Threatened Species Assessment

Cyanothamnus anemonifolius subsp. *aurifodinus*

Goldfield Boronia

Taxonomy

Cyanothamnus anemonifolius subsp. *aurifodinus* (P.G. Neish) Duretto & Haslewood

It was previously known as *Boronia anemonifolia* subsp. 2 (Duretto 1999) and *Boronia anemonifolia* subsp. *aurifodina* P.G. Neish.

Current conservation status

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

Proposed conservation status

Endangered in Australia

Criteria A2bce+4bce; B2ab(ii,iii,iv,v)

Species Information

Description and Life History

The taxon is a shrub to 1.2 m high; branches glabrous or hirsute between decurrent leaf-bases; leaves usually simple with trifid tips or sometimes trifoliolate, 5-15 mm long, 0.5-2.5 mm wide (to 6 mm wide if trifoliolate), glandular; leaflets terete or plane, very narrow-cuneate to 3 mm long (0.5-2 mm wide if leaf compound); petiole 3-7 mm long, longer than leaflets in trifoliolate leaves. Inflorescence (1-)3(-6)-flowered; peduncle 3-4 mm long. Sepals 1.5-2.5 mm long, glabrous to indumented, c. one-third as long as petals; petals 5-6 mm long, glabrous to glabrescent, persistent. The taxon flowers in spring. Some plants in these populations have trifoliolate leaves (as in subsp. *anemonifolius*) for a few nodes only (VicFlora 2021).

Generation Length

The generation length of Goldfield Boronia is inferred to be 50 to 75 years. The taxon is likely to have been both pulse and somewhat continuously recruiting pre-settlement, with major pulses post-fire at a 45-70 year frequency. In addition, it is likely that there were minor pulses in good seasons following severe droughts with some mortality due to drought stress. As for *Rutaceae* in general, long-term seed-banking ensures successful mass recruitment following each severe fire event which would have been rare pre-settlement. Rod Orr (pers. comm. 29/1/18) has observed individuals persisting for at least 50 years at a range of representative sites in long unburned vegetation.

Distribution

The taxon is apparently endemic in mallee communities between Bolangum (north of Stawell) and Rushworth (VicFlora 2021). It is confined to central Victoria in the goldfields area and is common in the Rushworth State Forest and widespread through the "Whipstick Forest" around Bendigo. It is restricted in range and is found mainly in state forests. The populations west of Bendigo towards Wedderburn represent the western most occurrence of the taxon (Neish & Duretto 2000).

Habitat

The taxon is found in low open eucalypt woodland with a diverse understorey (Neish & Duretto 2000).

Threats

There has been some past decline as a result of habitat loss to agriculture and some subpopulations may have been impacted by forestry operations.

Key threats include increasing frequency, intensity and landscape scale of fire, leading to a consequent increase of seed bank exhaustion, failure to replenish the seed bank and an associated exposure to drought-stress resulting in recruitment failure. Intense browsing pressure by wallabies, kangaroos, rabbits and hares can threaten the taxon, particularly during extended drought and during early seed recruitment. Although weed invasion is considered a lower threat, occurrences may be threatened by competition from overabundant native species and exotic weeds.

Spatial analysis of likely habitat for Goldfield Boronia on all land tenures, indicates that 14% occurs within the CAR reserve system, including parks and reserves, special protection zones and areas excluded from harvesting by prescription under the Victorian Code of Practice for Timber Production 2014 (the Code). Species-specific protections for Goldfield Boronia are included in the Code in Bendigo FMAs.

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%

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

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.

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*]

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.

based on any of the following:

(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 150 to 225 years is estimated to be 50 to 85% (midpoint 65), based on (b), (c) and (e) above.

Past decline is based on historic habitat loss to agriculture, including Box Ironbark Forest and some mallee communities.

The causes of the reduction may not have ceased, be understood or be reversible.

Eligible under Criterion A4 as Endangered

The population reduction over any 150 to 225 year period, including both past and future (up to 100 years in the future), is estimated to be 30 to 80% (midpoint 50), based on (b), (c) and (e) above. The causes of reduction may not have ceased, be understood or be reversible.

Past decline is based on historic habitat loss to agriculture. Future decline cannot be estimated with confidence since the timescale over which identified threats will operate cannot be predicted.

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 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
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 B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 160 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the Victorian Biodiversity Atlas (VBA).

The taxon is estimated to be severely fragmented, naturally at the regional scale and anthropogenically at the landscape scale, with no known mechanism for long range dispersal. Therefore the probability of recolonisation, in the event of local extinction, is remote.

It is estimated to have two locations. One location comprises all occurrences within reserved public land. A second location comprises those occurrences in fragmented agricultural landscapes or subjected to forestry activity or oil production.

It has a continuing decline in (ii), (iii), (iv) and (v) above, based on the current and projected impact of the identified threats.

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:

Ineligible under Criterion C

There is insufficient evidence to determine the number of mature individuals.

Criterion D. Very small or restricted population			
	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 km2 or number of locations ≤ 5

Evidence:

Eligible under criterion D2 as Vulnerable

The taxon is projected 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. Retrieved from: https://www.environment.vic.gov.au/__data/assets/pdf_file/0021/50448/Advisory-List-of-Rare-or-Threatened-Plants-in-Victoria-2014.pdf

Neish, P.G., & Duretto, M.F. (2000). The taxonomy of *Boronia anemonifolia* and *B. rigens* (*Boronia* sect. Cyanothamnus, Rutaceae). *Muelleria, 14*, 3-16.

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