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Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to reject a proposal to list the tree *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill as a Vulnerable species in Part 3 of Schedule 1 of the Act and to retain *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act.

A Conservation Assessment report and Preliminary Determination for *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill as a Vulnerable species was published from 28 July 2023 to 28 October 2023. Following consideration of advice and submissions received, *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill is to be retained as an Endangered species. Listing of Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Eucalyptus parvula L.A.S.Johnson & K.D.Hill was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.2(1)(b)(2)(c) and Clause 4.3(c)(d)(ei,iii,iv) because: (i) *Eucalyptus parvula* is estimated to have undergone a large population reduction of 50-80% over the last three-generation period of 160-210 years based on a decline in habitat quality across its range; (ii) *E. parvula* has a highly restricted extent of occurrence (EOO) of 560 km² and area of occupancy (AOO) of 92 km²; (iii) the species is known from 1–4 threat-defined locations; and (iv) continuing declines are inferred in area, extent and/or quality of habitat, the number of locations or populations, and the number of mature individuals due to threats including livestock grazing, changes in temperature and rainfall due to climate change, and land clearing and degradation.

The NSW Threatened Species Scientific Committee has found that:

1. *Eucalyptus parvula* is described as a “tree to 15 m high; bark persistent, shedding imperfectly on lower trunk, red-brown, fibrous-flaky or platy; smooth above, grey or green, shedding in long ribbons. Juvenile leaves opposite, elliptic to obovate to broad-lanceolate, glossy green. Adult leaves disjunct or opposite, lanceolate, 4–7 cm long, 0.6–1 cm wide, green, dull, concolorous. Umbellasters 7-flowered; peduncle terete, 4–7 mm long. Buds sessile, ovoid, 3–5 mm long, 2–3 mm diam., scar present; calyptra conical, shorter than and as wide as hypanthium. Fruit cylindrical, conical or ovoid, 3–4 mm long, 3–4 mm diam.; disc raised slightly; valves enclosed or rim-level.” (PlantNET 2022). *Eucalyptus parvula* was previously known as *Eucalyptus parvifolia* (Cambage 1909) but was renamed *E. parvula* by Hill and Johnson (1991) as the original name had already been used for a fossil eucalypt species.
2. The geographic distribution of *Eucalyptus parvula* is highly restricted, occurring primarily between Badja to the north and Cathcart in the south. It was previously thought that it may extend to Tinderry where some old (1963 and undated), outlying records were georeferenced, however recent examination of the herbarium

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specimens associated with these records found them to be misidentifications (G. Phillips *in litt.* July 2022). Recent examination of another two old (1971, 1995) herbarium specimens associated with outlying records near Wadbilliga Trig, and the absence of known habitat at the described locality, support the conclusion that these records were most likely misidentified as well (G. Phillips *in litt.* July 2022; J. Miles *in litt.* July 2022). The distribution lies within the South Eastern Highlands Bioregion and may extend into the adjacent South East Corner Bioregion (Department of Climate Change, Energy, the Environment and Water 2020), on the traditional lands of the Yuin (Walbanga and Djiringanj), Thaua and Ngarigo First Nations people (Horton 1996; NSW NPWS 2019; Tindale 1940).

3. Approximately 27% of known individuals of *Eucalyptus parvula* occur in South East Forest National Park and Wadbilliga National Park. The remaining occurrences of known individuals are on private property for which the predominant land use is cattle grazing.
4. *Eucalyptus parvula* grows mainly in grassy woodlands around the edges of broad, flat headwater valleys in frost hollows at elevations of 800–1200 m above sea level (Hill 2002; Miles 2008). It occurs on waterlogged humic soils derived from granite or granodiorite geologies (Miles 2008). Associated species include *E. pauciflora*, *E. stellulata*, and occasionally *E. viminalis*, *E. ovata*, and *E. rubida* (Miles 2008). As populations of *Eucalyptus parvula* grow predominantly on flats within headwater valleys separated by low ridges, its habitat across the landscape is naturally patchy (Miles 2008). However, clearing of woodlands in this habitat for grazing may also have contributed to fragmentation (Prober *et al.* 1990).
5. Extent of occurrence (EOO) and area of occupancy (AOO) for the species were calculated using Kew Geospatial Conservation Assessment Tool (GeoCAT; Bachman *et al.* 2011) based on a cleaned dataset with erroneous records excluded. The EOO is estimated to be 560 km² based on a minimum convex hull polygon encompassing all cleaned records of the species as recommended by IUCN (2022). The AOO is estimated to be 76–92 km² based on 2 x 2 km grid cells, the scale recommended for assessing AOO recommended by IUCN (2022). This encompasses the entire known historical and extant distribution of the species.
6. There are nine known populations of *Eucalyptus parvula* with a total of c. 3,476–4,046 mature individuals, as well as 4 outlier records which have very low accuracy and have not been formally surveyed. This estimate of the number of populations is based on several assumptions. Firstly, the two sites of occurrence at Duck Hole Creek are most likely part of one continuous population. Secondly, given the likely pollen and seed dispersal distances, it is unlikely that gene flow occurs regularly across distances greater than 1,000 m. And finally, the occurrence records at Badja have been assumed to represent a single population, due to the poor quality of information available from this area (old records with low spatial accuracy).
7. Accuracy of population counts is variable. Most stands are comprised mainly of single stemmed individuals with no evidence of resprouting, and counts are straightforward. However, at the Dragons Swamp population accurate counts are difficult due to the presence of many multi-stemmed plants that have resprouted from lignotubers. Dense sod grass often conceals the lignotuber surface making it

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difficult to determine whether closely growing stems are multiple plants or single resprouting individuals (Miles 2017). There is, therefore, some uncertainty over the total population estimate for *Eucalyptus parvula*. Furthermore, some of the populations were burnt during the 2019–2020 fire season and have not been formally resurveyed since.

8. Although the generation length for *Eucalyptus parvula* is unknown due to insufficient data on lifespan, primary juvenile period and fecundity, it is possible to infer from conservative estimates that have been calculated for other eucalypts. Fensham *et al.* (2020) calculated a minimum generation length of 70 years for Eucalypts assuming 4 years as the minimum age of reproduction, a λ value of 0.33 and 200 years as the minimum age of a large tree. If a younger age of 150 years is assumed, the minimum generation length would be 53.5 years.
9. The main threats to *Eucalyptus parvula* include livestock grazing and trampling leading to lack of recruitment; native vegetation clearing; changes in temperature and rainfall due to climate change; alteration of drainage; uprooting and ringbarking of individuals by feral pigs and deer; infection by *Phytophthora cinnamomi*; and recruitment suppression by invasive exotic plants. 'Clearing of native vegetation', 'Anthropogenic Climate Change', 'Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands', 'Herbivory and environmental degradation caused by feral deer' and 'Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* Linnaeus 1758', 'Infection of native plants by *Phytophthora cinnamomi*' and 'Invasion of native plant communities by exotic perennial grasses' are listed as Key Threatening Processes under the Act.
10. The population of *Eucalyptus parvula* consists of between one and four threat-defined locations when considering the threat of changes in temperature and rainfall due to climate change. This is because changes in the habitat niche of *E. parvula* driven by these climatic shifts, and increasing occurrences of drought that may accompany them, is the most serious plausible threat resulting in the smallest number of locations for the species, as defined by IUCN (2022).
11. Continuing declines are inferred for the habitat area, extent and quality; and the number of locations or populations due to the current observed threats of inhibited recruitment, due to livestock grazing and trampling, drought stress, and higher temperatures, fewer cool nights, higher precipitation in summer, and lower precipitation in winter due to anthropogenic climate change. As a large portion of the population occurs on private property, further clearing of the species and its habitat, and interference with drainage, also pose significant threats. The senescence of mature plants without any recruitment at sites such as Steeple Road Flat, and the private property side of Mowitts Swamp Creek, is evidence that these declines are currently occurring.
12. The estimated timespan of three generations in *Eucalyptus parvula* is between 160 and 210 years. This timespan encompasses the extensive clearing of habitat that has occurred since European colonisation. A large population size reduction is considered to have occurred since 1812, based on the current fragmented distribution of *E. parvula* contrasted with its high level of genetic diversity and low

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level of genetic divergence between subpopulations, suggestive of a once more continuous distribution (Prober *et al.* 1990). Furthermore, the dominant land use where *E. parvula* occurs is livestock grazing, and it is likely that the productive flats and swamp edges were preferentially cleared relative to the wider landscape of infertile soils and challenging topography (Prober *et al.* 1990; Fensham *et al.* 2020).

13. Given the above, a population size reduction of between 50–80% is estimated to have occurred in *Eucalyptus parvula* over the three-generation timespan of 160–210 years based on a decline in habitat quality. Approximately 75% of the AOO of *E. parvula* is mapped as being used for grazing (native pasture c. 64%, modified pasture c. 10%; DFSI 2017) or more intensive land uses such as infrastructure, cropping or plantation forestry (c. 1%; DFSI 2017). Given these land uses are likely to have resulted in direct clearing of trees (Prober *et al.* 1990) and reduced recruitment opportunities (Dorrough and Moxham 2005) since colonisation, a decline in habitat quality across this area is considered to have occurred. Thus, a population reduction of 50-80% is estimated to have occurred since 1812 based on this decline in habitat quality across the species' range. This reduction is also likely to continue into the future given grazing remains a common land use across much of the species' range, and future projections of rainfall and temperature changes driven by climate change are likely to further reduce the species habitat niche, meaning the causes of the population reduction have not ceased.
14. *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill is not eligible to be listed as a Critically endangered species.
15. *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in Australia in the near future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Endangered under Clause 4.2(1)(b)(2)(c) and Clause 4.3(b)(d)(ei,iii,iv).

Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

Assessment Outcome: Endangered under Clause 4.2(1)(b)(2)(c)

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.

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(2) - The determination of that criteria is to be based on any of the following:	
(a)	direct observation,
(b)	an index of abundance appropriate to the taxon,
(c)	a decline in the geographic distribution or habitat quality,
(d)	the actual or potential levels of exploitation of the species,
(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

Clause 4.3 - Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)

Assessment Outcome: Endangered under Clause 4.3(b)(d)(ei,iii,iv).

The geographic distribution of the species is:		
(a)	for critically endangered species	very highly restricted, or
(b)	for endangered species	highly restricted, or
(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:		
(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
(e)	there is a projected or continuing decline in any of the following:	
	(i)	an index of abundance appropriate to the taxon,
	(ii)	the geographic distribution of the species,
	(iii)	habitat area, extent or quality,
	(iv)	the number of locations in which the species occurs or of populations of the species,
(f)	extreme fluctuations occur in any of the following:	
	(i)	an index of abundance appropriate to the taxon,
	(ii)	the geographic distribution of the species,
	(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 - Low numbers of mature individuals of species and other conditions

(Equivalent to IUCN criterion C)

Assessment Outcome: Not met

The estimated total number of mature individuals of the species is:		
(a)	for critically endangered species	very low, or
(b)	for endangered species	low, or
(c)	for vulnerable species	moderately low,
and either of the following 2 conditions apply:		
(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):	
	(i)	for critically endangered species very large, or
	(ii)	for endangered species large, or

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		(iii)	for vulnerable species	moderate,
	(e)	both of the following apply:		
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and	
		(ii)	at least one of the following applies:	
		(A)	the number of individuals in each population of the species is:	
			(I)	for critically endangered species extremely low, or
			(II)	for endangered species very low, or
			(III)	for vulnerable species low,
		(B)	all or nearly all mature individuals of the species occur within one population,	
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.	

**Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)
Assessment Outcome: Not met**

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

**Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data deficient**

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

**Clause 4.7 - Very highly restricted geographic distribution of species–vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Not met**

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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NSW Threatened Species Scientific Committee

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Wilkins K, Le Breton T, Phillips GP (2024) Conservation Assessment of *Eucalyptus parvula* L.A.S.Johnson & K.D.Hill (Myrtaceae). NSW Threatened Species Scientific Committee.

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