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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 list *Leptospermum petraeum* Joy Thomps. as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that *Leptospermum petraeum* Joy Thomps. has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method, as provided by Section 4.14 of the Act. After due consideration of Commonwealth DCCEEW (2024), the NSW Threatened Species Scientific Committee has made a decision to list the species as Critically Endangered.

Summary of Conservation Assessment

Leptospermum petraeum Joy Thomps. was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(a)(d)(e i,ii,iv) because: 1) the species has a very highly restricted geographic distribution with an estimated area of occupancy and extent of occurrence of 12 km^2; 2) it is known from a single threat-defined location; and 3) there is an inferred continuing decline in the geographic distribution, number of subpopulations, and number of mature individuals due to adverse fire regimes and increased frequency and duration of drought due to climate change.

The NSW Threatened Species Scientific Committee has found that:

1. *Leptospermum petraeum* is described by Thompson (1989) as a "Spreading rigid shrub to 3 m tall, with bark close on small branches but later flaking in strips, the younger stems very stout, with a short pubescence and a flange seen only as a thickening extending below the leaf-base, and with branching at 45–60° or more but later curving so as to appear at a narrower angle. Leaves rather aromatic, mostly narrowly divergent, variable in size but usually *c*. 15 mm long and 5–6 mm wide, rather broadly elliptical, glabrescent with both surfaces soon glabrous and glossy but hairs persisting on margins and the petiole, the texture rather thick, the surface often tending to incurve or infold especially near the apex but older leaves flat or even slightly recurved in cross-section, the upper part tapering to an acute or acuminate, pungent pointed apex, the base rounded above a distinct somewhat thick-based petiole. Flowers white, *c*. 22 mm in diameter, single on modified shoots at the ends of short leafy side-branches, the subtending leaves often somewhat modified, the new growth developing from the flowering shoot after flowering. Bracts and bracteoles similar, broad, stiffly scarious and yellowish-brown. Hypanthium glabrous or with a short dense pubescence, 4 mm long, the upper part much expanded, the lower rounded above a stout, short, fluted pedicel, the top of the ovary glabrous. Sepals persistent, *c*. 4–6 mm long, long-deltoid, glabrous or with a close silky pubescence on the lower part, and, usually, long hairs on the upper, inrolled or folded with the tip minutely hooded. Petals *c*. 7 mm long. Stamens in bundles of 7, *c*. 2.5–3 mm long, the anther-cells *c*. 0.7 mm long, somewhat

recurved and folded, wide open and thickened, the outer part deep. Style inset, slender and tapered, with a small stigma. Ovary 5-locular, each loculus with *c*. 40 ovules in *c*. 6 rows on a large, close-set placenta. Fruit long-persistent, *c*. 7-8 mm in diameter, the rim not much extended, the lower part rather broadly rounded with the surface lifting, later flat-based and scaly, the valves very woody, exserted at first only as a low dome but on opening the surface lifting and the valves rising and spreading so as to be about equal to the base in depth an and somewhat broader than the rim. Mature seeds *c*. 2 mm long, linear-cuneiform, striate."

2. *Leptospermum petraeum* is restricted to Kanangra-Boyd National Park (NP), in the Central Tablelands of New South Wales (NSW). The population currently consists of three subpopulations, all within 5 km of each other (Tasker *et al*. 2024). *Leptospermum petraeum* may also occur within Wollemi NP, based on unconfirmed records (S. Clarke pers. comm. October 2022 in Commonwealth DCCEEW 2024).

3. *Leptospermum petraeum* has a very highly restricted geographic distribution. The area of occupancy (AOO) is estimated to be 12 km^2 based on 2 x 2 km grid cells, the scale recommended by IUCN (2022). The extent of occurrence (EOO) is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022) and was estimated to be 4 km^2. However, where EOO is less than AOO, the IUCN (2022) recommend EOO estimates be changed to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO. Therefore, the EOO for *L. petraeum* is also estimated to be 12 km^2.

4. The total population of *Leptospermum petraeum* is estimated to be approximately 46,000–61,000 mature individuals. This estimate is based on the number of resprouters and seedlings detected after the 2019–20 bushfires (no mature plants were located) and a conservatively assumed attrition rate of 30–50% for juvenile plants before they reach maturity (Benwell 1998; Ooi 2010; Commonwealth DCCEWW 2024). Six of the nine previously recorded subpopulations were unable to be found post-fire in 2021, with plants only re-located at three subpopulations (Tasker *et al*. 2024). Resprouting plants were found at two of these subpopulations, and seedlings were found at all three. The estimated numbers of mature individuals in each subpopulation are: 27,695–38,556, 15,506–18,813 and 2,650–3,710.

5. *Leptospermum petraeum* is known to grow in rock crevices of granite outcrops (Thompson 1989). A survey by Benson and Keith (1985) described its habitat as a "Broad ridge top of Devonian Lambie Group with shallow sandy loam" and growing in *Eucalyptus stricta* scrub, suggesting the species may also occur on sedimentary substrates. Recent field surveys in 2021 (Tasker *et al*. 2024) described *L*. *petraeum* as occurring on "plateau and rocky slopes with granite boulders dominated by mallee *Eucalyptus* spp., *Hakea* spp., *Platysace* spp. and *Lomandra* spp."

6. The flowering period of *Leptospermum petraeum* is recorded as occurring from November to April (Thompson 1989). Fruits of *L. petraeum* are described as woody and long-persistent, indicating the species is likely to have a serotinous seed bank from which seeds are released after fire or after plant/branch senescence. Seed dispersal is likely to be proximal to the plant, although long-distance dispersal may occur sporadically via wind due the small mass of the seed (White *et al*. 2020).

7. *Leptospermum petraeum* responds to fire with new seedling recruitment, as well as resprouting from burnt adults (Tasker *et al*. 2024). The life span of *Leptospermum petraeum* is unknown, but *Leptospermum* species with similar growth forms have been shown to live >60 years, with estimates of up to 150 years (Benson and McDougall 1999). The primary juvenile period of *L*. *petraeum* is similarly unknown. Many other *Leptospermum* species have an estimated primary juvenile period of 1–5 years (White *et al.* 2020), and *L. petraeum* is likely to be closer to the longer end of this range given the affinity of *L*. *petraeum* for water-limited habitats with low productivity (Gosper *et al*. 2022).

8. The primary threat to *Leptospermum petraeum* is adverse fire regimes. Having an inferred primary juvenile period of around five years, it is likely that high frequency fire (*i.e*. fire intervals of less than 10 years) would not allow sufficient time for seedlings to mature and replenish the serotinous seed bank. High severity fire, and interactions between fire and other threats, particularly increased frequency and duration of drought due to climate change, are also recognised as significant threats to the species. 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and competition' and 'Anthropogenic climate change', are listed as Key Threatening Processes under the Act.

9. *Leptospermum petraeum* is known from one threat-defined location based on the threat of adverse fire regimes. All subpopulations were burnt in the 2019–20 bushfires, and have the potential to all be adversely affected again by a similar future fire event.

10. High severity fire is likely to reduce the population size and health of *Leptospermum petraeum* through mortality of standing plants and their serotinous seed bank and seed banks due to heat death of vital tissues above ground and depletion of below ground starch reserves in standing plants (Keith 1996, Clarke *et al*. 2015). Furthermore, extreme and extended soil heating can compromise the reproductive capacity of the species by impairing the survival of regenerative organs located below ground (Whelan and Ayre 2022). Mortality rates may be high in populations of resprouting species after extreme severity fires (Nicholson *et al*. 2017). It is predicted that extreme severity fires will become more frequent in the region occupied by the species (Abram *et al*. 2021). Such fire regimes will negatively affect population persistence of *L. petraeum* by increasing mortality of established plants and reducing seed bank accumulation and seedling establishment. Given that no seedlings or resprouting individuals could be located at six of the nine subpopulations surveyed after the 2019-2020 bushfires (Tasker *et al*. 2024), a continuing decline in extent of occurrence, area of occupancy, number of subpopulations, and number of mature individuals is inferred due to adverse fire regimes. Increasing and/or extreme fire events may exacerbate other threats, including increasing mortality post-fire (Twidwell *et al*. 2016; Pegg *et al*. 2020).

11. The projected increased duration and frequency of droughts (Ukkola *et al*. 2020) is also considered likely to reach the upper limits of drought tolerance for *Leptospermum petraeum*. In the years leading up to a fire event, drought depletes carbohydrate resources held within plant tissues and reduces reproductive output, adversely affecting the size of the seed bank available for post-fire recruitment, and

carbohydrate reserves for resprouting (Nolan *et al*. 2020). If drought occurs post-fire, it can adversely affect post-fire recruitment success by reducing seed germination and seedling survival, as well as slowing rates of growth and maturation, leading to interval squeeze (Enright *et al*. 2015).

12. *Leptospermum petraeum* Joy Thomps. is eligible to be listed as a Critically Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate 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:
Critically Endangered under Clause 4.3(a)(d)(e i,ii,iv)

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Data Deficient

(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.
(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: Critically Endangered under Clause 4.3(a)(d)(e i,ii,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 Clause 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
		(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: Vulnerable under Clause 4.7

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.

Professor Angela Moles, FRSN
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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