

Grevillea montis-cole subsp. *montis-cole* Mount Cole Grevillea

Taxonomy

Grevillea montis-cole subsp. *montis-cole* R.V. Sm.

Although Mount Cole Grevillea is readily distinguished from the other subspecies, Langi Ghiran Grevillea (subsp. *brevistyla*) by its longer pistil, a recent phylogenetic analysis of southern Holly Grevilleas (Holmes et al. 2014) showed that the two subspecies fall into separate clades and possibly occupy different niches. The Mount Cole Grevillea is found on granitic loam soils as an understorey shrub, whereas the Langi Ghiran subspecies grows in granite outcrops in more exposed sites at higher altitudes (Holmes et al. 2014). They noted that this pattern of variation was unexpected for morphologically similar plants separated by just a few kilometres, but possibly could be attributed to historical hybridisation and introgression.

On the basis of this evidence, the Langi Ghiran Grevillea (subsp. *brevistyla*) may soon be elevated to species status (i.e. *Grevillea brevistyla*) and *Grevillea montis-cole* subsp. *montis-cole* may be subsumed into *Grevillea montis-cole*, making the species entirely endemic to the Mount Buangor/Mount Cole Range and further reinforcing its uniqueness and significance (David Cameron and Neil Marriott pers. comm.).

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 2019).

Categorised as Rare in the 2014 Advisory list of rare or threatened flora (DEPI 2014).

Proposed conservation status

Critically Endangered in Australia

Criterion B1ab(i,ii,iii,iv,v)

Species Information

Description and Life History

G. montis-cole is a straggling to open semi-erect shrub 0.6-1.5 m high. Branchlet indumentum sparse villous. Leaves 3-7 cm long, 1.5-5.5 cm wide, 5-15-partite; primary lobes spreading, often 2-5-fid with subtriangular ultimate lobes; lower surface with scattered spreading hairs along the veins, or almost glabrous; margin shortly recurved. Conflorences terminal, erect to decurved, simple, secund, 2-6 cm long; peduncles (10-)7-15(-20) mm long, 0.6-0.8 mm wide, usually with at least some hairs, rarely occasional peduncles glabrous; rachis with spreading hairs; perianth green to brown, narrow, outer surface subsericeous to tomentose, inner surface glabrous; ovary stipitate, villous, style bright red, glabrous, pollen presenter oblique. Fruits tomentose, with reddish dorsal markings.

Subsp. *montis-cole* is distinguished from subsp. *brevistyla* by its habit, leaf shape and pistil length: it is a spreading shrub 1-1.5 m high; leaves usually longer than wide; pistil 26-27.5 mm long. The taxon flowers mainly from October to November (VicFlora 2021).

The taxon is apparently fire-sensitive and killed by intense fire, recruiting from a soil-stored seedbank of unknown longevity, and an obligate seed regenerator, reproducing only by seed. Recruitment is likely to be continuous but pulsed after fire. The taxon is likely to be a facultative outbreeder, pollinated by honeyeaters, with gene flow mostly only a few hundred metres. Seeds are passively dispersed with secondary dispersal by ants which bury the seeds after eating the elaiosome.

Grevillea montis-cole subsp. *montis-cole*

Mount Cole Grevillea

Generation Length

The generation length of *G. montis-cole* subsp. *montis-cole* is suspected to be 35 to 50 years. This is based on the longevity typical for *Grevillea* plants, and fire frequency. The longevity is plausibly 30-50 years or more but may be habitat-dependent and varying with competition and predation by wallabies in particular. The taxon is inferred to be a fire-sensitive obligate seed regenerator recruiting from a soil-stored seedbank episodically, following intense fire events, supplemented by more continuous, sporadic or opportunist recruitment in response to localised site disturbance events or optimal seasonal conditions, particularly in wetter sites where readily setting seed and unlikely to be fire-dependent for recruitment. The fire interval is likely to have been 35-70 years under undisturbed pre-European settlement conditions.

Distribution

The taxon is endemic in the Mt Buangor-Mt Cole Range area north-west of Beaufort in western Victoria (VicFlora 2021).

Habitat

The taxon occurs in wet to dry forest dominated by various *Eucalyptus* species, often moderately shaded, with low to tall scrub in the understorey. The substrate is coarse-grained granitic loam and elevation is c. 520-900 m asl. It often occurs among granite outcrops (VicFlora 2021).

Threats

The pre-eminent threat is climate change, specifically decreased rainfall, increased evaporation, extreme temperatures and drying of springs and soaks.

Altered fire regimes are likely to result in increased frequency and intensity of fire and inappropriate timing of prescribed fire, as well as potential impacts of bushfire suppression activities.

Environmental damage by Sambar (*Rusa unicorn*), especially to spring-fed soaks, and targeted browsing by Black Wallabies, Sambar, Fallow Deer (*Dama dama*), Red Deer (*Cervus elaphus*), rabbits, hares and goats is probable; seedlings are especially vulnerable. Other threats include weed invasions, Cinnamon Root-rot (*Phytophthora cinnamomi*), Grevillea Leaf Skeletoniser (a native lepidopteran), and decreased pollination success of the honeyeater guild, because of reduced flowering and co-occurring floral resources (e.g. *Epacris impressa*, *Correa reflexa*).

Community forestry operations continue in the Mt Cole forests and are an ongoing threat to this taxon. However, the Victorian *Code of Practice for Timber Production 2014* includes species-specific protections for *Grevillea montis-cole* in the Midlands Forest Management Area. Spatial analysis of likely habitat on all land tenures for Mount Cole Grevillea indicates that 29% occurs within the Comprehensive, Adequate and Representative (CAR) reserve system, including parks and reserves and special protection zones. Further areas are excluded from harvesting by prescription under the Victorian Code of Practice for Timber Production 2014 (the Code). Species-specific protections for the taxon are included in the Code: *avoid disturbance to verified populations within areas available for harvesting*. A substantial proportion of the likely habitat for this taxon occurs on private land; it should be noted that the Victorian Planning Provisions regulate the clearing of native vegetation on private land in Victoria and include tighter restrictions in cases involving the habitat of threatened species.

Many of these threats operate synergistically, notably increased fire frequency and mechanical disturbance are expected to increase exposure of recruiting stands to targeted browsing by wallabies, goats, Fallow Deer, potentially Red Deer and Sambar, rabbits and hares, and also to the risk of drought-induced recruitment failure.

In its final recommendation report in support of listing (SAC 2019), the Flora and Fauna Guarantee Act Scientific Advisory Committee stated:

Disturbances associated with logging history in particular are strongly implicated in the decline of this taxon. Other key threats include frequent fuel reduction burning or wildlife (that could harm the taxon by increasing mortality and inhibiting regeneration); human recreational impacts through direct destruction and habitat degradation; Climate Change exacerbating fire impacts and reducing the environmental domain at lower elevation; accidental introduction or spread of Cinnamon Fungus driving up mortality rates; and browsing pressure of wallabies, deer and rabbits inhibiting regeneration. The current trajectory of decline collectively driven by these threats could reasonably be expected to result in the taxon's extinction over coming decades in the absence of appropriate

Grevillea montis-cole subsp. montis-cole

Mount Cole Grevillea

interventions. Any locally acting catastrophic events such as successive and frequent wildfires, a sudden outbreak of Cinnamon Fungus or a severe regional drought could potentially wipe out the species very suddenly.

There remains some contention as to the role of current and historic forestry operations in the decline of this species.

IUCN Criteria

Criterion A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p>A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p>			
<p style="text-align: center;">} based on any of the following:</p> <ul style="list-style-type: none"> (a) direct observation [except A3] (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites 			

Evidence:

Eligible under Criterion A2 as Endangered

The population reduction over the past 105 to 150 years is estimated to be 30 to 70% (midpoint 50%), based on (a), (b), (c) and (e) above.

This is based on the inferred impact of the identified threats, supported by recent field observations by Neil Marriott (pers. comm.).

Eligible under Criterion A3 as Endangered

The population reduction over the next 100 years is projected to be 50 to 90% (midpoint 70%), based on (c) and (e) above.

This is based on an extrapolation of recent inferred trends. The worsening impacts of climate change suggest the current trajectory of decline could reasonably be expected, in the absence of appropriate interventions, to result in the near extinction of the taxon in coming decades.

Eligible under Criterion A4 as Endangered

The population reduction over any 105 to 150 year period, including both past and future (up to 100 years in the future), is inferred to be 50 to 95% (midpoint 70%), based on (a), (b), (c) and (e) above.

Grevillea montis-cole subsp. *montis-cole* Mount Cole Grevillea

Population reductions are based on the suite of threats, particularly climate change.

Criterion B. Geographic range in the form of either B1 (extent of occurrence) and/or B2 (area of occupancy)			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Eligible under Criterion B1 as Critically Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 46 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

It is estimated to have one location, since the prevailing threats apply consistently across the highly restricted geographic and ecological range of the taxon. The increasing impact of climate change and fire risk, with associated adult mortality and recruitment failure.

It has a continuing decline in (ii), (iii) and (v) above as a result of the effects of the suite of threats, particularly climate change-related decreased rainfall, increased evaporation, extreme temperatures and drying of springs and soaks. Increased frequency and intensity of fire, impacts of fire suppression activities, damage by Sambar deer to spring soaks, weed invasion and Cinnamon Root-rot Fungus are also likely to contribute to habitat damage.

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 40 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA. As above, it has one location and has a continuing decline in (ii), (iii) and (v) above.

Grevillea montis-cole subsp. montis-cole

Mount Cole Grevillea

Criterion C. Small Population size and decline		Critically Endangered	Endangered	Vulnerable
Number of mature individuals		< 250	< 2,500	< 10,000
AND at least one of C1 or C2				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2	An observed, estimated, projected or inferred continuing decline AND least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Eligible under Criterion C1 as Vulnerable

There are 2,000 to 3,000 mature individuals. This estimated was provided by Bill Molyneux in 2018, although recent observations by Neil Marriott (pers. comm.) suggest this may now be an overestimate.

There is estimated to be a continuing decline of 50 to 90% within three generations.

Criterion D. Very small or restricted populations		Critically Endangered	Endangered	Vulnerable
Number of mature individuals (observed or estimated)		< 50	< 250	< 1,000
D2. Only applies to the VU category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time.		-	-	D2. Typically: AoO < 20 km ² or number of locations ≤ 5

Evidence:

Eligible under criterion D2 as Vulnerable

The taxon is estimated to be very restricted.

Criterion E (Quantitative Analysis) was not addressed as the taxon does not have a detailed Population Viability Analysis.

References

DEPI (2014) *Advisory list of rare or threatened plants in Victoria - 2014*. Department of Environment and Primary Industries, Melbourne.



Grevillea montis-cole subsp. *montis-cole* Mount Cole Grevillea

Holmes, G.D., Downing, T.L., James, E.A., Blacket, M.J. Hoffmann, A.A. and Bayly, M.J. (2014) Phylogeny of the holly grevilleas (Proteaceae) based on nuclear ribosomal and chloroplast DNA. *Australian Systematic Botany* 27: 56-77.

Makinson R.O. (2000) *Grevillea*, *Flora of Australia* 17A:1-460. Australian Biological Resources Study, Canberra.

Olde, P. and Marriott, N. (1994) *The Grevillea Book: Volume 3* Kangaroo Press: Kenthurst.

SAC (2019) Flora and Fauna Guarantee Scientific Advisory Committee: Final Recommendation on a Nomination for Listing. Nomination No. 885 *Grevillea montis-cole* subsp. *montis-cole*.

Smith R.V. (1983). *Grevillea montis-cole* sp. nov. (Proteaceae) from Victoria. *Muelleria* 5(3) 223-227.

VicFlora (2021). Flora of Victoria, Royal Botanic Gardens Victoria: *Grevillea montis-cole* subsp. *montis-cole*. Retrieved from: <https://vicflora.rbg.vic.gov.au/flora/taxon/303eb263-9616-4f6c-9760-0bfa720c1988>