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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 the shrub *Bertya mollissima* Blakely as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that *Bertya mollissima* Blakely has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method (DCCEEW 2023). The acceptance of this assessment is provided for in section 4.14 of the Act.

The NSW Threatened Species Scientific Committee accepts the assessment outcome of the Commonwealth Threatened Species Scientific Committee in its Conservation Advice for *Bertya mollissima* of Endangered under IUCN Criterion 2: B2ab(i,ii,iii,iv)

Summary of Conservation Assessment

Bertya mollissima Blakely was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(b)(d)(e ii,iii,iv) because: (i) *Bertya mollissima* has a highly restricted geographic distribution with an Area of Occurrence of 20 km^2; (ii) *Bertya mollissima* known from a small number (3) threat-defined locations; (iv) there is inferred continuing decline in the number of mature individuals, geographic distribution, habitat quality, and number of threat-defined locations in which *B. mollissima* occurs due to high-frequency fire, browsing by feral goats and the effects of climate change.;
The NSW Threatened Species Scientific Committee has found that:

1. *Bertya mollissima* Blakely (family Euphorbiaceae) is a shrub growing to 3 m tall, completely covered with a medium to dense layer of soft stellate hairs, which they lose with age. The leaves are 5–20 mm long by 2–5 mm wide, dark green on the upper surface and paler on the lower surface, with a prominent midrib. The species have both male and female flowers on the same plant, although can be predominantly male or female. The flowers are shortly pedunculate; male flowers with five small tomentose bracts, two outer ones narrower than the three inner ones; female flowers with two or four bracts. The fruits are oblong in shape, up to 8 mm long by 3.6 mm wide, hairy, and usually single seeded (Halford and Henderson 2002; PlantNET 2021).

2. *Bertya mollissima* is endemic to north-eastern New South Wales (NSW) and has been known to occur historically from Mount Kaputar, the Warrumbungle and Liverpool Ranges and the Scone and Singleton districts (Halford and Henderson 2002). In 2002, the species appeared to be most common within Mount Kaputar National Park (NP) and Warrumbungle NP (Halford and Henderson 2002). Historically, the species was known from at least eight sites (BioNet 2021). However, within the last 20 years only four extant sites are known; Mount Kaputar

summit and Waa Gorge in Mount Kaputar NP, Ukerbarley Aboriginal Area, and Bundella Lookout in Coolah Tops NP (BioNet 2021). The species has been historically found within the Warrumbungle NP; however, the species has not been collected or observed in the area since 1978 (Halford and Henderson 2002; BioNet 2021).

3. *Bertya mollissima* has a highly restricted geographical distribution. The Extent of Occurrence (EOO) is estimated at 7,672 km^2 and the Area of Occurrence (AOO) is estimated at 20 km^2. The AOO is based on 2 x 2 km grid cells, the scale recommended by IUCN (2022). The EOO is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022). The figures for EOO and AOO are based on mapping of point records from 2000 to 2021.

4. The number of individuals of *Bertya mollissima* is unknown. Data on population size is available from only one site occupied by *B. mollissima,* the summit of Mount Kaputar. In 2019, the site was estimated at 40 mature individuals (G. Phillips pers. comm. April 2023). The Mount Kaputar site then burnt in the 2019-20 bushfires and surveys post-fire found two mature individuals and 100s of seedlings immediately adjacent to parent plants (G. Phillips pers. comm. April 2023; RBGDT 2020). Although three of the sites lack population data, it is unlikely that they significantly exceed that of the estimated pre-fire abundance at Mount Kaputar summit. It is therefore likely that all of the known subpopulations contain less than 250 mature individuals each.

5. *Bertya mollissima* grows on steep hillsides and mountain summits in shallow sandy or gravelly soil in rock cracks and among boulders. The species typically occurs within heath or open woodland communities surrounded by *Eucalyptus* spp. between 500 to 1500 m above sea level (Halford and Henderson 2002; PlantNET 2021). The habitat at the Mount Kaputar NP site is recorded as a rocky mountain summit with Ribbon Gum *Eucalyptus nobilis*, *Olearia* sp., *Muehlenbeckia* sp. 'Mt Norman' and *Pelargonium inodorum* (RBGDT 2020).

6. *Bertya mollissima* flowers from September to December, with fruits in December (Halford and Henderson 2002; PlantNET 2021). The species may be wind pollinated, like other member of the genus in northern NSW (Fatemi and Gross 2009; DEE 2016), and pollination between subpopulations, which are approximately 25 km apart, is unlikely. *Bertya mollissima* is a fire sensitive obligate seeder (Copeland 2008; RGBDT 2020), with limited seed dispersal (RBGDT 2020).

7. *Bertya mollissima* is considered to have three threat-defined locations based on the most serious plausible threat of high fire frequency. The sites at Mt Kaputar and Ukerbarley Aboriginal Area sites were burnt during the 2019-20 bushfire season. With an increasing fire threat due to climate change (Canadell *et al*. 2021), another extensive fire season similar to this one occurring within the minimum fire tolerable interval for the species could deplete the seedbank and threaten local extinction at these sites.

8. The EOO, AOO, number of locations and habitat quality of *Bertya mollissima* are all inferred to be declining. Habitat quality is likely declining due to grazing and trampling by feral goats and threatens to decline further due to change to precipitation regimes and the potential for erosion caused by extreme weather events under climate change. Continuing decline may also result from interactions between fire and feral goat herbivory, leading to a further loss of seedlings.

9. Feral goats *(Capra hircus*) are inferred to be a threat to *Bertya mollissima* (RBGDT 2020) because the areas surrounding known sites at Mount Kaputar NP, Coolah Tops NP, Warrumbungle NP and Ukerbarley Aboriginal Area have feral goat populations (NSW NPWS 2002b; 2012; 2021). Unlike many other feral herbivores, goats graze on the rocky outcrops and slopes that the species grows on. Grazing by herbivores can act to significantly limit recruitment by affecting the establishment of seedlings, which constrains post-fire recovery (Legge *et al.* 2019). These goat populations are controlled periodically via aerial and occasional ground shooting (NSW NPWS 2002b; 2012; 2021). 'Competition and habitat degradation by feral goats (*Capra hircus*)' is listed as a Key Threatening Process under the NSW *Biodiversity Conservation Act 2016*.

10. The incidence of moist conditions in high altitude forests like those found on Mount Kaputar are projected to contract under future climates (DECCW 2010). As such, the suitability of currently occupied habitat of *Bertya mollissima* is projected to decline from the increasing temperature and changing precipitation patterns of climate change. Mount Kaputar NP occurs within the New England and North West region of NSW, where maximum temperatures are projected to increase by 0.7–1°C by 2030 and 1.9–2.7°C by 2070 compared to temperatures from 1990 to 2009, with more hot days and fewer cool nights (OEH 2014b). Ukerbarley Aboriginal Area occurs within the Central West and Orana region of NSW, where similar temperature changes are projected (OEH 2014a). Coolah Tops NP is found on the border of these two regions. Additionally, the species grows in rocky habitat and increased erosion from increasingly extreme rainfall events from climate change may deplete the soil seedbank (DPIE 2020). 'Anthropogenic Climate Change' is listed as a Key Threatening Process under the Act.

11. *Bertya mollissima* is threatened by a high frequency fire regime that does not allow plants to reach reproductive maturity and replenish the soil seedbank, ultimately leading to a lack of recruitment. The juvenile period of *B. mollissima* is unknown, but reasonably suspected to be approximately 3 years. Subpopulations may also be threatened by too infrequent fire that leads to the senescence of mature plants and a decline in the seed bank prior to recruitment (Whelan 1995; Bond and van Wilgen 1996). However, this depends on the rate of decay of the soil–stored seedbank, which is currently unknown. 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the Act.

12. *Bertya mollissima* Blakely is not eligible to be listed as a Critically Endangered species.

13. *Bertya mollissima* Blakely 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 4.3(b)(d)(e, ii,iii,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: Endangered under Clause 4.3 (b)(d)(e ii,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 Clause C)
Assessment Outcome: Data deficient

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: Data Deficient

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.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation

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