Threatened Species Assessment

Thesium australe
Austral Toad-flax

Taxonomy

Thesium australe R. Br.

Current conservation status

Listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1991).

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

Proposed conservation status

Endangered in Victoria

Criteria A2ce; B1ab(i,ii,iii,iv,v)c(iv)+2ab(i,ii,iii,iv,v)c(iv)

Species Information

Description and Life History

The taxon is a perennial herb (but stems mostly annual from woody rootstock) to c. 40 cm high, glabrous, pale green or yellow-green; stems 1-several, little-branched, wiry, striate. Leaves alternate, linear, mostly 1-4 cm long, 0.5-1.5 mm wide, rather lax, acute, midrib decurrent, margins entire, sessile; lowest leaves scale-like. Inflorescences axillary; peduncle 1-3 mm long, united with leaf-base; bracteoles 2, opposite, linear, mostly 2-5 mm long, inserted on leaf 1-3 mm above axis; pedicel very short. Receptacle cupular-globose, c. 1 mm long; tepals oblong, c. 1.5 mm long, united at base, finely keeled, tips incurved, green with white margins; stamens inserted c. halfway on tepals; style c. 1 mm long, stigma globular. Fruit globose, c. 2 mm diam., reticulate-striate. Flowers mostly spring and summer (VicFlora 2019). The taxon is semi-parasitic on roots of grassland species (Leigh *et al.,* 1984 2 cited in DSE 2003), notably kangaroo grass (*Themeda australis*) (Scarlett *et al*., 2003 2 cited in DSE 2003). The dispersal mechanism is suspected to be wind, the distance suspected to be insubstantial in view of the very small flowers (Arn Tolsma, pers. comm.).

Generation Length

The generation length of *Thesium australe* is estimated to be 20 to 30 years. The taxon is commonly observed to germinate well after fire. In alpine regions, this would occur historically once or twice a century. However, observations at Green Hills (Gillingall) indicate that adequate regeneration does occur without fire, at least where the grassland is lightly grazed by cattle (Scarlett 1987 cited in DSE 2003). Similarly, a population of Austral Toad-flax at Glen Allen in southern NSW, which has been grazed only by native herbivores for the past 10 years, appears to be adequately maintained in the absence of fire (G. Earl pers. comm cited in DSE 2003). Archer (1987 cited in DSE 2003) also observed high seed germination after the drought of 1983. This suggests pulse recruitment after a stimulation event. The taxon is a short-lived species. Leigh and Briggs (1989 cited in DSE 2003) suggest that it is a strict biennial, but plants cultivated at La Trobe University lived up to three years from germination. In the field most plants may not live more than two years, which accounts for Leigh and Briggs' observations. It is not known how long the seeds persist in the soil, but it is likely to be several decades given the low rates of recruitment events (fire or drought) in high-altitude regions. Generation length would therefore be longer than the longevity of individual plants, reflecting decadal frequency of recruitment opportunities and is likely to be 20-30 years.

Distribution

The taxon was once widespread across Victoria, but all recent collections are from highland areas in the vicinity of Wulgulmerang and it is believed to have become extinct across most of its Australian range due to loss of habitat and grazing (VicFlora 2019). Despite to extensive searches by botanists from La Trobe University, Austral Toad-flax has been found at only five sites in Victoria since 1979. All sites are confined to areas between 800 m2 and 24 ha. The localities for two relatively recent, unconfirmed collections from Second Emu Plain and Racecourse Paddock on 'Rockbank' property, have not been searched; these records were not known to La Trobe University before 1990. It is possible that the 'Racecourse Paddock' record is the same locality as A.C. Beauglehole's 'Mt Hamilton' record. The Lake King Area (W50) was not specifically searched, but Austral Toad-flax was not found on the Gippsland Plains, during searches for other species in grassland remnants between 1979 and 1984.

Habitat

The taxon grows in grasslands, woodlands and herbfields, usually in damp situations (VicFlora 2019). The taxon has a wide ecological tolerance having been recorded from subtropical, temperate and sub-alpine climates, and on soils derived from sedimentary, igneous and metamorphic rocks as well as recent alluvium. However, it is largely confined to grasslands, grassy woodlands or sub-alpine grassy heathlands. Whilst the taxon is usually associated with *Themeda triandra* (Kangaroo Grass) and (less frequently) with *Poa* spp., it will grow with other hosts, at least in the glasshouse.

Threats

DSE (2003) states that the Victorian range of the taxon has contracted markedly since European settlement. From the early days of colonisation, grasslands and grassy woodlands have been utilised for agriculture. The habitat destruction and fragmentation arising from such utilisation has caused the threatened status of the taxon. The contraction in the documented range of the taxon is due to heavy grazing and cultivation of grasslands and grassy woodlands in the lowlands of Victoria. Changes in fire regime may also be responsible for the absence of the taxon fom the native grassland remnants of the lowland plains (Scarlett and Parsons 1982 cited in DSE 2003). The absence of the taxon from areas with dense shrub and/or tree cover at known sites suggests that the maintenance of open conditions by frequent firing in the long-term may be as important for the survival of the taxon as the apparent stimulation of germination by fire. As the taxon is semi-parasitic on other plants, especially Kangaroo Grass, it is likely that activities that impact on Kangaroo Grass are likely to impact on the taxon. The main identified threats to the taxon are: lack of fire/disturbance (Cohn, 2004 cited in OEH); existing and intensified grazing by livestock, native herbivores and feral herbivores (Scarlett et al., 2003 cited in DSE 2003)); residential, infrastructure and agricultural development (OEH, 2013), weed invasion (e.g. blackberry *(Rubus* spp.)) (Scarlett *et al* cited in DSE 2003;, 2003; OEH, 2013); and infrastructure (road and rail) maintenance, particularly road widening and re-routing (OEH, 2013). Lack of disturbance causes lower, mid and upper stratum canopy thickening (Scarlett *et a*l., 2003; Cohn, 2004], which reduces species diversity in the lower stratum. Nevertheless, the taxon has been observed to germinate in lightly grazed country and after drought (Scarlett et al., 2003 cited in OEH). The literature suggests that it benefits from some light disturbance. However, intensification of grazing, and subsequent compaction and trampling by livestock, represents a disturbance regime very different to grazing by native animals.

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 60 to 90 years is estimated to be 30 to 50%, based on (c) and (e) above.

The taxon was once widespread across Victoria but all recent collections are from highland areas in the vicinity of Wulgulmerang. The taxon is believed to have become extinct across most of its Australian range due to loss of habitat and grazing. DSE (2003) states that the Victorian range of Austral Toad-flax has contracted markedly since European settlement. The Austral Toad-flax was once present in Victoria from Wando Vale in the west northwards to the New South Wales border. Historical collections are mainly from south of the Great Divide, but the taxon was once present on the upper Goulburn, Ovens and Murray Rivers. It is likely that the population has reduced by two thirds since settlement and perhaps by half in the last century.

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

Eligible under Criterion A3 as Vulnerable

The population reduction over the next 60 to 90 years is projected to be 20 to 30%, based on (c) and (e) above.

Most populations are now in conservation areas but climate change, increased, high-intensity fires and drought may impact on populations. Feral horses are active in core areas around Wulgulmerang, and the intense trampling and grazing by these animals will have cancelled out any benefit of removing cattle grazing. The population is projected to continue to reduce, perhaps by another third within a century.

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 4,110 km², based on accepted, post-1970 records from the Victorian Biodiversity Atlas (VBA).

It is estimated to have two locations. Alpine species tend to exist in 'islands' of habitat within a matrix of lower-altitude forest. This forest separates subpopulations reproductively, but links them in terms of fuel, and disturbances such as fire and feral horses can affect large areas. Thus, the populations in the east alps can be lumped into one large location, both subject to the same events, but the isolated location to the west is clearly too far away. The two locations are both subject to potential stochastic events. Grazing impacts in the east alps (feral horses and possibly cattle, will be far more severe than in the population near Myrtleford. The latter is highly unlikely to be burnt by the same events, but may be more susceptible to climate change impacts due to lower elevation.

It has a continuing decline in (i), (ii), (iii), (iv) and (v). It is estimated to have extreme fluctuations in (iv) above (DSE 2003).

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 112 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the VBA. As above, it has 2 locations, has a continuing decline in (i), (ii), (iii), (iv) and (v) and extreme fluctuations in (iv) 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

It is estimated that there are 10,000 to 30,000 mature individuals, which exceeds the thresholds for criterion C.

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

DSE (2003) FFG Action Statement No. 56. Austral Toad Flax *Thesium australe.* Department of Sustainability and Environment, East Melbourne.

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Tolsma A. and Cheal D. (2012) High Country Grazing Research: Results of Surveys for Significant Flora Species and Communities. Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment, Heidelberg.

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