The Minister's delegate approved this Conservation Advice on13/07/2017.

Conservation Advice

Eucalyptus cuprea

mallee box

Conservation Status

Eucalyptus cuprea (mallee box) is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective from the 16 July 2000.The species was eligible for listing under the EPBC Act as on 16 July 2000 it was listed as Endangered under Schedule 1 of the preceding Act, the *Endangered Species Protection Act 1992* (Cwlth).

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

The main factors that are the cause of the species being eligible for listing in the Endangered category are its limited distribution, severe fragmentation, and the continued decline in quality of habitat.

Description

The following description is based on Evans, Brown and English (1999).

The mallee box stands upright 4 – 6 m tall, with a 'stocking' of thin, flaky and fibrous grey bark, above which it is smooth and grey or coppery. The juvenile leaves are light green and oval-shaped. The adult leaves are narrow, approximately 11 cm long and 2.3 cm wide, and a glossy dark green. The juvenile buds are club-shaped, with a distinct scar from the early loss of the outer operculum (or bud cap). The inflorescence is terminal and has small white flowers, 6 mm long and 4 mm wide, with inner stamens that are inflected (folded in), and with outer stamens that lack anthers. The valves of the stalked cup-shaped fruits, up to 5 mm long and 4 mm wide, are positioned below the rim, and hold greyish-brown seeds.

The mallee box's lack of anthers distinguishes it from similar Eucalyptus species. Mallee box can be confused with *Eucalyptus loxophleba* subsp. *loxophleba* (York gum), which has heart-shaped, smoky-grey juvenile leaves, as distinct from the light green oval or egg shape leaves of the mallee box. The pattern of veins in the leaves of mallee box is much denser than the York gum, and mallee box seeds are darker, being a greyish brown.

Mallee box is related to, but differs from *Eucalyptus. absita* (Badgingarra box) in the light green, oval-shaped juvenile leaves and a less prominent disc. *Eucalypotus petraea* (granite rock box) is also related to mallee box but has larger buds and fruits.

Distribution

Mallee box is endemic to Western Australia where its distribution is limited to an area spanning from north of Galena to south of Northampton (Area of Occupancy is 48 km^2) (Evans, Brown & English 1999). In 1999, it was known from five populations: two populations north of Galena Bridge, two west of Ogilvie, and one west of Nanson, with a historical (pre 1990) population having once occurred north of Northhampton (Evans, Brown & English 1999). By 2011, mallee box had been discovered in a total of 12 locations divided into 29 populations, each averaging approximately 12 individuals (K Atkins pers. comm. 10 November 2016). The total estimated population size in 2011 was 359 individuals, nearly one third of which (100 individuals) occurred in a single population (K Atkins 2016, pers. comm. 10 November 2016). The difficulties

associated with determining accurate population counts for clonal mallee, where one genetic individual may appear to be a clump of plants, means that these population estimates should be viewed as approximate. Genetic analyses indicate that the populations in the north are genetically distinct from Central/Southern populations (Sampson & Byrne 2016).

Seed from mallee box has been collected and stored by the Threatened Flora Seed Centre, formerly, by the Kings Park and Botanic Garden (Evans, Brown & English 1999). Sixteen healthy plants were propagated from the first collection in 1995 (of which no seed remains).

Relevant Biology/Ecology

Mallee box grows on rises in brown sandy loam with sandstone or sometimes with granite, and in red-brown 'clayey loam' with laterite (Patrick 2001). It has also been recorded from a clay flat (Patrick 2001). Mallee box grows emergent above low heath with other emergents, including *Nuytsia floribunda* (Western Australian Christmas tree), and heath species, including *Melaleuca megacephala* (hillock bush) and *M. scabra* (rough honey-myrtle), or in tall shrubland with *E. loxophleba (York gum), Acacia acuminata* (raspberry jam), *Dodonaea inaequifolia* and *Allocasuarina* spp. (Patrick 2001).

Mallee box is a clonal species with the capacity for asexual regeneration, but also produces flowers for reproduction with other individuals. Flowering can occur between August and November (Evans, Brown & English 1999), generally in October (Patrick 2001). The species is likely to be long-lived (Evans, Brown & English 1999).

Although mallee box's response to disturbance, including fire, was unknown at the turn of the century (Evans, Brown & English 1999; Patrick 2001), field and anecdotal evidence suggests that the species exhibits persistent lignotuber development, with several populations regenerating after repeated 'stumping' events (Evans, Brown & English 1999). It is likely that lignotubers allow the species to survive isolated fire events, which may in turn cue seed germination (Evans, Brown & English 1999).

Threats

The main threats to the box mallee are farming activities, grazing by sheep (*Ovis aries*), weeds, competition from local species, clearing and firebreak maintenance, insect infestation, road maintenance activities, fire events occurring too frequently for regeneration to be successful, and habitat fragmentation causing lack of connectivity between genetic individuals (Evans, Brown & English 1999).

Table 1 — Threats impacting the mallee box in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Land use, habitat loss and fragmentation		
Road and property maintenance	known past	In 2011 there were five populations that occurred on road reserves, including one on a main road (K Atkins 2016 pers. comm. 10 November 2016). There is evidence of road maintenance activities (spraying, mowing and grading) having threatened one population previously (Evans, Brown & English 1999). At the time of the last survey, most mallee box (331 of 359 individuals at 2011) occurred on private property (K Atkins 2016 pers. comm. 10 November 2016). Farm and other private property maintenance, including clearing, fertilizer and chemical drift, as well as induced competition for resources with farmed produce, are likely to be threats to this species.
Land clearance	known past potential current	The two historical incidents where mallee box was removed illegally were due to clearing for firebreaks and crop production (Evans, Brown & English 1999). Clearance activities have also removed associated vegetation, making the mallee more vulnerable to other threat factors (Evans, Brown & English 1999).
Lack of connectivity between fragmented populations	known current	Most *Eucalyptus* species do not form viable seed from self-pollination, and cross pollination between individual mallee box is limited (Evans, Brown & English 1999). This is due in part to the other threats impacting in the species, as well as the lack of connectivity between remaining populations. Lack of connectivity between fragmented populations reduces the genetic diversity of a species that, by virtue of its clonal nature, may already have low genetic diversity (Evans, Brown & English 1999).
Fire		
Too frequent burning/lack of timely disturbance events	suspected current/future	Evans, Brown & English (1999) speculate that mallee box seed germinates following fire events, suggesting that it may be dependent on fire for propagation; however, if fire events are too frequent, lignotubers and/or soil seedbanks could be depleted, or juvenile plants killed before reaching maturity. Lack of disturbance events at appropriate intervals to stimulate propagation may also be disadvantageous.
Competition with invasive flora		
Weeds	known past/current	Weed invasion has occurred at all populations, and weeds compete with seedlings and other local species for light, nutrients, and space. These introduced species respond more favourably to the increased level of fertiliser and soil disturbance and are therefore out-competing mallee box and other local species. Grassy weeds also increase the risk of fire (Evans, Brown & English 1999).

Physical damage by fauna		
Sheep (*Ovis aries*)	known past, potential current	Grazing by sheep has been identified as an active threat to seedling recruitment at the populations west of Ogilvie (Evans, Brown & English 1999). Sheep use the mallee for shelter, their droppings causing nitrification of the soil. They also prune roots and branches, consume seedlings/saplings, and compact the soil.
Leaf mite	known past, potential current	In 1999, an unidentified leaf mite was found to occur in high numbers, covering up to 70% of the leaf surface on up to 80% of the mature trees in two populations (Evans, Brown & English 1999).
Moth	known past, potential current	There is evidence of infestation by an unidentified moth species that appears to prefer mallee box. The presence of the moth potentially impacts on the photosynthetic capacities of individuals; however, moth infestation is believed to be more symptomatic of poor health due to other threats, than it is itself a threat to the mallee box (Evans, Brown & English 1999).

Conservation Actions

Conservation and Management priorities

Land use, habitat loss and fragmentation

- Prevent habitat disturbance outside of prescribed disturbance events.
- Ensure land managers are aware of the species' occurrence and provide protection measures against key and potential threats.
- Consider implementing Declared Rare Flora (DRF) markers for the roadside population north of Galena Bridge.[1]
- Secure populations by establishing mallee box in protected areas, or using appropriate mechanisms (e.g. covenants) to secure populations on private land.

Fire

- Fires must be managed to ensure that prevailing fire regimes do not disrupt the life cycle of the mallee box, that they support rather than degrade the habitat necessary to its survival, that they do not promote invasion of exotic species, and that they do not increase impacts of grazing/predation.
- Physical damage to the habitat and individuals of the mallee box must be avoided during and after fire operations.
- Fire management authorities and land management agencies should use suitable maps and install field markers to avoid damage to the mallee box.
- Avoid successive fire intervals that are shorter than the period required to maintain recovery capacity of re-sprouting individuals.
- Minimise use of prescribed fire for fuel reduction and follow up with appropriate weed control.

[1] DRF markers are used in Western Australia and are two standardised yellow markers at either end of a site, which are bent to face towards each other, indicating that DRF plants may occur anywhere between the markers, from the road's running surface to the fence. They alert people working in the vicinity to the presence of DRF, and the need to avoid work that may damage vegetation in the area (DEC 2013).

Competition with invasive flora

- Where weeds and other fast growing plant species are a threat to the mallee box, use physical or chemical control methods as an alternative to prescribed fire, where appropriate noting that many invasive species germinate in response to physical disturbance of soils.
- Use weed control methods appropriate to the species of weed/vine in question. Removal methods should be selected with a view to preventing inadvertent harm to the mallee box or its broader ecological community.

Physical damage by fauna

- Install stock proof fencing around the populations west of Ogilvie to alleviate grazing pressure and the impact of farming activities on these populations. Include a suitable buffer area to allow for regeneration of mallee box and its habitat.
- Where moth and leaf mite species have been properly identified, and the impact of these species on the mallee box is shown to be threatening the survival of the population, consider control methods to remove these species from severely impacted plants.

Ex situ Strategies

- Collect seed and/or cuttings from each of the populations as a high priority, in order to preserve genetic diversity. Ex situ propagation should be ongoing, with a view to reintroducing propagated individuals to suitable locations (translocation) within the historic or potential habitat.
- Ex situ seed for this species is stored at the Threatened Flora Seed Centre, WA.

Translocation

- Using habitat suitability modelling as guidance, identify suitable sites for the establishment of additional populations in the wild and for linking existing populations. Relevant policies should be referred to for guidance for undertaking translocations (e.g. Vallee et al. 2004).

Stakeholder engagement

- Relevant stakeholders are local government, roadside maintenance workers and private landowners.
- The objective for engagement with the primary stakeholder groups for this species is to enable accurate identification of the species, in order to avoid adverse impacts through clearing, chemical drift, and nitrification of soil and soil compaction associated with livestock.

Survey and Monitoring priorities

- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary
- More precisely assess population size, distribution, ecological requirements and the relative impacts of threatening processes by weeds and invertebrates. The threats of vines, moths, leaf mites and weeds should ideally be identified at species level in order to inform mitigation strategies.

- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Monitor the size and structure and reproductive status of populations at different stages in the fire cycle, taking opportunities to monitor after planned and unplanned fires (where they occur) and improve understanding of the fire response of the species.
- Precise fire history records must be kept for the habitat and extant populations (confirmed and suspected) of the mallee box.
- Undertake survey work in suitable habitat and potential habitat to locate additional populations/occurrences/remnants.

Information and research priorities

- More understanding is needed around the longevity of the mallee box, its pollination vectors, and its requirements for successful propagation. This should include seed germination and/or vegetative propagation trials to determine the requirements for successful establishment.
- Implement an annual census to monitor emergence and re-sprouting success.
- Improve understanding of the mechanisms of the species' response to different fire regimes and identify appropriate fire regimes for its conservation by undertaking appropriately designed experiments in the field and/or laboratory. Where appropriate, use understanding and research on fire responses among related (e.g. congeneric) or functionally similar eucalypt species to develop fire management strategies for conservation. As part of this, identify optimal fire regimes for regeneration (vegetative regrowth and/or seed germination), and response to other prevailing fire regimes.
- Consider undertaking analysis of genetic diversity within and across populations with a view to undertaking a connectivity analysis to identify critical habitat linkages and barriers to the movement of individuals and gene flow. Investigate options for improving genetic connectivity/robustness among populations.
- Research the usefulness and appropriateness of a citizen science monitoring programs.
- Develop predictive models for the species geographical distributions based on the environmental conditions of sites of known occurrences to identify sites for translocation. Requires robust a data-set of species presence information with plus the range of environmental variables that are known to influence the species' distribution. If this data are not available then a research priority should be to collect and assimilate this information (Phillips et al., 2006).

References cited in the advice

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