Threatened Species Assessment

Phebalium squamulosum subsp. *ozothamnoides*
Mountain Phebalium

Taxonomy

Phebalium squamulosum subsp. *ozothamnoides* (F. Muell.) Paul G. Wilson

Current conservation status

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

Proposed conservation status

Endangered in Victoria

Criteria B1ab(iii)+2ab(iii)

Species Information

Description and Life History

The taxon is a compact shrub to c. 1 m high; branchlets smooth, ferruginous-lepidote. Leaves coriaceous, oblong-obovate to broadly obovate, cuneate or suborbicular, 7-11(-16) mm long, 2-7 mm wide, apex rounded, upper surface scurfy to glabrous, smooth to scaberulous, midrib not impressed, lower surface smooth, silvery- to ferruginous-lepidote, margins entire, recurved to revolute. Inflorescence a terminal, (3-)5-10(or more)-flowered umbel-like cluster; peduncle absent or short; pedicels 3-8 mm long. Calyx shortly hemispherical or subturbinate, 0.5-1.2 mm long, silvery- or ferruginous-lepidote, smooth to verrucose; petals imbricate, elliptic, 2-4.5 mm long, yellow to cream, silvery- or ferruginous-lepidote; stamens exserted, anthers yellow; disc not apparent; ovary lepidote. Follicles erect, truncate or slightly rounded at apex, c. 3.5 mm long. Flowers Spring and Summer (VicFlora 2017).

Generation Length

The generation length of *Phebalium squamulosum* subsp. *ozothamnoides* is estimated to be 50 to 80 years. This is based on a plausible longevity of 50-80 years and the inference that the taxon is a fire-sensitive obligate seed regenerator which recruits episodically post-fire at pre-settlement intervals of 50-60 years or more depending on local habitat conditions. There may also be some trickle recruitment in response to localised disturbance events.

Like most Rutaceae, the taxon recruits from long-persistent soil-stored seedbanks which can outlast the lifespan of the last cohort of post-fire recruits.

Distribution

The taxon is rather rare in Victoria and is confined to the Alpine region at Moroka River Gorge, upper Buchan River, Mitta Mitta, Mt Tingaringy, and Cathedral Range. It also occurs in New South Wales and the Australian Capital Territory (VicFlora 2017).

A geographically isolated specimen from Sugarloaf Peak, near Buxton, has been tentatively determined as this subspecies, however the specimen may be a form of subsp. *squamulosum* which occurs locally and whose leaves are reduced in length due to the exposure of the site (VicFlora 2017).

The identity of a 1987 Albrecht collection taken in the Moroka Gorge in the Victorian Alps is problematic. One duplicate at the Herbarium of the Botanic Gardens (Canberra) has been determined as subp. *Squamulosum,* yet

this collection is the only support in the Australian Virtual Herbarium (AVH) for the assertion in VicFlora (2017) that subsp. *ozothamnoides* occurs in the Moroka River Gorge.

Beauglehole specimens taken in 1973 at Mounts Gibbo and Sassafras are also problematic since one of these specimens was subsequently redetermined by Bryan Mole, who took a more restrictive circumscription of subsp. *ozothamnoides*, as subsp. *alpinum*. The difficulty in reliably distinguishing these two subspecies is demonstrated by a number of specimens, taken in the Kosciuszko area in NSW, assigned to either *P. squamulosum* subsp. *alpinum* x *ozothamnoides* or to *P. squamulosum* subsp. *alpinum-ozothamnoides* intergrades in the AVH.

Habitat

According to VicFlora (2017), the taxon occurs in elevated areas in forest, woodland, and heath in rocky sites. It has a markedly bimodal habitat range within Victoria with some stands occurring on elevated mountain summits and others occurring in riparian sites, typically at much lower elevations. Consequently, the taxon occupies a far greater elevation range than is suggested by VicFlora (2017), ranging from 1,795 m at Mt Hotham to 1,730 m at Mt Gibbo, to 1448 m at Mt Tingaringy, to 920 m at Mt Sugarloaf on the Cathedral Range, to 900 m on the Murray River at the confluence with Bulley Creek, to 760 m on the Buchan River, to 660 m on the Bundara River, to 330 m on the Mitta Mitta River, to 115 m on the Snowy River below the Tullach Ard Gorge. However, all these sites are consistently rocky with gravelly to shallow or skeletal soils.

Threats

Historic decline due to habitat loss is likely to have been negligible since most Victorian occurrences are in remote or elevated sites of no value for agriculture or forestry. Current and future threats include the potential impact of increasing fire risk, repeat fire events at intervals close to the tolerable fire interval for the taxon, recruitment failure in response to climatic drying and warming, and planned burning regimes.

Recruiting stands are particularly susceptible to targeted browsing by native and exotic herbivores including wallabies, rabbits, deer, and potentially possums, although the distinctive oil content of the foliage and bark may reduce palatability for some herbivores. All occurrences may be threatened by the increasing density of Sambar Deer (*Rusa unicolor*) throughout the region, based on their impact on both juvenile and adult stands of the closely related *Nematolepis wilsonii* in the Central Highlands of Victoria. Sambar Deer have demonstrated their ability to browse and ringbark *N. wilsonii* by antler-rubbing and now constitute the greatest threat to that highly localised endemic.

Although the taxon is inferred from its habitat range to be highly drought-tolerant, the increasing risk of extreme drought stress is likely to become an increasingly significant long-term threat, particularly to stands recruiting following intense bushfire. When coupled with targeted browsing by Sambar Deer and other herbivores, this is likely to result in recruitment failure, seedbank depletion and local extinction.

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:

Ineligible under Criterion A

The past population reduction does not meet the threshold for eligibility under criterion A2. There is insufficient evidence to determine whether will be a future reduction in population size (criterion A3).

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 Endangered

The Extent of Occurrence (EoO) across the taxon's range is estimated to be 2,610 to 13,589 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA). The lower bound estimate excludes several records including the Sugarloaf Peak specimen record due to its uncertain identity, which is potentially referable to subsp. *squamulosum*, the unconfirmed site records for the Mount Hotham area, which may be referable to subsp. *alpinum,* and the specimen records for Mt Gibbo and Mt Sassafras which may also be referable to subsp. *alpinum*.

The taxon is estimated to be severely fragmented naturally at the subregional and landscape scales, with geographically isolated occurrences separated by distances greatly exceeding the dispersal range of the taxon, which has no specialised mechanism for long-distance dispersal. Seed is likely to be dispersed by ants (myrmecochory) at the metre scale only.

It is estimated to have 1 location, and has a continuing decline in (iii) above, based on the current and projected impact of the identified threats.

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 40 to 60 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA.

As above, the taxon is severely fragmented, has 1 location, and has a continuing decline in (iii) 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:

Ineligible under Criterion C as Data Deficient

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 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. 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

VBA (2019). Victorian Biodiversity Atlas: *Rusa unicolor* Sambar Deer. Retrieved from: https://vba.dse.vic.gov.au/vba/index.jsp

VicFlora (2017). Flora of Victoria, Royal Botanic Gardens Victoria: *Phebalium squamulosum* subsp. *ozothamnoides*. Retrieved from: https://vicflora.rbg.vic.gov.au/flora/taxon/c611f83d-a01b-49cf-919f-387ca728d5a9