | |
| *Rytidosperma setaceum* (formerly *Austrodanthonia setacea*) | Small-flower Wallaby-grass | 57 | 42 | 4 | 11 | | 2 | |
| *Goodenia pinnatifida* | Cut-leaf Goodenia | 53 | 41 | 7 | 5 | A | 2 | X |
| *Wahlenbergia luteola* | Yellow-wash Bluebell | 51 | 39 | 9 | 3 | A | | |
| *Daucus glochidiatus* | Native Carrot | 50 | 31 | 7 | 12 | | | X |
| *Einadia nutans* subsp. *nutans* | Climbing Saltbush | *50 | 32 | 7 | 11 | | | |
| *Lagenophora huegelii* | Coarse Bottle-daisy | 46 | 35 | 4 | 7 | A | 2 | |
| *Crassula colligata subsp.* | Australian Stonecrop | *46 | 34 | 6 | 6 | | | X |
| *Amyema miquelii* | Box Mistletoe | 45 | 33 | 4 | 8 | | | X |
| *Elymus scaber* var. *scaber* | Native Wheat-grass | *44 | 38 | 4 | 2 | A | 2 | |
| *Vittadinia gracilis* | Woolly New Holland Daisy | 40 | 32 | 5 | 3 | A | | |
| *Dianella revoluta* var. *revoluta* | Black-anther Flax-lily | 40 | 25 | 6 | 9 | | | X |
| *Stackhousia monogyna* | Creamy Candles | 40 | 24 | 5 | 11 | | 2 | X |
| *Asperula conferta* | Common Woodruff | 39 | 30 | 5 | 4 | A | 2 | X |
| *Bulbine bulbosa* | Bulbine-lily | 39 | 28 | 4 | 7 | | 2 | X |
| *Acacia paradoxa* | Kangaroo Thorn | 38 | 23 | 6 | 9 | | | X |
| *Crassula decumbens* var. *decumbens* | Spreading Crassula | 36 | 28 | 1 | 7 | | | |
| *Themeda triandra* | Kangaroo Grass | 36 | 25 | 4 | 7 | | 2 | X |
| *Austrostipa nitida* | Balcarra Spear-grass | 34 | 21 | 8 | 5 | | | |
| *Austrostipa scabra* subsp. *falcata* | Slender Spear-grass | 32 | 26 | 1 | 5 | | | |
| *Acacia acinacea* | Wreath Wattle | 32 | 24 | 4 | 4 | A | 1 | X |
| *Eutaxia microphylla* | Common Eutaxia | *31 | 21 | 5 | 5 | | 2 | |
| *Austrostipa nodosa* | Tall Spear-grass | 30 | 28 | | 2 | | | |

| | | Sites | Records in Sites according to EPBC Confidence rating | | | Previous species coding | | |
|---|---|---|---|---|---|---|---|---|
| ***Species*** | **Common name** | **Total** | **High** | **Med** | **Low** | **Davies 1997** | **Robertson 1998** | **Specht 1972** |
| *Eucalyptus leucoxylon* subsp. *pruinosa* | Inland South Australian Blue Gum | 30 | 25 | 3 | 2 | | 2 | |
| *Callitris gracilis* | Southern Cypress Pine | 30 | 19 | 7 | 4 | | | X |
| *Lepidosperma viscidum* | Sticky Sword-sedge | 30 | 17 | 7 | 6 | | 2 | |
| *Astroloma humifusum* | Cranberry Heath | 30 | 14 | 3 | 13 | | | X |
| *Aristida behriana* | Brush Wire-grass | 29 | 24 | 3 | 2 | A | 2 | |
| *Crassula colorata* var. *colorata* | Dense Crassula | 29 | 22 | 2 | 5 | | | |
| *Rytidosperma auriculatum* (formerly *Austrodanthonia auriculata)* | Lobed Wallaby-grass | 28 | 22 | 1 | 5 | A | 2 | |
| *Thysanotus patersonii* | Twining Fringe-lily | 28 | 15 | 4 | 9 | | | X |
| *Crassula colorata* var. *acuminata* | Dense Crassula | 26 | 19 | 2 | 5 | | | |
| *Ptilotus spathulatus* | Pussy-tails | *26 | 21 | 3 | 2 | | | |
| *Chrysocephalum semipapposum* | Clustered Everlasting | 25 | 19 | 4 | 2 | | | |
| *Calostemma purpureum* | Pink Garland-lily | 25 | 18 | 2 | 5 | A | 2 | X |
| *Poa crassicaudex* | Thick-stem Tussock-grass | 25 | 15 | 3 | 7 | | | |
| *Clematis microphylla* | Old Man's Beard | 25 | 13 | 4 | 8 | | | |
| *Pultenaea largiflorens* | Twiggy Bush-pea | 25 | 11 | 7 | 7 | | | |
| *Senecio quadridentatus* | Cotton Groundsel | 24 | 17 | 4 | 3 | | | X |
| *Levenhookia dubia* | Hairy Stylewort | 24 | 15 | 3 | 6 | | 1 | |
| *Wahlenbergia stricta* subsp. *stricta* | Tall Bluebell | 23 | 16 | 1 | 6 | | | |
| *Chrysocephalum apiculatum* | Common Everlasting | 23 | 11 | 7 | 5 | | 2 | X |
| *Vittadinia cervicularis* var. *cervicularis* | Waisted New Holland Daisy | 22 | 19 | 1 | 2 | | | |
| *Convolvulus remotus* | Grassy Bindweed | 22 | 16 | 2 | 4 | | | |
| *Vittadinia cuneata* var. cuneata | Fuzzy New Holland Daisy | *22 | 16 | 4 | 2 | | 2 | |
| *Acaena echinata* | Sheep's Burr | *22 | 13 | 4 | 5 | | 2 | |
| *Triptilodiscus pygmaeus* | Small Yellow-heads | 21 | 18 | 1 | 2 | A | 2 | |
| *Scaevola albida* | Pale Fanflower | *21 | 17 | | 4 | | 2 | X |
| *Enchylaena tomentosa* var. *tomentosa* | Ruby Saltbush | *21 | 15 | 3 | 3 | | | |
| *Calocephalus citreus* | Lemon Beauty-heads | 20 | 18 | 1 | 1 | A | 2 | |
| *Austrostipa eremophila* | Rusty Spear-grass | 20 | 17 | 2 | 1 | | | X |
| *Geranium retrorsum* | Grassland Geranium | 20 | 16 | 3 | 1 | | | |
| *Wahlenbergia gracilenta* | Annual Bluebell | 20 | 13 | 2 | 5 | | | |
| *Leptorhynchos squamatus* subsp. *squamatus* | Scaly Buttons | 20 | 12 | 1 | 7 | | 2 | X |
| *Goodenia blackiana* | Native Primrose | 20 | 9 | 4 | 7 | | | |
| *Actinobole uliginosum* | Flannel Cudweed | 19 | 16 | | 3 | | 2 | |
| *Caesia calliantha* | Blue Grass-lily | 19 | 12 | 1 | 6 | | | X |
| *Schoenus apogon* | Common Bog-rush | 19 | 12 | 1 | 6 | | | X |
| *Arthropodium fimbriatum* | Nodding Vanilla-lily | 18 | 16 | 1 | 1 | A | 2 | |
| *Juncus subsecundus* | Finger Rush | 17 | 13 | 3 | 1 | A | | |
| *Austrostipa scabra* subsp. *scabra* | Rough Spear-grass | 17 | 12 | 4 | 1 | | | |
| *Lomandra effusa* | Scented Iron-grass | 17 | 11 | 6 | | | 2 | |
| *Wurmbea dioica* subsp. *dioica* | Early Star-lily | *17 | 13 | 1 | 3 | | 2 | X |
| *Chenopodium desertorum* subsp. *microphyllum* | Small-leaf Goosefoot | 16 | 15 | 1 | | | | |
| *Sida corrugata* var. *corrugata* | Corrugated Sida | *16 | 14 | 2 | | A | | |

| | | Sites | Records in Sites according to EPBC Confidence rating | | | Previous species coding | | |
|---|---|---|---|---|---|---|---|---|
| ***Species*** | **Common name** | **Total** | **High** | **Med** | **Low** | **Davies 1997** | **Robertson 1998** | **Specht 1972** |
| *Cymbonotus preissianus* | Austral Bear's-ear | 15 | 11 | 3 | 1 | A | 2 | X |
| *Enneapogon nigricans* | Black-head Grass | 15 | 11 | 2 | 2 | A | 2 | |
| *Hydrocotyle laxiflora* | Stinking Pennywort | 15 | 10 | 2 | 3 | | | |
| *Glycine rubiginosa* | Twining Glycine | *15 | 9 | 2 | 4 | | | X |
| *Pogonolepis muelleriana* | Stiff Cup-flower | 14 | 11 | | 3 | | | |
| *Hyalosperma semisterile* | Orange Sunray | 14 | 10 | 3 | 1 | | | |
| *Lomandra nana* | Small Mat-rush | 14 | 10 | | 4 | A | | |
| *Maireana brevifolia* | Short-leaf Bluebush | 13 | 11 | 2 | | | | |
| *Austrostipa setacea* | Corkscrew Spear-grass | 13 | 9 | 1 | 3 | A | 2 | X |
| *Galium gaudichaudii* | Rough Bedstraw | 13 | 9 | 1 | 3 | | | X |
| *Plantago varia complex* | Native Plantain | 13 | 9 | 2 | 2 | | 2 | X |
| *Salsola tragus* | Buckbush | 13 | 9 | 2 | 2 | | | |
| *Euphorbia drummondii* | Caustic Weed | *13 | 11 | 1 | 1 | A | 2 | X |
| *Lomandra micrantha* subsp. *micrantha* | Small-flower Mat-rush | *13 | 11 | | 2 | | | |
| *Austrostipa curticoma* | Short-crest Spear-grass | 12 | 12 | | | A | | |
| *Brachyscome lineariloba* | Hard-head Daisy | 12 | 10 | | 2 | | | |
| *Dodonaea viscosa* subsp. *spatulata* | Sticky Hop-bush | 12 | 9 | 1 | 2 | | | X |
| *Plantago gaudichaudii* | Narrow-leaf Plantain | 11 | 11 | | | A | | |
| *Rytidosperma erianthum* (formerly *Austrodanthonia eriantha)* | Hill Wallaby-grass | 11 | 9 | 1 | 1 | | 2 | |
| *Rytidosperma pilosum* (formerly *Austrodanthonia pilosa*) | Velvet Wallaby-grass | 11 | 9 | 1 | 1 | | | |

*This is an underestimate of frequency due to taxonomic variations

E**PBC Confidence rating** = confidence that the vegetation represents the Peppermint Box Grassy Woodland ecological community, according to the definition in the EPBC Act Policy Statement 3.7 (Australian Government 2007).

A total of 180 sites in the biological survey database containing *Eucalyptus odorata* in the Mt Lofty Ranges, Flinders Ranges and adjacent areas were considered as possible Peppermint Box Grassy Woodland. These 180 sites were classified as High, Medium or Low confidence (of being Peppermint Box Grassy Woodland), based on a desk-top assessment of their vegetation structure, species composition and site photo.

State-wide, *Eucalyptus odorata* was present at 390 survey sites. Sites with *Eucalyptus odorata* of the whipstick mallee form, or with shrub cover greater than 30% were excluded.

**High confidence**

- Tree form Peppermint Box is an overstorey dominant or co-dominant.
- Abundance and type of shrubs – there is not a dense cover of heathy species.
- High percentage of 'grassy habitat' species.

**Medium Confidence**

- Includes sites where Peppermint Box is subdominant to SA Blue Gum
- Shrubs present, but not dense cover of heathy species.

**Low Confidence**

- Includes sites where Peppermint Box is subdominant to SA Blue Gum
- Shrub cover may be relatively high, but not dense cover of heathy species.

**References for definitions and sources of coding for species previously listed as grassy ecosystem species**

Australian Government (2007), *EPBC Act Policy Statement 3.7 Nationally Threatened Species and Ecological Communities: Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*, Australian Government Department of the Environment and Water Resources, Canberra.

Davies R.J-P (1997), Weed *Management in Temperate Native Grasslands and Box Grassy Woodlands in South Australia*, Black Hill Flora Centre, Botanic Gardens of Adelaide, Adelaide. Table 1, page 6. Plant species which are largely confined, in the agricultural regions of South Australia, to native grasslands and grassy woodlands. "A" signifies listed in table.

Robertson, M. (1998), *A Biological Survey of Grasslands and Grassy Woodlands of the Lofty Block Bioregion of South Australia 1995-1996*, Department for Environment, Heritage and Aboriginal Affairs, South Australia. Table 7, page 21. Native species occurring predominantly (75% or more of quadrat records) in grassy vegetation in Lofty Block Bioregion. 2, 1, 0 are varying levels of significance of association with grassy vegetation sites.

Specht, R.L. (1972), *The Vegetation of South Australia,* 2nd Edition, Government Printer, Adelaide. Appendix III page 259. Plant Species Recorded in the "Savannah" land systems. 1. Native species. Association: Peppermint box association, Mt Lofty Ranges region (original source Adamson and Osborn 1924 and Specht and Perry 1948). The association referred to includes grey box grassy woodland. The survey region covered in these earlier reports is primarily the southern Mt Lofty Ranges, therefore it does not include the core distribution of peppermint box grassy woodland in the Northern Lofty region. X=present.

## Appendix 5: Woodland structure and floristic composition of Peppermint Box Grassy Woodland of South Australia

### Woodland Structure

The vegetation structure of Peppermint Box Grassy Woodland has been described variously as Low Woodland (Hyde 1996; Robertson 1998; Neagle 2008), Low Open Woodland (Croft 2008) and Open Woodland (Hyde 1996). The tree stratum is generally low (5 to 10 m), but may be taller (up to 15m) at sites with higher rainfall, deeper soil profiles or more fertile soil. Tree spacing can range from very sparse to dense, with woodland tree canopy cover varying from 5% up to 70% or more. Sites surveyed in the Lofty Block region commonly have a tree canopy cover of 30-70% (Robertson 1998). Canopy cover in degraded remnants may be less than 5%, due to past clearance, ongoing thinning or tree decline coupled with suppressed regeneration.

The understorey consists of an open shrub layer over a herbaceous ground layer dominated by perennial native grasses (Robertson 1998). Medium to tall shrubs are generally scattered, providing open cover of up to 30%. Native grasses, herbs, forbs and prostrate shrubs form a discontinuous ground stratum beneath and between the tree and open shrub layers, interspersed with mosses, lichens and bare patches (e.g. Robertson 1998; Neagle 2008). At some sites the understorey can be very sparse, with large areas of bare soil and lichen or moss crust (Robertson 1998; Neagle 2008). Embedded rocks and loose surface stones are often present, providing additional structure and micro-habitats for animals and plants. Tree hollows, bark, natural fallen timber and leaf litter also contribute structural complexity and habitat.

### Floristic composition

The floristic composition of *Eucalyptus odorata* Woodland groups fitting the definition for Peppermint Box Grassy Woodland of South Australia has been described in various surveys (e.g. Hyde 1996; Robertson 1998; Brandle 2001; Neagle 2008). Robertson's (1998) *Eucalyptus odorata* Low Woodland floristic group broadly typifies the Peppermint Box Grassy Woodland ecological community (Davies 2000). The main features of this group are summarised below.

*Eucalyptus odorata* Low Woodland

*Eucalyptus odorata* is the dominant tree species, over an open to sparse shrub layer and herbaceous ground layer dominated by Wallaby-grasses and Spear-grasses. The most commonly occurring understorey species are Common Wallaby-grass (*Rytidosperma caespitosum*), Rough Spear-grass (*Austrostipa scabra* subsp. *scabra*), Crested Spear-grass (*Austrostipa blackii*) and Small-flower Wallaby-grass (*Rytidosperma setaceum*). Frequently occurring forbs include Native Sorrel (*Oxalis perennans*), Common Vanilla-lily (*Arthropodium strictum*), Dense Crassula (*Crassula colorata*), Australian Stonecrop (*Crassula colligata*) and Wingless Fissure-plant (*Maireana enchylaenoides*). Golden Wattle (*Acacia pycnantha*) and Sweet Bursaria (*Bursaria spinosa* subsp. *spinosa*) are the most frequently recorded tall shrubs. Other woodland trees sometimes occurring with *E. odorata* and co-dominant at some sites include Inland South Australian Blue Gum (*Eucalyptus leucoxylon* subsp. *pruinosa*) or other SA Blue Gum sub-species, Mallee Box (*E. porosa*) and Southern Cypress Pine (*Callitris gracilis*).

The Peppermint Box Grassy Woodland ecological community contains a high diversity of native plant species across the distribution range. Surveys of 69 *Eucalyptus odorata* Low Woodland sites in the Mid North found a total of 297 native plant taxa (Neagle 2008), with the number of native plant taxa per 30m x 30m survey quadrat varying from 17 to 45 perennial species and 11 to 28 annual species. Previous surveys across the wider Lofty Block region recorded similar results, with native plant diversity in survey quadrats varying from 13 to 68 species (average 35.5) (Robertson 1998). Around

500 different native plant taxa have been recorded in sites classified as Peppermint Box Grassy Woodland in the Flinders Lofty Block Bioregion (DEH 2009). Most of these are annual and perennial herbs and forbs which often have patchy distribution and low cover/abundance in the woodland, but can constitute 60% or more of the native plant diversity at a site (DEH 2009 data).

Plant families and species commonly represented in Peppermint Box Grassy Woodland include:

**grasses** - Brush Wire-grass (*Aristida behriana*), Wallaby-grasses (*Rytidosperma*, formerly *Austrodanthonia*, spp.), Spear-grasses (*Austrostipa* spp.), Native Wheat-grass (*Elymus scaber* var. *scaber*), Black-head Grass (*Enneapogon nigricans*), Kangaroo Grass (*Themeda triandra*);

**daisies** - Lemon Beauty-heads (*Calocephalus citreus*), Everlastings (*Chrysocephalum semipapposum and C. apiculatum*), Orange Sunray (*Hyalosperma semisterile*), Coarse Bottle-daisy (*Lagenophora huegelii*), Scaly Buttons *(Leptorhynchos squamatus* subsp. *squamatus*), Small Yellow-heads (*Triptilodiscus pygmaeus*), New Holland Daisies (*Vittadinia* spp.);

**lilies** - Common Vanilla Lily (*Arthropodium strictum*), Nodding Vanilla-lily (*A. fimbriatum*), Bulbine-lily (*Bulbine bulbosa*), Flax-lilies (*Dianella revoluta* and *D. longifolia var. grandis*), Iron-grasses/Mat-rushes (*Lomandra* spp.), Fringe-lilies (*Thysanotus* spp.), Early Nancy *Wurmbea dioica* subsp. *dioica*);

**chenopods** - Small-leaf Goosefoot (*Chenopodium desertorum* subsp. *microphyllum*), Climbing Saltbush (*Einadia nutans*), Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*), Wingless fissure-plant (*Maireana enchylaenoides*) and Bottle Fissure-plant (*M. excavata*);

**bluebells** - Yellow-wash Bluebell (*Wahlenbergia luteola*), Tall Bluebell (*W. stricta* subsp. *stricta*) and Annual Bluebell (*W. gracilenta*);

**primroses/fan-flowers** - Cut-leaf Goodenia *(Goodenia pinnatifida*), Native Primrose (*G. blackiana*), Small-flower Goodenia (*G. pusilliflora*), Pale Fanflower (*Scaevola albida*), Spur Velleia (*Velleia paradoxa*); and

**peas** - Golden Wattle (*Acacia pycnantha*), Wreath Wattle (*A. acinacea*), Common Eutaxia (*Eutaxia microphylla*), Twining Glycine (*Glycine rubiginosa*), Twiggy Bush-pea (*Pultenaea largiflorens*) and Behr's Swainson-pea (*Swainsona behriana*).

The native plant species most commonly recorded in vegetation surveys of Peppermint Box Grassy Woodland in the Mount Lofty Ranges, Flinders Ranges and adjoining areas are listed in Appendix 4.

Shrub species commonly recorded in Peppermint Box Grassy Woodland remnants in the Flinders Lofty Block Bioregion are Golden Wattle (*Acacia pycnantha*), Sweet Bursaria (*Bursaria spinosa* subsp. *spinosa*), Wreath Wattle (*Acacia acinacea*), Kangaroo Thorn (*Acacia paradoxa*), Common Eutaxia (*Eutaxia microphylla*), Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*), Twiggy Bush-pea (*Pultenaea largiflorens*) and Sticky Hop-bush (*Dodonaea viscosa* subsp. *spatulata*) (DEH 2009 data).

Other canopy trees recorded in the ecological community throughout the Flinders Lofty Block Bioregion include River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*), Pink Gum (*E. fasciculosa*), Grey Box (E. *microcarpa*), Beaked Red Mallee (*E. socialis*), Sugar Gum (*E. cladocalyx*), Drooping Sheoak (*Allocasuarina verticillata*) and Northern Cypress Pine (*Callitris glaucophylla*) (DEH 2009).

Information on the floristic composition of Peppermint Box Grassy Woodland on Eyre Peninsula is limited, but indicates similarities with the woodlands of the Flinders Lofty Block Bioregion. Smith (1963) described *E. odorata* as one of two eucalypts forming true savannah woodland on lower Eyre Peninsula, often occurring as a pure dominant, but sometimes with *E. petiolaris* (formerly *E. leucoxylon*) on wetter soils, or *Allocasuarina verticillata* (formerly *Casuarina stricta*) on drier, skeletal soils. The savannah understorey included *Rytidosperma caespitosum* (formerly *Austrodanthonia caespitosa*), various

*Austrostipa* species, *Dianella revoluta* and *Bulbine semibarbata* (Smith 1963). Shrubs, including *Acacia acinacea*, *Cassinia complanata*, *Daviesia pectinata*, *Dodonaea baueri*, *Eutaxia microphylla* and *Enchylaena tomentosa* occurred in transitional areas between the savannah woodland and 'mallee scrub' (Smith 1963). Many woodland areas in the southern Eyre Hills IBRA sub-region were burned by an extensive bushfire in January 2004. Some remnants that may have been Peppermint Box Grassy Woodland are in transitional regrowth stages (M. Robertson, pers. comm.). These may not fit the EPBC Act definition of the ecological community, due to high densities of regenerating shrubs and 'mallee-form' regrowth of *E. odorata* trees.

**References:**

Brandle, R, (2001), *A Biological Survey of the Flinders Ranges, South Australia 1997-1999*. Department for Environment & Heritage, South Australia.

Croft, T. (2008), 'Pre-European Vegetation', in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*, ed N. Neagle, Department for Environment and Heritage, South Australia.

Davies, R, (2000), 'Nomination for Listing of Peppermint Box (*Eucalyptus odorata*) Grassy Woodland as a Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*', Report prepared for the WWF Australia.

Department for Environment and Heritage (2009), Biological Databases of South Australia records, Department of Environment and Natural Resources, Adelaide.

Hyde, M.K. (1996), Eucalyptus odorata *Woodlands in South Australia*, Wallowa Mallee Research, Blackwood, South Australia.

Neagle, N. (2008), 'Vegetation', in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*, ed N. Neagle, Department for Environment and Heritage, South Australia.

Robertson, M. (1998), *A Biological Survey of Grasslands and Grassy Woodlands of the Lofty Block Bioregion of South Australia 1995-1996*, Department for Environment, Heritage and Aboriginal Affairs, South Australia.

Smith, D.F. (1963), 'The Plant Ecology of Lower Eyre Peninsula, South Australia', *Transactions of the Royal Society of South Australia*, **87**, pp. 93-118.

## Appendix 6: Native fauna of Peppermint Box Grassy Woodland of South Australia

The information below is based mainly on biological surveys of *Eucalyptus odorata* Low Woodland in the Mid North (Neagle 2008), the Eastern Mount Lofty Ranges (Johnson 2003), Beetaloo Valley (Philpott 2003) and Mount Brown Conservation Park (Herbert 2000).

### Mammals

Kangaroos are the most frequent and abundant mammals recorded in Peppermint Box Grassy Woodland: the Western Grey Kangaroo (*Macropus fuliginosus*), Euro (*M. robustus*), and Red Kangaroo (*M. rufus*) have been recorded at biological survey sites (Herbert 2000; Johnson 2003; Neagle 2008). Common Brushtail Possums (*Trichosurus vulpecula*) have also been recorded frequently in Peppermint Box Grassy Woodland sites (Neagle 2008; Johnson 2003). Short-beaked Echidnas (*Tachyglossus aculeatus*) occupy a wide range of habitats, including Peppermint Box Grassy Woodland (Johnson 2003; Neagle 2008). A small terrestrial mammal species, the Common Dunnart (*Sminthopsis murina*) was recorded in Peppermint Box Grassy Woodland in the Burra Hills (Neagle 2008). This species is generally associated with drier mallee vegetation (Brandle 2008a) and may only extend into the ecological community along the eastern ranges of the Mid North.

Bats play an important role in control of insects, in remnant vegetation and the adjoining agricultural land (Lumsden and Bennett 2000). Bat species recorded in Peppermint Box Grassy Woodland include the Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Southern Freetail Bat complex (*Mormopterus* sp.), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*C. morio*) and White-striped Freetail Bat *Tadarida australis* (Neagle 2008).

The Common Brushtail Possum is rated as rare in South Australia and considered endangered and declining in the Northern and Yorke and Eyre Peninsula regions (Gillam and Urban 2008; Gillam and Urban 2009). Common Brushtail Possums are strongly associated with grassy woodlands (Brandle 2008a) and mature Peppermint Box trees often have well developed hollows which provide shelter and breeding dens for possums (J. Turner, personal observation).

### Birds

At least 61 native bird species, including many woodland specialists, have been recorded at Peppermint Box Grassy Woodland survey sites in the Mid North and Eastern Mount Lofty Ranges (Neagle 2008; Johnson 2003). The most frequently recorded species at these sites include the Australian Magpie (*Cracticus tibicen*), Galah *(Eolophus roseicapillus*, syn. *Cacatua roseicapilla*), Grey Shrike-thrush (*Colluricincla harmonica*), Little Raven (*Corvus mellori*), Striated Pardalote (*Pardalotus striatus*), Red Wattlebird (*Anthochaera carunculata*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*), Mistletoe Bird (*Dicaeum hirundinaceum*), Crimson Rosella (*Platycercus elegans*), Red-rumped Parrot (*Psephotus haematonotus*) and Weebill (*Smicrornis brevirostris*) (Johnson 2003; Neagle 2008).

Neagle (2008) identified an assemblage of 22 native birds species associated with rough-barked woodlands dominated mainly by *Eucalyptus odorata*. Species indicative of this group are the Grey Shrike-thrush, Striated Pardalote, Crimson Rosella, Rufous Whistler (*Pachycephala rufiventris*), Yellow Thornbill (*Acanthiza nana*), Yellow-rumped Thornbill (*A. chrysorrhoa*), Buff-rumped Thornbill (*A. reguloides*), Brown-headed Honeyeater (*Melithreptus brevirostris*) and White-winged Chough (*Corcorax melanorhamphos*). All except one of these species was also recorded frequently in Peppermint Box Grassy Woodland further south in the Eastern Mount Lofty Ranges (Johnson 2003). It is not known whether these species are common to Peppermint Box Grassy Woodland across the entire distribution range, or could be considered characteristic species of the ecological community.

Seventeen of the species recorded in the Mid North surveys (Neagle 2008) are woodland birds thought to be in decline in the Mid North region (DEH 2005b). Many of these species, including the Brown Treecreeper (*Climacteris picumnus*), Grey Fantail (*Rhipidura fuliginosa*), Jacky Winter (*Microeca fascinans fascinans*), Red-capped Robin (*Petroica goodenovii*) and White-winged Chough, were also recorded in Peppermint Box Grassy Woodland further south in the Eastern Mount Lofty Ranges (Johnson 2003; Paton *et al.* 1994) and are regarded as declining species in the Mount Lofty Ranges region (Willson and Bignall 2009). The Diamond Firetail (*Stagonopleura guttata*), another declining woodland bird species in both regions, has been recorded in Peppermint Box Grassy Woodland in the southern Flinders Ranges (Herbert 2000) and the Mid North and Eastern Mount Lofty Ranges (D. Potter, pers. comm.).

The Diamond Firetail (*Stagonopleura guttata*) is listed as vulnerable in South Australia (NPW Act). It is a ground-feeding, seed-eating woodland bird which nests in foliage, including mistletoe clumps. Diamond Firetails prefer the small seeds of native grasses and require habitat containing a mix of grass species with different seed maturation times to ensure their food supply throughout the year (Willson and Bignall 2009).

Three species recorded in Peppermint Box Grassy Woodland are listed as rare in South Australia. White-winged Choughs (*Corcorax melanorhamphos*) are ground-feeding woodland birds which live and breed in family groups and specialise in probing for invertebrates in leaf litter and soft soil (Antos and Bennett 2006). The Jacky Winter (*Microeca fascinans fascinans*) is an insectivorous species that prefers open woodland and mallee vegetation. They use a variety of woodland substrates and pounce on prey mainly in leaf litter, on bare ground or in the air (Antos and Bennett 2006). Peregrine Falcons (*Falco peregrinus*) are raptors which forage over a range of habitats, including open woodlands. They prefer to nest on rocky cliffs, but also nest in woodland trees, using large tree hollows or abandoned nests of other large birds (Pruett-Jones et al. 1981; Olsen 1982).

**Reptiles**

Only a few systematic surveys of reptiles have been done in Peppermint Box Grassy Woodland (e.g. Johnson 2003; Neagle 2008), making it difficult to draw conclusions about characteristic species of the ecological community. At least 20 reptile species have been recorded in biological surveys of Peppermint Box Grassy Woodland sites in the Mid North and Eastern Mount Lofty Ranges. These include four geckos, three dragons, 11 skinks and two elapid snakes (Johnson 2003; Neagle 2008). Some of the same species were recorded in the southern Flinders Ranges (Herbert 2000).

The most frequently recorded reptile species at Mid North sites are the Dwarf Skink (*Menetia greyii*), Three-toed Earless Skink (*Hemiergis decresiensis*), Sleepy Lizard (*Tiliqua rugosa*) and Common Snake-eye (*Morethia boulengeri*) (Neagle 2008). The Eastern Brown Snake (*Pseudonaja textilis*) is the most commonly recorded snake. Three of the most frequently recorded species - Bougainville's Skink (*Lerista bougainvillii*), Dwarf Skink and Common Snake-eye – show an affinity for Grassy Woodland and Open Forest habitats (Brandle 2008b). Two other reptiles with an affinity for grassy woodlands, the Central Bearded Dragon (*Pogona vitticeps*) and Eastern Bluetongue (*Tiliqua scincoides*) (Brandle 2008a), have also been recorded at Peppermint Box Grassy Woodland survey sites (Johnson 2003; Neagle 2008). However, there is insufficient information to conclude that any of these are characteristic species or indicator species of Peppermint Box Grassy Woodland.

The Flinders Worm Lizard (*Aprasia pseudopulchella*) is associated with grassland and grassy woodland habitats (Brandle 2008b) and has been recorded in grassy woodlands with *Eucalyptus odorata* as a sub-dominant tree (Philpott 2003). Its distribution range overlaps with that of Peppermint Box Grassy Woodland and it is considered likely to occur in the ecological community. The Flinders Worm Lizard is listed nationally as vulnerable under the EPBC Act. However, increased survey effort in South Australia found the Flinders Worm Lizard is more common than previously thought and the species is no longer listed in the Threatened Species Schedules of the SA NPW Act. A

species assessment in the Northern and Yorke region determined that Flinders Worm Lizard populations are stable or increasing and the species status is rated as 'least concern' in that region (Gillam and Urban 2008).

### Amphibians

Frogs are semi-aquatic animals, requiring at least some surface water for reproduction. Some frog species inhabit temperate grassy woodlands, persisting through dry periods by burrowing into the soil (Herbert 2000; Armstrong 2003) or sheltering in moist, shaded micro-climates under rocks, plant litter, tree hollows and fallen logs (Cogger 2000; Martin and Green 2002). Frogs are difficult to survey in dry conditions and there is very limited information available on species occurring in Peppermint Box Grassy Woodland.

The Brown Toadlet (*Pseudophryne bibronii*) has been collected in a pit-fall trap at a Peppermint Box Grassy Woodland survey site in the Mid North (Neagle 2008). The Brown Toadlet is rated as rare in South Australia (Table 1). The Common Eastern Froglet (*Crinia signifera*) and Spotted Grass Frog (*Limnodynastes tasmaniensis*) have been heard calling at night in *Eucalyptus odorata* Woodland with shrub and grassy understorey, but not found in day time in searches of that remnant (Hutchinson *et al*. 1999). Other burrowing frog species may also occur in the ecological community.

### Invertebrates

Invertebrates are a major component of the fauna species diversity and biomass above and below ground in temperate grassy woodland communities (Martin and Green 2002). Invertebrates provide many important ecological functions in grassy woodlands, including plant pollination; nutrient cycling and break-down of organic matter; soil aeration and maintenance of soil structure; food for other woodland fauna, including mammals, birds, reptiles and amphibians; and creation of habitat for other species (e.g. Cogger 2000; Martin and Green 2002; Antos and Bennett 2006; Willson and Bignall 2009).

No systematic surveys of the invertebrates of Peppermint Box Grassy Woodland have been undertaken and there is limited information available. Biological surveys at nine *Eucalyptus odorata* Low Woodland over grasses sites in the Mid North recorded insect taxa from 9 orders and 30 different families; and non-insect invertebrate taxa from 6 orders and 9 families (Queale and Neagle unpublished data). However, invertebrate sampling at these sites was passive via pit-fall lines and micro-pits (Queale and Neagle 2008), without active searches in a range of habitats (such as air, bark, twigs, leaf-litter, foliage, flowers, soil) so is not representative of invertebrate diversity at these sites.

No butterflies or moths (Lepidoptera) were recorded at the *Eucalyptus odorata* Low Woodland in the Mid North (Queale and Neagle unpublished data) although many larval host plants and nectar plants of woodland butterfly and moth species are common in the ecological community. For example, Box Mistletoe (*Amyema miquelii*) is a host plant to Azure butterflies (*Ogyris* spp.); Iron-grasses (*Lomandra densiflora* and other *Lomandra* species) are larval hosts of the Phigalia Skipper (*Trapezites phigalia*); and *Oxalis perennans*, one of the 'disturbance resistant' plant species, is a larval food of the Chequered Copper (*Lucia limbaria*) (Grund 2009). Some of these woodland butterflies have obligate symbiotic relationships with attendant ant species (Grund 2009). While the presence of host plants does not mean their dependent species also occur, it does suggest further surveys would be worthwhile.

Targeted surveys and monitoring are needed to find out more about the invertebrates associated with Peppermint Box Grassy Woodland.

### References:

Antos, M.J. and Bennett, J.F. (2006), 'Foraging ecology of ground-feeding woodland birds in temperate woodlands of southern Australia', *Emu*, **106**, pp. 29-40.

Armstrong, D. (2003), 'Frogs' in *A Biological Survey of the Southern Mount Lofty Ranges, South Australia, 2000-2001,* eds D. Armstrong, S. J. Croft and J.N. Foulkes. Department for Environment and Heritage, South Australia.

Brandle, R. (2008a), 'Mammals' in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk,* ed N. Neagle, Department for Environment and Heritage, South Australia.

Brandle, R. (2008b), 'Reptiles'. in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk,* ed N. Neagle, Department for Environment and Heritage, South Australia.

Cogger, H.G. (2000), *Reptiles and Amphibians of Australia: 6th Edition*, Reed New Holland, Sydney.

Department for Environment and Heritage (2005), *Woodland birds need your help!*, Threatened Species Information Sheet, Department for Environment and Heritage, South Australia.

Gillam, S. and Urban, R. (2008), *Species Risk Assessment Pilot Project Phase 1 Report: Regional Species Conservation Assessments, Northern and Yorke Region*, Department for Environment and Heritage, South Australia.

Gillam, S. and Urban, R. (2009), *Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, West Region*, Department for Environment and Heritage, South Australia.

Grund, R. (2009*), South Australian Butterflies Checklist: July 2009 Update*. Website viewed 1 February 2010, http://www.sabutterflies.org.au/checklist.htm

Herbert, A. (2000), *Fauna Survey of Mount Brown Conservation Park*, Nature Conservation Society of South Australia, Adelaide.

Hutchinson, C.R, Matejcic, P. and Matejcic, N. (1999), 'Field Naturalists Society of South Australia Inc. Mammal Club Fauna and Vegetation Survey Mrs English's Scrub (owned by Syd Nairn) 11th-13th September 1999', *SA Naturalist*, **74**, pp. 4-12.

Johnson, R. (2003), *A Flora and Fauna Survey of Grassy Ecosystems in the Eastern Mount Lofty Ranges*, Nature Conservation Society of South Australia, Adelaide.

Lumsden, L. and Bennett, A. (2000), 'Bats in rural landscapes: a significant but largely unknown faunal component', in *Balancing Conservation and Production in Grassy Landscapes,* eds T. Barlow and R. Thorburn, Environment Australia, Canberra.

Martin, T.G. and Green, J.L. (2002), 'Wildlife and core conservation areas', in *Managing & Conserving Grassy Woodlands*, eds S. McIntyre, J.G. McIvor and K.M. Heard, CSIRO Publishing, Collingwood.

Neagle, N. (Ed.) (2008), *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk,* Department for Environment and Heritage, South Australia.

Olsen, P. D. (1982), Ecogeographic and temporal variation in the eggs and nests of the Peregrine, *Falco peregrinus*, (Aves Falconidae) in Australia. *Aust. Wildl. Res*. **9,** pp. 277-91.

Paton, D.C., Carpenter, G. and Sinclair, R.G. (1994), 'A second bird atlas of the Adelaide region. Part 1: changes in the distribution of birds: 1974-75 vs 1984-85', *South Australian Ornithologist,* **31**, pp. 151-193.

Philpott, V. (2003), *The Biodiversity and Natural History of Beetaloo Valley*, Nature Conservation Society of South Australia, Adelaide.

Pruett-Jones, S.G., White, C.M. and Devine, W.R., (1981), Breeding of the Peregrine Falcon in Victoria, Australia, *Emu*, **80**, Supplement, pp. 253-269.

Queale, L. and Neagle, N. (2008), 'Terrestrial Macro-invertebrates', in *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*, ed N. Neagle, Department for Environment and Heritage, South Australia.

Willson, A. and Bignall, J. (2009), *Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia*, Department for Environment and Heritage, South Australia.

## Appendix 7: Protection of Peppermint Box Grassy Woodland in parks and reserves

One National Park, five Conservation Parks and three other NPW Act reserves protect areas of the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community.

**Mount Remarkable National Park** is a 16,000 ha reserve in the Southern Flinders Ranges, 45 km north of Port Pirie. The Park protects a variety of forest and woodland communities, including 348 ha of woodlands with *E. odorata*. Around 212 ha (60%) of these woodlands fit the general definition of Peppermint Box Grassy Woodland, although the proportion that meets the Condition Class criteria for EPBC Act listing has not been assessed. The remaining 136 ha include sites where *E. odorata* is sub-dominant to *E. leucoxylon* subsp. *pruinosa* and/or shrub cover is considered likely to be greater than 30%. This 136 ha may also include patches that meet the criteria for the listed community, and warrants further assessment.

**Mount Brown Conservation Park** is a 1,749 ha reserve in the Southern Flinders Ranges, approximately 15 km south east of Quorn. The Park contains a diverse range of habitats and vegetation communities, including woodlands. At least 254 ha of woodlands have *E. odorata* as a dominant or sub-dominant tree over mixed herbaceous and shrub understoreys. An estimated 42 ha fit the definition for Peppermint Box Grassy Woodland, and 76 ha are rated as medium confidence of being the listed ecological community. A further 136 ha are considered less likely to be the listed ecological community, as *E. odorata* is recorded as a sub-dominant species and/or the shrub cover may be higher than 30%. All these woodlands including the 'low confidence' areas should be checked in the field and assessed for their Condition Class ratings.

**Sandy Creek Conservation Park** is a 158 ha reserve ten kilometres east of Gawler, acquired and proclaimed in the 1960s to protect native vegetation of the Barossa Valley sandy soil lowlands. The Park contains areas of *Eucalyptus odorata* Woodland. The desk-top assessment of mapped polygons identified 32 ha as Peppermint Box Grassy Woodland. The proportion of this which meets the Condition Class criteria for EPBC Act listing has not been assessed.

**Spring Gully Conservation Park** is a 398 ha reserve approximately ten kilometres south of Clare. The Park, which was established in 1962 to protect Red Stringybark (*E. macrorhyncha*) woodland, contains a variety of low forest and woodland vegetation types with grassy or sclerophyll shrub understoreys. It includes 50 ha of Peppermint Box Grassy Woodland, mapped as *Eucalyptus odorata + E. leucoxylon* Woodland over native and introduced grasses and herbs. The proportion of this 50 ha which meets the Condition Class criteria for EPBC Act listing should be determined by field assessment.

**Hopkins Creek Conservation Park** is a 516 ha reserve 27 km south east of Burra, proclaimed in 2010. The desk-top assessment of survey and mapping data identified nine hectares of Hopkins Creek which may be Peppermint Box Grassy Woodland; the proportion that meets the Condition Class criteria for EPBC Act listing has not been assessed.

**Black Hill Conservation Park** is a 684 ha reserve, approximately ten kilometres north east of Adelaide. Proclaimed in 1972, the Park adjoins the Adelaide metropolitan area and protects significant remnant vegetation and wildlife habitat on the western slopes of the Mount Lofty Ranges. Thirty-three hectares of the Park have been mapped as *Eucalyptus odorata* Woodland, of which two hectares are considered to be Peppermint Box Grassy Woodland. This remnant is isolated from the main distribution of the ecological community. Based on survey data, the remaining 31 ha of mapped

woodland are rated as 'low confidence' of being the listed ecological community, but could include patches that meet the criteria.

**Tucknott Scrub Conservation Park** is a 362 ha reserve 25 km north of Pt Lincoln in the Eyre Hills IBRA sub-region. The Park contains 1.4 ha of *Eucalyptus odorata* Woodland considered to be Peppermint Box Grassy Woodland. A site assessment is required to check the current species composition and determine the proportion that meets the EPBC Condition Class criteria.

**Para Woodland Reserve** is a 321 ha former farm property eight kilometres south east of Gawler, managed jointly by Nature Foundation SA and the Department of Environment, Water and Natural Resources to protect and restore grassy woodland ecosystems. The reserve includes 46.5 ha of Peppermint Box Grassy Woodland. The proportion of this woodland meeting the Condition Class criteria for EPBC Act listing has not been assessed.

**Para Wirra Recreation Park** is a 1,507 ha reserve approximately ten kilometres south east of Gawler. It has a very small remnant (0.11 ha) of *Eucalyptus odorata* Woodland which, based on survey data, is considered to be Peppermint Box Grassy Woodland. The current species composition and Condition Class rating of the remnant requires field checking.

## Appendix 8: Weed species affecting the Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia ecological community

Perennial woody weeds, annual grasses and herbs, perennial grasses and other introduced perennial herbs threaten native species composition, structure and habitat values of Peppermint Box Grassy Woodland.

Annual exotic grasses and herbs are the most frequently recorded weeds at Peppermint Box Grassy Woodland survey sites (Davies 1997; Robertson 1998; Neagle 2008; DEH 2009). Wild/Bearded Oats (*Avena barbata*) is the most common weed in the ecological community. Along with several other annual grasses including Great Brome (*Bromus diandrus*), Large Quaking Grass (*Briza maxima*), Rat's Tail Fescue (*Vulpia myuros* forma *myuros*) and Wimmera Rye Grass (*Lolium rigidum*), Wild Oats invade the open spaces between the native plants, establishing dense stands and developing significant dry biomass at many sites. These Mediterranean annual grasses have demonstrated negative impacts on native species diversity in Peppermint Box Grassy Woodland, directly through competition with native grasses and forbs; and indirectly through build up of litter, which suppresses regeneration of native grasses and forbs and favours regeneration of exotic annual grasses (Lenz *et al.* 2003).

Woody weeds are a significant problem in the ecological community, shading, suppressing and out-competing the native species and altering the structure and fauna habitats of the woodland. Fleshy fruited species dispersed by birds, such as European Olive (*Olea europaea*), African Boxthorn (*Lycium ferocissimum*), Briar/Dog Rose (*Rosa* spp.) and Bridal Creeper (*Asparagus asparagoides*) (a geophyte) are difficult to eradicate and require ongoing monitoring and control. Other problem woody weeds include Boneseed (*Chrysanthemoides monilifera* subsp. *monilifera*), Broad-leaf Cotton Bush (*Gomphocarpus cancellatus*), African Daisy (*Senecio pterophorus*), Montpellier Broom (*Genista monspessulana*), English Gorse (*Ulex europaeus*) and Tagasaste (*Chamaecytisus palmensis*).

Needle grasses (*Nassella* spp.) and Coolatai Grass (*Hyparrhenia hirta)*, (in the southern Lofty Block region) and Buffel Grass (*Cenchrus ciliaris)* (in the northern Lofty Block region) have not been recorded in Peppermint Box Grassy Woodland, but would have significant impacts on the ecological community if they invaded, and should be considered potential threats.

Many small annual and perennial weed species, such as Hairgrasses (*Aira* spp.), Lesser Quaking Grass (*Briza minor)*, Bulbous Meadow-grass (*Poa bulbosa)*, Guildford Grass (*Romulea* spp.), Velvet Pink (*Petrorhagia dubia)* and Pimpernel (*Lysimachia arvensis)* are widespread and sometimes abundant in grassy woodlands. They occur at sites with a long history of sustained heavy grazing, are difficult to control and are considered a lower threat to native biodiversity than the other species listed above.

### References

Davies, R.J.-P. (1997). *Weed Management in Temperate Native Grasslands and Box Grassy Woodlands in South Australia*. Black Hill Flora Centre, Athelstone, South Australia.

Department for Environment and Heritage (2009), Biological Databases of South Australia records, Department of Environment and Natural Resources, Adelaide.

Lenz, T.I., Moyle-Croft, J.L. and Facelli, J.M. (2003). Direct and indirect effects of exotic annual grasses on species composition of a South Australian grassland, *Austral Ecology* 28, 23-32.

Neagle, N. (2008). *Vegetation*. In Neagle, N. (Ed.) (2008). *A Biological Survey of the Mid North and Yorke Peninsula, South Australia, 2003-2004: Assessment of Biodiversity Assets at Risk*. Department for Environment and Heritage, South Australia.

Robertson, M. (1998). *A Biological Survey of Grasslands and Grassy Woodlands of the Lofty Block Bioregion of South Australia 1995-1996*. Department for Environment, Heritage and Aboriginal Affairs, South Australia.