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Notice of and reasons for 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 *Gaultheria viridicarpa* J.B.Williams as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act and, as a consequence, to omit reference to *Gaultheria viridicarpa* J.B. Williams ms subsp. *viridicarpa* and *Gaultheria viridicarpa* subsp. *merinoensis* J.B. Williams ms from Part 3 of Schedule 1 (Vulnerable species) of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Gaultheria viridicarpa is eligible for listing as Endangered, as the highest threat category met by the taxon across all categories, under Clause 4.3(b) (d) (e i, iii) because: i) the distribution of the species is very highly restricted with an area of occupancy of between 32 km^2 and 48 km^2 and an extent of occurrence of 635 km^2; ii) the species is known from only four locations; and iii) there is continuing decline in the quality of habitat and number of individuals.

The NSW Threatened Species Scientific Committee has found that:

1. *Gaultheria viridicarpa* J.B.Williams (family Ericaceae) is described in PlantNET (2018) as a "spreading low shrub 0.2–0.7 m high, spreading to c. 1.6 m dia., or sometimes slender; stems glabrous or almost so, with a few scattered bristles. Leaves narrow-elliptic to broad-ovate, 1.5–6 cm long, 6–20 mm wide, apex acute to rounded, apiculate, margins finely toothed, lamina glabrous, usually thick, leathery, the veins often impressed on upper surface; petiole 1–3 mm long. Inflorescence 1-flowered, in upper axils or in a terminal cluster or short panicle, each peduncle with a terminal flower and 4–9 bracteoles. Sepals ovate, enlarging and becoming firm-fleshy in fruit, remaining green. Corolla 4–5.5 mm long, white. Nectary a 10-lobed ring. Fruit, including the green calyx, 5–6 mm diam. when fresh". *Gaultheria viridicarpa* is distinguished from *G. appressa*, the only other member of the genus found near *G. viridicarpa*, by having a 1-flowered inflorescence (versus 3–11-flowered inflorescences) and the sepals remaining green with fruit (versus becoming white or pinkish) (PlantNET 2018).

2. *Gaultheria viridicarpa* has a complicated taxonomic history because of the widespread use of informal and unpublished manuscript names. The taxon was originally formally described as *G. appressa* var. *glabra*, but has also been called *G.* sp. A (Williams and Chapman 1992), *G.* sp. Point Lookout (J.B.Williams NE37757), *G. viridicarpa* J.B. Williams ms subsp. *viridicarpa, G. viridicarpa* J.B. Williams subsp. *viridicarpa* ms, and *G. viridicarpa* subsp. *merinoensis* J.B. Williams ms. The two subspecies of *G. viridicarpa*, though listed in the Act, were never formally described. Telford and Williams (2012) raised *G. appressa* var. *glabra* to species rank and created the new name *G. viridicarpa.* They did not recognise any subspecies.

3. *Gaultheria viridicarpa* is known from two areas separated by approximately 260 kilometres. The northernmost population occurs in the Mount Merino area of the McPherson Range, on the Queensland (Qld)–NSW border, c. 20 km north-west of Murwillumbah. Southern populations are confined to the eastern New England area, from near Ebor and south to Point Lookout along the Great Escarpment, c. 70 km east of Armidale (NSW). *Gaultheria viridicarpa* occurs in skeletal soils on basalt along cliff-lines of erosional calderas of Pleistocene shield volcanoes,

the northern population on the Tweed Volcano, and the southern populations on the Ebor Volcano (Telford and Williams 2012).

At Mount Merino, *Gaultheria viridicarpa* occurs at c. 1,160 m altitude (Telford and Williams 2012; Weber and Box 2016) on the boundary of Limpinwood Nature Reserve (NSW) and Lamington National Park (Qld). The only known population predominantly occurs on a steep inaccessible south-facing cliff face that is frequently shrouded in cloud (Weber and Box 2016). It commonly grows in crevices and overhangs from the cliff top to 10 m down the cliff face and is restricted to three vegetation communities: within 1 m of the cliff edge in microphyll thicket where it is in low abundance; in low mossy shrubland up to 5 m down the cliff in high abundance; and montane mossy herbfield up to 10 m down the cliff in moderate abundance (Weber and Box 2016). Associated species are given in Weber and Box (2016) and Scott and Duretto (2018). *Gaultheria viridicarpa* individuals in the shadier microphyll thicket above the cliff face are less vigorous than those in more exposed habitats (Weber and Box 2016).

In the New England area there are three known populations of *Gaultheria viridicarpa*: Point Lookout and Majors Point, both in New England National Park, and the third located at Allans Water, between Ebor and Dorrigo, likely to be on private land. At New England National Park, *G. viridicarpa* occurs on rocky sites adjacent to cliff tops, in cracks in rock faces and in rock overhangs beneath cliffs at 1,400–1,560 m altitude (Telford and Williams 2012). The associated vegetation is *Eucalyptus pauciflora* shrubby open forest and the margins of *Nothofagus moorei* layered closed forest (Telford and Williams 2012). The only record for Allans Water is an herbarium collection made in 1992 (University of New England Herbarium, NE 57394). The collection was made in cool temperate rainforest dominated by *Nothofagus moorei* on the escarpment edge.

4. *Gaultheria viridicarpa* has a highly restricted geographic distribution. The extent of occurrence (EOO) was estimated to be 635 km^2 and is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2017). The area of occupancy (AOO) was estimated to be between 32 km^2 and 48 km^2. This calculation was based on the species occupying 8 to 12 (2 km x 2 km) grid cells, the spatial scale of assessment recommended by IUCN (2017). The lower bound reflects the mapped database records, the upper bound includes the anecdotal evidence that the species occurs scattered around the rim of the escarpment in New England NP from Banksia Point to Majors Point (Clarke *et al.* 2000).

5. The total population size of *Gaultheria viridicarpa* is not known with certainty but probably lies between 2500 and 3500 individuals. A recent specific survey of the Mount Merino area for the species estimated that there were between 500 and 1500 individuals (Weber and Box 2016). Scattered individuals (< 20) of *G. viridicarpa* occurred in the vicinity of Mount Merino Lookout, and the majority occurred along inaccessible cliff faces (Weber and Box 2016). Beyond the one known area of cliff face, no further *G. viridicarpa* plants were found despite searches of nearby areas (Weber and Box 2016).

   There have been no recent surveys of *Gaultheria viridicarpa* in the New England area. Clarke *et al.* (2000) concluded the total population for the New England area was < 2000 plants. They reported that the species was common around the escarpment edge over a distance of c. 10 km from Banksia Point to Majors Point. At Point Lookout the number of plants has been estimated to be 450 (Clarke *et al.* 2000) and several hundred (Telford and Williams 2012; L

Copeland *in litt*. July 2018). Approximately 200 plants were recorded at Allans Water (Clarke *et al.* 2000).

6. The main threats to *Gaultheria viridicarpa* include disturbance by recreational activities (bushwalking, camping and abseiling), erosion and cliff collapse, weed incursion and climate change. Until recently, it was thought the species may be extinct at Mount Merino due to recreational pressures associated with high visitation, trampling of habitat by campers and abseilers, and previous infestations of weeds above the cliffs (W. Buch pers. comm. July 2018). *G. viridicarpa* is mostly confined to a steep cliff just below the escarpment rim and is inaccessible without ropes. Abseiling as a recreational activity is a threat to *G. viridicarpa* and its habitat (W. Buch pers. comm. July 2018). The area is also prone to landslide and cliff collapse, an event which could remove a significant portion of the population of *G. viridicarpa* (Weber and Box 2016). The populations in New England National Park are under threat from disturbance due to bushwalkers, walking track maintenance, and erosion (OEH SOS 2018). There are many walking tracks through the habitat and erosion is exacerbated by high rainfall and bushwalkers walking off track. The high altitude vegetation grows relatively slowly and any damage can take a significant amount of time to recover (S Horton pers. comm. October 2018).

7. The specific weeds in the Mount Merino area which may threaten *Gaultheria viridicarpa* are *Ageratina riparia* (Mist Flower), *A. adenophora* (Crofton Weed) and *Hypochaeris radicata* (Flat Weed) (Weber and Box 2016). All three species are daisies with light wind-blown seeds that can reach cliff ledges and germinate and establish. In the recent survey, all these weeds were present in low abundance and the *Ageratina* species appeared to be impacted by fungal biocontrol agents (Weber and Box 2016). Weeds were effectively removed a few years ago from above the cliffs and have not returned (W. Buch pers. comm. July 2018). However, weeds present in Limpinwood Nature Reserve may encroach up the escarpment from below. Weeds are widespread in the Limpinwood Nature Reserve and the Border Ranges area generally making them difficult to control (J. Mallee pers. comm. August 2018). In New England National Park *Ageratina riparia* (Mist Flower) occurs at Point Lookout and Majors Point in the cliff areas. It is difficult to remove from cliff environments, and once established may disperse into *Gaultheria viridicarpa* habitat (S. Horton *in litt.* July 2018).

8. *Gaultheria viridicarpa* grows at high elevations in mist zones receiving high rainfall (Weber and Box 2016; S. Horton *in litt.* July 2018) and moisture from cloud cover, making this habitat particularly sensitive to the effects of anthropogenic climate change (Laidlaw *et al*. 2011; Tanner-McAllister *et al*. 2018). With an expected increase in temperature, the elevation with cloud cover is predicted to rise in Lamington National Park (Laidlaw *et al*. 2011) exposing the habitat of *G. viridicarpa* to extended periods of drier conditions. Should predictions for rising cloud base layers under a warming climate occur (Pounds *et al.* 1999; Richardson *et al.* 2003; Laidlaw *et al*. 2011; Tanner-McAllister *et al*. 2018), then the habitat of the species is likely to diminish over time. Changes in the timing of rainfall are predicted for the North Coast of NSW with an increase in spring and autumn rainfall and a decrease in winter rainfall (Adapt NSW 2018). The area at Mount Merino is prone to landslide and cliff collapse and the risk of this occurring would be highest following very heavy rainfall events associated with, for example cyclones and east coast lows. The proportion of east coast lows that are of high intensity is expected to increase (Dowdy *et al.* 2015; Adapt NSW 2018; Tanner-McAllister *et al.* 2018), potentially escalating the risk of land slips. 'Anthropogenic Climate Change' is listed in the Act as a Key Threatening Process.

9. *Gaultheria viridicarpa* J.B.Williams is not eligible to be listed as a Critically endangered species.

10. *Gaultheria viridicarpa* J.B.Williams is eligible to be listed as an 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*:

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 i, iii).

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: Vulnerable under Clause 4.4 (c)(e i ii A(lll))

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: 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.~~

Dr Marco Duretto
Chairperson
NSW Threatened Species Scientific Committee

Supporting document:

Scott J, Duretto M (2019) Conservation Assessement of *Gautheria viridicarpa* J.B.Williams (family Ericaceae), version 1.0. NSW Threatened Species Scientific Committee.

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