



Conservation Advice for *Eucalyptus x balanites* (Cadda Road Mallee)

In effect under the *Environment Protection and Biodiversity Conservation Act 1999* from 29 September 2021.

This document provides a foundation for conservation action and further planning.



Photo of *Eucalyptus x balanites* (Cadda Road Mallee) © Copyright, Brooker & Kleinig (1986) (from ALA 2021)

Conservation status

Eucalyptus x balanites (Cadda Road Mallee) is listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act) effective from 16 July 2000. The species is eligible for listing because prior to the EPBC Act, it was listed as Endangered under the *Endangered Species Protection Act 1992* (Cwlth).

The Cadda Road Mallee is listed as Endangered due to its limited distribution, small number of subpopulations and small population size.

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 the [Species Profile and Threat Database](#).

Species information

Taxonomy

Conventionally accepted as *Eucalyptus x balanites* Grayling & Brooker (1992). The taxon was first recognised as *E. sp. E.* Nambung having been discovered in 1985, was subsequently named as *E. balanites* (Grayling & Brooker 1992). The species was described as the hybrid *E. x balanites* by Nicolle & French (2012), who believed it to be a hybrid between *E. decipiens* (Limestone

Marlock) and *E. lane-poolei* (Salmon White Gum). While the hybrid status is not confirmed, *E. x balanites* is currently retained as the accepted name (APNI 2021).

Description

The Cadda Road Mallee is an erect, robust tree mallee, 5–8 metres tall and to 15 metres wide. It is a sprawling tree with rough flaky grey bark up to the branchlets. Seedling leaves are opposite for 6–10 pairs, petiolate, oblong to elliptical, to 4.5 x 2.5 cm and dull green. Juvenile leaves are alternating, petiolate, elliptical, to 6.3 x 3.5 cm and dull green. Adult leaves are alternating, petiolate, lanceolate, to 10 x 2 cm, green, dull or slightly glossy, side veins very numerous. Inflorescences are unbranched, 11-flowered, and 1–2 cm long. Stamens are inflexed, all fertile, and cream. The style is twisted near the base. The fruit is very shortly pedicellate and hemispherical, usually with four slightly exerted valves. The seed is dark grey with longitudinal grooves (Grayling & Brooker 1992).

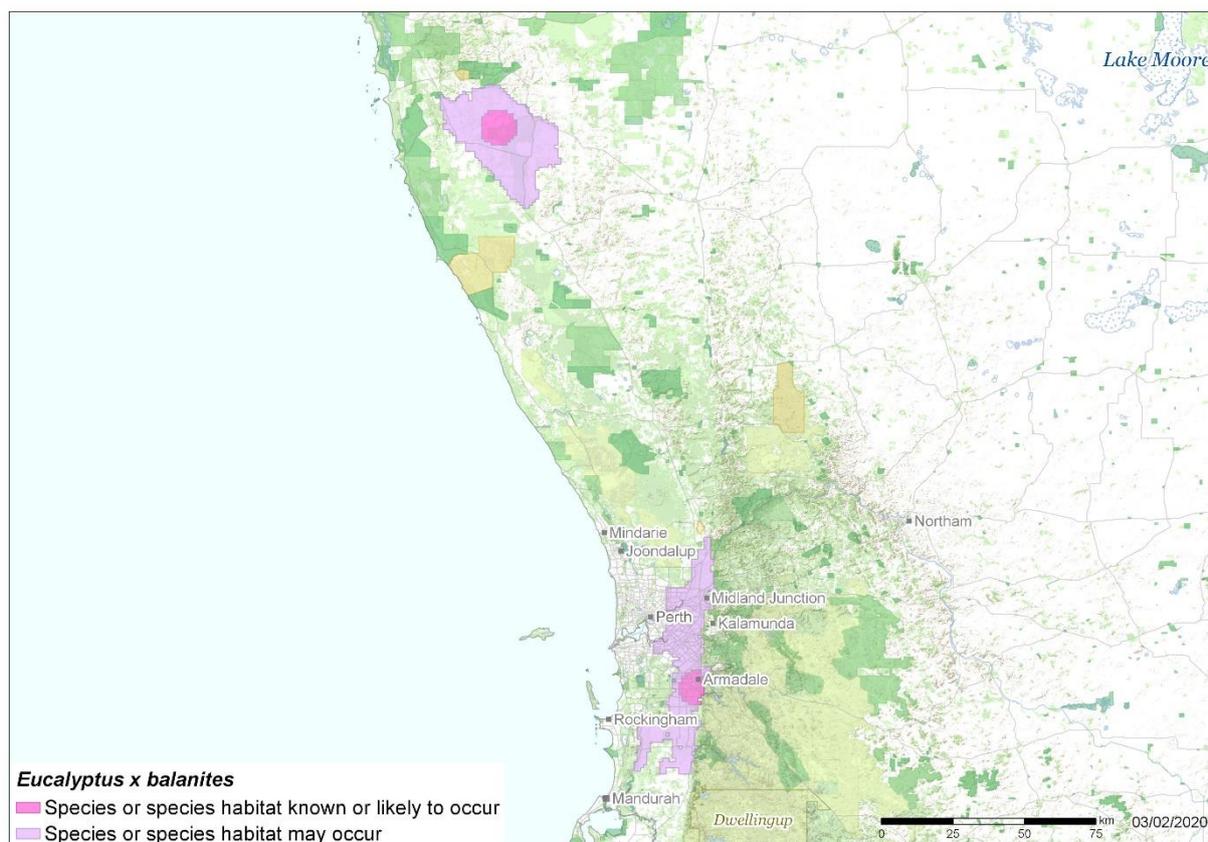
Distribution

The Cadda Road Mallee is endemic to south-western Western Australia (WA), where it occurs in two subpopulations, one at Badgingarra National Park near Nambung, and a second near Armadale, southeast of Perth (ALA 2021; Map 1). The subpopulation at Badgingarra National Park contains approximately 25 individuals (DBCA 2021). This population was reported to number approximately 50 individuals in 1992, 25 individuals in 2012 and 25 in 2019. The apparent decline since 1992 may represent a change in counting method (DBCA 2021). A single plant occurs in the Armadale subpopulation (DEC 2004). There is some uncertainty around the origin of the Armadale plant, with some suggestion it may have been planted (DEC 2004). In 2013, the following notes about the Armadale tree were made:

“The condition of the tree has worsened since 2012 (when it was considered healthy). There are numerous branches twisted and broken then rotted out. A lot of rot observed in the centre of the main branches and quite a number of canopy branches have died back. Lots of new buds on extremities but not a lot of fruit at the correct stage for seed collection. Small remnant in very good condition, so unsure of the reason for the tree decline. Seed collection was undertaken during this site visit. Post and rail fence has been constructed by the Shire of Armadale to protect the tree.” (DBCA 2021)

Although the species may have been more widespread prior to the clearing of native vegetation in the area, as a probable natural hybrid it is likely to have always been naturally rare.

Map 1 Modelled distribution of the Cadda Road Mallee



Source: Species distribution data [Species of National Environmental Significance](#) database, Base map Geoscience Australia

Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.

Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the specific habitat type or geographic feature that represents to recent observed locations of the species (known to occur) or preferred habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The Cadda Road Mallee occurs on the traditional lands of the Yued and Whadjuk people of the Noongar Nation (South West Aboriginal Land & Sea Council 2020). The South West Native Title Settlement, which resolves Noongar native title claims in the South West of Western Australia, including across the lands of the Whadjuk, in exchange for a package of benefits commenced on 27 January 2021. The significance of the Cadda Road Mallee for the Noongar Peoples is unknown.

Relevant biology and ecology

Reproductive ecology

The Cadda Road Mallee flowers from October to February (Grayling and Brooker 1992). The species produces few mature fruits or fertile seeds (Brown et al. 1998). The vast majority of buds are shed before they develop into fruits. Some remain on the tree, but become dry and hard

soon after flowering (Grayling 1989). The degree of pollen fertility is low and highly variable between plants (2–40%), and relative to the number of flowers produced, the fruit-set is extremely low (DEC 2004). Although the normal number of flowers per inflorescence is eleven, it is rare to find more than one mature fruit per peduncle. It appears the plants have a mechanism whereby developing fruits devoid of at least one healthy embryo are dropped, perhaps in order to preserve energy (Grayling 1989). Observations of the contents of mature fruits have shown that each fruit contains a single fully-formed seed coat which in 60% of cases, contains no embryo (Grayling 1989). There has been no natural seedling recruitment observed in the field at either subpopulation (DEC 2004). This may be due to low seed production, high levels of disturbance (Armadale subpopulation), or heavy grazing by kangaroos (Badgingarra National Park subpopulation) (Hockey 1996).

There is no data on the lifespan or generation length of the Cadda Road Mallee, although like most mallee eucalypts it is likely to be long lived, probably in the order of several hundred years (Ogden 1978).

Hybrid status

Studies were carried out by Grayling (1989) to test the hybrid origin of the Cadda Road Mallee. The shape and size of the buds and the operculum of the Cadda Road Mallee is intermediate between the Salmon White Gum and Limestone Marlock. In addition, both subpopulations occur near subpopulations of Salmon White Gum and have very low pollen and seed viability, suggesting the taxon may be of hybrid origin. An extreme shortage in the number of seeds for this species (only seeds from one plant were used in the enzyme study) precluded the thorough isoenzyme investigation, however the results from the limited number of enzyme assays carried out suggested that the Cadda Road Mallee may be a hybrid of Salmon White Gum and Limestone Marlock (DEC 2004). The hybrid status was formally published by Nicolle & French (2012), although the basis of their decision that the species was of hybrid origin was that the species was sterile. However, Grayling (1989) reported that the species does produce viable seed, just in very low amounts. Grayling (1989) also germinated seedlings, most of which had different seedling morphology to the Salmon White Gum and Limestone Marlock. The species was considered for delisting from the EPBC Act in 2013 on the basis of its presumed hybrid origin, but the Threatened Species Scientific Committee decided that due to the inconsistencies in Nicolle & French (2012), the species should be retained as a stable hybrid until evidence is provided to the contrary.

Habitat ecology

The Cadda Road Mallee grows on light coloured sandy soils with surface laterite. It grows in a woodland of *Eucalyptus lanepolei* (Salmon White Gum) and *Corymbia calophylla* (Marri) over an open shrubland of mixed species (Armadale subpopulation) or in gently sloping heathlands with emergent mallees (Badgingarra National Park subpopulation). Associated species include *Allocasuarina humilis* (Dwarf Sheoak), *Adenanthos* sp. (*Adenanthos*), *Banksia candolleana* (Propeller Banksia), *B. menziesii* (Firewood Banksia), *Calothamnus sanguineus* (Silky-leaved Blood-flower), *Chordifex chaunocoleus* (no common name), Marri, *Dasyopogon bromeliifolius* (Pineapple Bush), *Daviesia speciosa* (Bitter Pea), *Banksia bipinnatifida* (Pinnate-leaved Dryandra), *Banksia nivea* (Honeypot Dryandra), Salmon White Gum, *E. marginata* (Jarrah), *Eremaea* sp. (*Eremaea*), *Grevillea wilsonii* (Wilson's Grevillea), *Hakea conchifolia* (Shell-leaved Hakea), *Haemodorum laxum* (no common name), *Hakea flabellifolia* (Fan-leaved Hakea), *Hypocalymma serrulatum* (no common name), *Kingia australis* (bullanock), *Lambertia multiflora*

(Many-flowered Honeysuckle), *Leucopogon* sp. (Beard Heath), *Lomandra* sp. (Mat Rush), *Macropidia fuliginosa* (Macropidia), *Nuytsia floribunda* (Western Australian Christmas Tree), *Petrophile linearis* (Pixie Mops) and *Xanthorrhoea gracilis* (Graceful Grass-tree).

Fire ecology

Field observations indicate that plants are sensitive to high fire intensity, but may tolerate less intense fires (DEC 2004). A prescribed burn in Badgingarra National Park in 1997 resulted in the accidental burning of part of the Cadda Road Mallee subpopulation. Those individuals that experienced high fire intensity only coppiced in the following season, with no other regeneration observed. The trees that experienced more mild fire behaviour displayed re-shooting on stems and branches exceeding 25 mm, and prolific shooting from the stump/trunk bases. The Badgingarra National Park subpopulation was also likely burnt in the late 1980s and in December 2002 in bushfires, although there is no information on the species' response following these fires (DEC 2004).

Habitat critical to the survival

Due to the species eligibility for listing (highly restricted range, severe fragmentation and small population size), all habitat is considered critical to the survival of the species.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Important populations

In this section, the word population is used to refer to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

There is sufficient evidence through the species eligibility for listing, to declare all populations/the national population as important populations of this species under particular pressure of survival and which therefore require protection to support the recovery of the species.

Threats

The major threats to the Cadda Road Mallee are droughts (driven by climate change), inappropriate disturbance regimes, habitat destruction, disease, herbivory, competition with weeds and the genetic consequences of small subpopulations (Table 1). The species is threatened by several fire-related threats, including high frequency fire, fire-drought interactions, fire promoted weed invasion and possibly fire-disease interactions.

Table 1 Threats impacting Cadda Road Mallee

Threat	Status and severity ^a	Evidence
Climate Change		
Increased frequency and severity of bushfire	<ul style="list-style-type: none"> • Timing: current/future • Confidence: known • Consequence: major • Trend: increasing • Extent: across the entire range 	<p>Climate projections for south-western Australia include reduced rainfall, increased average temperatures, and more frequent bushfires (CSIRO & Bureau of Meteorology 2015).</p> <p>Severe fires are known to damage the Cadda Road Mallee through damage to individual trees and possible</p>

Eucalyptus x balanites (Cadda Road Mallee) Conservation Advice

		mortality of soil-stored seed (DEC 2004). Frequent fire is also likely damaging to the species if there isn't enough time for recovery processes between fire intervals (Noble 2001; DEC 2004).
Increased frequency and severity of drought	<ul style="list-style-type: none"> • Timing: current/future • Confidence: known • Consequence: unknown • Trend: increasing • Extent: across the entire range 	<p>Climate projections for south-western Australia include reduced rainfall, increased average temperatures, and more frequent droughts (CSIRO & Bureau of Meteorology 2015). Such changes in climate may cause widespread plant mortality, as many plants are vulnerable to drought stress and hydraulic failure (Allen et al. 2010; Choat et al. 2012).</p> <p>Furthermore, Cadda Road Mallee may be subject to threat from fire-drought interactions because resprouting stems are vulnerable to embolization and drastically lowered xylem hydraulic conductivity during post-fire drought, increasing individual mortality risk (Pratt et al. 2014).</p> <p>The small population size and restricted distribution of the species may also increase population extinction risk, following stochastic events, such as droughts (DEC 2004).</p>
Inappropriate fire regime		
High frequency and severity of fuel-reduction burning	<ul style="list-style-type: none"> • Timing: current • Confidence: inferred • Consequence: major • Trend: unknown • Extent: across the entire range 	While the Cadda Road Mallee is capable of tolerating occasional fires, the species is likely sensitive to very frequent fires (Noble 2001). There is concern that the frequency of hotter burns at the Badgingarra National Park subpopulation may have depleted the soil seed stores (G. Broun pers. comm. in DEC 2004).
Genetic threats resulting from small and fragmented subpopulations		
Small subpopulation size	<ul style="list-style-type: none"> • Timing: current • Confidence: inferred • Consequence: major • Trend: unknown • Extent: across its entire range 	Many small, isolated subpopulations are subject to the effects of low genetic diversity (Frankham et al. 2014). The Cadda Road Mallee is likely to be suffering the effects of hybridisation or inbreeding depression, manifesting in extremely low seed viability (DEC 2004). As a result, recruitment is very rare (DEC 2004).
Habitat destruction		
Roadside maintenance activities	<ul style="list-style-type: none"> • Timing: current • Confidence: inferred • Consequence: major • Trend: unknown • Extent: across part of its range 	The Cadda Road Mallee occurs near roadsides and may be threatened by accidental damage resulting from road maintenance or related activities (e.g. fire break construction).

Eucalyptus x balanites (Cadda Road Mallee) Conservation Advice

Recreational activities	<ul style="list-style-type: none"> • Timing: current • Confidence: inferred • Consequence: moderate • Trend: unknown • Extent: across part of its range 	The habitat around the Armadale subpopulation is frequently used for horse riding and there are many tracks throughout the site. This activity increases the risk of weed invasion, damage to the vegetation and disturbance to seedlings (DEC 2004).
Disease		
Dieback caused by <i>Phytophthora</i> spp.	<ul style="list-style-type: none"> • Timing: current • Confidence: suspected • Consequence: moderate • Trend: unknown • Extent: across the entire range 	<p><i>Phytophthora cinnamomi</i> is an introduced soil-borne pathogen, which infects a large range of plant species and may contribute to plant death, particularly when other stresses are present, such as waterlogging, drought and bushfire (DOEE 2018). <i>Phytophthora cinnamomi</i> can disperse in water flowing from roots of infected plants to roots of healthy plants and by mud clinging to vehicles, animals and walkers (DOEE 2018). Dieback caused by <i>P. cinnamomi</i> is listed as a Key Threatening Process under the EPBC Act (DOEE 2018).</p> <p>The susceptibility of the Cadda Road Mallee to dieback disease (caused by <i>Phytophthora</i> spp.) is unknown and requires clarification, although many other <i>Eucalyptus</i> species are susceptible (DOEE 2018).</p> <p><i>Phytophthora cinnamomi</i> has been recorded in the reserve to the west of the railway, so there is the potential for it to occur within the area containing the Armadale subpopulation. Access, particularly by horses, increases the risk of the disease being introduced and/or spread.</p>
Native species		
Browsing by macropods	<ul style="list-style-type: none"> • Timing: current • Confidence: known • Consequence: moderate • Trend: unknown • Extent: across part of its range 	Heavy browsing by <i>Macropus fuliginosus</i> (Western Grey Kangaroo) has been documented at the Badgingarra National Park subpopulation and is suspected to be contributing to the lack of recruitment of this species (DEC 2004).
Competition with weeds	<ul style="list-style-type: none"> • Timing: current • Confidence: known • Consequence: moderate • Trend: unknown • Extent: across part of its range 	Weeds are currently a minor threat to the Armadale subpopulation. However, they likely compete with any seedlings that germinate at the site. Fire can also promote weed invasion by creating gaps for superior competitors. The subpopulation at Badgingarra National Park does not appear to be threatened by weeds.

Status—identify the temporal nature of the threat;

Confidence—identify the extent to which we have confidence about the impact of the threat on the species;

Consequence—identify the severity of the threat;

Trend—identify the extent to which it will continue to operate on the species;

Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and using available literature.

Table 2 Cadda Road Mallee risk matrix

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain	Low risk	Moderate risk	Very high risk	Very high risk Increased frequency and severity of bushfire	Very high risk
Likely	Low risk	Moderate risk	High risk Competition with weeds Browsing by macropods	Very high risk Small subpopulation size	Very high risk
Possible	Low risk	Moderate risk	High risk Dieback caused by <i>Phytophthora</i> spp. Recreational activities	Very high risk High frequency and severity of fuel-reduction burning Roadside maintenance activities	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	High risk	Very high risk

Priority actions have then been developed to manage the threat particularly where the risk was deemed to be ‘very high’ or ‘high’. For those threats with an unknown or low risk outcome it may be more appropriate to identify further research or maintain monitoring.

Conservation and recovery actions

Primary conservation objective

By 2030, the population of the Cadda Road Mallee will have increased in abundance and viable subpopulations are sustained in habitats where very high risk threats are managed effectively.

Conservation and management priorities

Habitat loss

- Install and maintain physical protection measures against accidental destruction where necessary (e.g. bollards demarcating the extent of the Badgingarra National Park subpopulation).
- Ensure that best practice methods for roadside and utility corridor maintenance are used to protect the species and its habitat (e.g. avoid the use of herbicide, ensure slashing does not impact Cadda Road Mallee plants, ensure grading of roadside verges is restricted to the road shoulder and does not encroach onto roadside vegetation).
- Ensure all subpopulations are adequately documented on databases used by land managers and, where deemed necessary, physically identified to avoid accidental damage.
- Limit public access around the plant at Armadale.

Climate change and bushfire

- Develop and implement a fire management strategy that optimises the survival of the species:
 - Avoid planned burns in all recently burnt habitat.
 - Protect unburnt subpopulations (no planned burns, clearing or other disturbance).
 - Take the likelihood of increasingly frequent bushfires into account when developing planned burning programs, to avoid excessively frequent burning of any subpopulations.
- Provide maps of known occurrences to local and state fire services and seek inclusion of mitigation measures in bushfire risk management plan/s, risk register and/or operation maps.
- Identify all habitat that are likely to remain or become suitable habitat under climate change scenarios, and protect this habitat from threats.

Disease

- Determine the susceptibility of the Cadda Road Mallee to *P. cinnamomi* (e.g. through ex situ testing if appropriate, or inference from similar species if there are too few seeds/ex situ plants to justify direct testing).
- If susceptible, implement a *P. cinnamomi* management plan (DOEE 2018) to ensure that:
 - the pathogen is not introduced into subpopulations of the threatened species and that the spread in areas outside of, but adjacent to, any subpopulation is mitigated.
 - potential translocation sites are free of, and do not become infected by, *P. cinnamomi*.
 - mitigation measures (e.g. treatment with phosphite) are implemented if required.

Native species

- If warranted, reduce the impacts of browsing by native herbivores by using fencing or herbivore control, particularly post-fire.

Invasive species

- Monitor the impacts of weeds across all subpopulations and implement appropriate control measures if there is evidence to suggest that weeds are, or have the potential to become, a threat capable of causing a decline of the subpopulation.

Inappropriate disturbance

- Planned burns should generally be excluded from subpopulations of the Cadda Road Mallee unless data indicate that lack of disturbance is a serious threat. Any planned burns should take into account impacts on other species and vegetation communities, and resulting management issues (e.g. post-fire weed control).

Genetic threats resulting from small and fragmented subpopulations

- Collect and maintain ex situ seed collections at appropriate institutions from both subpopulations to ensure genetic diversity is captured.
- If appropriate, continue to create new subpopulations by implementing conservation translocations in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018).

Stakeholder engagement/community engagement

- Engage and involve Traditional Owners in conservation actions, including survey, monitoring and management actions.
- Liaise with the local community and government agencies to ensure that up-to-date population data and scientific knowledge inform the implementation of conservation actions for this species.
- Engage interested nature conservation, land management and landholder groups in conservation management activities (such as survey and monitoring), and engage the broader local community through participation at local community events and collaboration with local schools.

Survey and monitoring priorities

- Undertake surveys to locate additional subpopulations of the Cadda Road Mallee.
- Establish and maintain monitoring programs to:
 - determine trends in the size and distribution of subpopulations,
 - document the distribution and frequency of recruitment,
 - determine threats and their impacts (including weeds, feral herbivores, drought),
 - document and improve understanding of post-fire recovery,
 - monitor the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Improve understanding of recruitment, including conditions required to trigger recruitment (e.g. disturbance, rainfall) and threats to immature plants and seedlings.

- Confirm the hybrid status and population genetics of all both subpopulations to determine the priority of conservation investment in the species and appropriateness of attempts (e.g. genetic mixing) to increase genetic diversity.

Links to relevant implementation documents

[Eucalyptus balanites Interim Recovery Plan 2004-2009. Interim Recovery Plan no. 182 \(2004\)](#)

[Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* \(2018\)](#)

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