Threatened Species Assessment

Eucalyptus carolaniae
Mount Martha Bundy

Taxonomy

Eucalyptus carolaniae Rule

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 2016).

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

Proposed conservation status

Critically Endangered in Australia

Criteria A3ce+4ce; B1ab(iii,iv,v)+2ab(iii,iv,v); C1+2a(ii)

Species Information

Description and Life History

The taxon is a small to medium, robust, often spreading type of rough-barked mountain grey-gum to 20 m tall. The bark is sub-fibrous, box-like, grey-brown and deeply furrowed. Seedling leaves are broadly ovate, discolorous, pale green, sub-lustrous on the upper surface and whitish on the lower surface. The taxon flowers in summer (SAC 2016).

The combination of features which distinguish *E. carolaniae* are its relatively small habit, its rough, box-type bark which usually extends to the upper trunk and sometimes to the major branches, its seedling stems that are square in cross-section in early seedling development, its juvenile leaves that are ovate to broadly elliptical or sub-orbicular and initially lustrous and light green but become dull and blue-green with age, its large adult leaves, its long, flattened peduncles, its shortly pedicellate, cigar-shaped buds and its basally tapered, sessile or sub-sessile, thin-walled fruits (Rule 2012). *E. carolaniae* shares features with both *E. cypellocarpa* and *E. goniocalyx* which may raise the possibility that it is derived from hybrid stock. Initially the proposition of hybridism had some merit as the adult trees exhibit slight variation in the amount of persistent rough bark on the trunk. Despite this, other adult features within the population are uniform and repeated seedling trials have consistently produced uniform seedlings, all of which supports *E. carolaniae* as a true-breeding, distinct taxon (Rule 2012).

Generation Length

The generation length of *Eucalyptus carolaniae* is inferred to be 75 to 250 years (midpoint 100 years). This is based on the longevity of closely related taxa, notably *E. cypellocarpa*, which confidently reach senescence at 200-300 years or more. It is also based on the ability of the taxon to survive most bushfire events by epicormic or basal resprouting, and a pre-settlement fire frequency that is likely to fall within the range of 25-50 years.

Distribution

The taxon is endemic to Victoria, and is entirely restricted to a single population in a small area at Mt Martha on the Mornington Peninsula. An ecological study estimated the population as approximately 500 naturally occurring trees and saplings, nearly all of which occur along a linear strip of bushland forming the Norfolk-Hopetoun Reserve, and extending on to a section of the lower extremity of the Mt Martha Golf Course (Picone and McCaffrey 2006). A

large proportion of the population is sandwiched along a narrow easement between housing blocks between Norfolk and Hopetoun Roads (Rule 2012).

Habitat

The taxon grows along a sheltered gully in deep soils derived from granite. The mean annual rainfall of the area is approximately 650 mm, most of which falls in winter (Rule 2012). Associated taxa include *E. radiata* subsp. *radiata*, *E. viminalis* subsp. *viminalis* and *E. ovata* var. *ovata which* are sympatric with *E. carolaniae*, whilst *E. obliqua* and *E. pauciflora* subsp. *pauciflora* occur in the vicinity. Hybrids with *E. viminalis* have been observed in the field (Rule 2012).

Threats

The taxon's proximity to housing means that it is potentially threatened by changes to hydrology, damage to roots, and removal of trees for public safety (e.g. fire). Other potential threats include dieback from insect attack and infection by pathogens such as Myrtle Rust (SAC 2016).

The habitat until recently has been infested with blackberries and other weeds. Its close proximity to the golf course and houses remains a concern as the long-term impact of changes to nutrient levels and to drainage patterns is unknown (Rule 2012). A revegetation program has reintroduced several hundred seedlings to an area of the golf course which abuts naturally occurring trees. The reserve and the golf course, which are managed by the Mornington Shire Council, offer some protection to the taxon. The taxon's numbers are critically low and there are threats from changes to drainage patterns and nutrient levels (Rule 2012).

In addition, Yugovic (2015) has documented thoroughly the catastrophic impact of targeted browsing by both Brush-tail Possum and Ring-tail Possum in small isolated remnant stands of native vegetation, particularly on the Mornington Peninsula, in response to the long-term absence and exclusion of top-level predators and mesopredators. The taxon is observed to provide nesting habitat for Ring-tail Possum.

Low genetic diversity does not appear to pose a threat to the survival of the taxon since field observations and seedling trials indicate an appreciable level of morphological variation within the population (Rule 2005). However, observed hybridisation of the taxon with adjacent stands of *E. viminalis* subsp. *pryoriana* (Coast Manna-gum) and, possibly, with *E. botryoides* (Southern Mahogany) (Walker 2005 pers. comm.), a plantation taxon within the Mount Martha Municipal Golf Course, threaten the future integrity of its gene pool.

The most significant emerging threat in the long-term is likely to be climatic warming and drying, resulting in increased mortality of adults and recruitment failure in response to extreme drought stress (Rule 2005).

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 225 to 750 years is estimated to be 30 to 80% (midpoint 50%), based on (c) and (e) above.

Historic decline in the extent of native vegetation, particularly of the grassy woodland vegetation, throughout the Mornington Peninsula, suggests that the taxon is likely to have suffered significant decline in population size since European settlement. The population appears to have remained reasonably stable over the 1990-2005 period of field observation (Rule 2005). Field observation suggests that the type population is likely to have been halved in local extent through land clearance to urban development, including partial clearance for golf course development.

Eligible under Criterion A3 as Critically Endangered

The population reduction over the next 100 years is projected to be 50 to 90% (midpoint 80%), based on (c) and (e) above.

Future decline is based on identified threats. These include the edge effects of urban development, changes to hydrology, weed invasion, potential infection by *Phytophthora cinnamomi* and Myrtle Rust, possum browsing, inappropriate fire regimes, and climate change.

Eligible under Criterion A4 as Critically Endangered

The population reduction over any 225 to 750 year period, including both past and future (up to 100 years in the future), is estimated to be 80 to 95%, based on (c) and (e) above. The causes of reduction may not have ceased, be understood or be reversible.

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 B1 as Critically Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 8 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA). The EoO has been made equal to the AoO to ensure consistency with the definition of AoO as an area within EoO.

It is estimated to have 1 location, and has a continuing decline in (iii), (iv) and (v) above as a result of the edge effects of urban development, changes to hydrology, weed invasion, potential infection by *Phytophthora cinnamomi* and Myrtle Rust, possum browsing, inappropriate fire regimes, and climate change.

Eligible under Criterion B2 as Critically Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 8 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA.

As above, it has 1 location, and has a continuing decline in (iii), (iv) and (v) above.

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 Critically Endangered

The total population size is estimated at 120 mature individuals (Rule 2005).

A continuing decline of 50 to 90% (midpoint 80%) is estimated to occur within 1 generation.

Eligible under Criterion C2 as Critically Endangered

It is estimated that there are 120 mature individuals. The number of mature individuals is estimated to continue to decline, and the percentage of mature individuals in one subpopulation is 90-100 %,

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 D as Endangered

It is estimated that there are 120 mature individuals.

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.

Picone, A. and McCaffrey, N. (2006). Mount Martha Bundy *Eucalyptus* aff. *cypellocarpa* (Mornington Peninsula), Population, Census & Conservation Management Plan. Practical Ecology: Preston, Victoria.

Rule, K.J. (2005). Species Information Sheet - *Eucalyptus carolaniae.* Species Profile and Threat Database.

Rule, K. (2012). Five new endemic eucalypts for Victoria. *Muelleria, 30*(2), 83-105.

SAC (2016). Flora and Fauna Guarantee Scientific Advisory Committee: Final Recommendation on a Nomination for Listing. Nomination No. 864 *Eucalyptus carolaniae*. Department of Environment and Primary Industries, Victoria.

VicFlora (2016). Flora of Victoria, Royal Botanic Gardens Victoria: *Eucalyptus carolaniae.* Retrieved from: https://vicflora.rbg.vic.gov.au/flora/taxon/5d782540-437d-4f8d-b33e-04d60b1778ed

Yugovic, J. (2015). Do ecosystems need top predators? A review of native predator-prey imbalances in south-east Australia. *The Victorian Naturalist, 132*(1), 4-12.