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Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list *Philotheca obovatifolia* (Bayly) P.I.Forst. as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act and, as a consequence, to omit reference to *Philotheca obovatifolia* (Bayly) P.I. Forst. from Part 2 of Schedule 1 (Endangered species) of the Act. Listing of Vulnerable species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that *Philotheca obovatifolia* (Bayly) P.I.Forst. has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method, as provided by Section 4.14 of the Act. After due consideration of DCCEEW (2023), the NSW Threatened Species Scientific Committee has made a decision to list the species as Vulnerable.

Summary of Conservation Assessment

Philotheca obovatifolia (Bayly) P.I.Forst. was found to be Vulnerable in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.5 (c) and Clause 4.7 because: 1) There is a low number of mature individuals (<1000); and 2) the number of locations (two) of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.

The NSW Threatened Species Scientific Committee has found that:

1. *Philotheca obovatifolia* (Bayly) P.I.Forst. (family Rutaceae) is a small compact shrub that grows to a height of about 1 m and has glandular-warty branchlets with distinctive stem clasping leaves. The leaves are densely clustered near the ends of the branchlets and are broadly egg-shaped with the narrower end towards the base, 28–60 mm long by 14–30 mm wide, with a prominent midrib on the lower surface. The flowers are arranged singly or in groups of up to five on a conspicuous peduncle up to 10 mm long, each flower on a pedicel 5–9 mm long. There are five triangular sepals and five elliptic to oblong cream-coloured petals 8–9 mm long, 3.5–4 mm wide and tinged with pink. The ten stamens are hairy. Flowering occurs in late spring and the fruit is about 7 mm long with a beak about 3 mm long (Wilson 2013). Seeds are up to 3.95 mm in length (Australian Plantbank pers. comm. May 2022).

2. *Philotheca obovatifolia* is endemic to eastern Australia, with a distribution that spans the New South Wales (NSW) and Queensland border. There are eight known populations of *Philotheca obovatifolia*, of which seven are in NSW. According to surveys in NSW from 2014 and 2021, there are five known subpopulations in Werrikimbe National Park (NP), one in Bril Bril State Forest and one in Kippara State Forest (ELA 2021a, 2021b). Both state forest sites are separated from each other by approximately 8 km and by cleared agricultural land (ELA pers. comm. March 2022) and are 20 km east of the Werrikimbe NP populations. In Queensland, the species is known to occur on Mount Barney and Mount Ernest in the state's southeast.

3. The geographic distribution of *Philotheca obovatifolia* is highly restricted. The extent of occurrence (EOO) is estimated at 6,966 km^2 and the area of occupancy (AOO) is estimated at 24 km^2. The EOO was calculated using a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022). The AOO is based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2022).

4. The population size of *Philotheca obovatifolia* requires further survey work to refine current estimates, but the number of mature individuals is likely to be more than 250 and fewer than 1000. Based on surveys conducted in 2021, approximately 559 individuals in five out of seven initially identified subpopulations in NSW were re-located, of which approximately 43% of individuals (238) were considered mature (ELA 2021a, 2021b). Given the remote terrain the species occurs in, and the lack of surveys in 2021 at two known populations, further unrecorded mature individuals may exist in NSW. In Queensland, post-fire surveys were conducted in 2020-2021, but only two small individuals (<30 cm; one of which was flowering) were found near the summit of Mount Barney in late 2021. Actual numbers of mature individuals in Queensland are likely to be greater due to unsurveyed habitat. It is expected that juveniles surveyed in 2021 will reach maturity in the near future (primary juvenile period 3-5 years; ELA pers. comm. April 2022; P.I. Forster pers. comm. April 2022).

5. *Philotheca obovatifolia* occurs in montane (800−1300 m above sea level) heathland, shrubland or woodland on rocky substrates derived from granite or rhyolite (Forster 2005). The soil and geology of sites occupied by the species in Werrikimbe NP are shallow sandy loam between small outcrops of ignimbrite (ELA 2014). The associated vegetation includes stunted trees of *Eucalyptus campanulata*, *E. scias* and *Allocasuarina littoralis* and a sparse shrub layer with *Leptospermum novae-angliae*, *Platysace lanceolata*, *Acacia tessellata* and *Callistemon comboynensis*. A dense ground layer includes *Lepidosperma laterale*, *Entolasia stricta*, *Lomandra longifolia* and *Xanthosia pilosa*.

6. *Philotheca obovatifolia* flowers in late spring (Wilson 2013). The age of senescence or decline of individuals is unknown but suggested to be >20 years (Hunter 2003; P.I. Forster pers. comm. April 2022). The time from resprouting after fire to flowering (secondary juvenile period) is also unknown, but the time from seed to maturity (primary juvenile period) is suspected to take 3–4 years (ELA pers. comm. April 2022) or 4–5 years (P.I. Forster pers. comm. April 2022). Members of the Rutaceae are likely to have persistent soil seedbanks (Auld and Ooi 2008) and generally have physiological seed dormancy (Auld 2001), and therefore potentially delayed germination (Baskin and Baskin 2014).

7. There is evidence *Philotheca obovatifolia* is likely to regenerate from both seed and resprouting after fire. Field surveys in 2021 (ELA 2021a, 2021b) suggested *P. obovatifolia* underwent recruitment after the 2019-20 bushfires through vigorous seedling emergence in Werrikimbe NP, with approximately 87% of surveyed plants being juveniles. In contrast, the species seemed to respond to fire through resprouting in the Bril Bril and Kippara State Forests, with approximately 94% of surveyed individuals being adult resprouters. Resprouting as a fire response may depend on fire severity and whether the root stocks are killed (P.I. Forster pers. comm. April 2022). *Philotheca obovatifolia* populations may be sensitive to the

length of fire return intervals (i.e. fire frequency) due to the time required to accumulate a seed bank and develop regenerative organs.

8. *Philotheca obovatifolia* is estimated to occur in two threat-defined locations, based on the most serious plausible threat of adverse fire regimes: one in NSW spanning Werrikimbe NP, Bril Bril and Kippara State Forests, and one in Queensland around Mount Barney NP. Because all populations in NSW were affected by a single fire in 2019-20 (ELA 2021a, 2021b), it is plausible that two or more fires in close succession could affect the species' entire distribution in NSW. The NSW and Queensland populations are geographically separated by approximately 340 km.

9. *Philotheca obovatifolia* is predominately threatened by adverse fire regimes and climate change. A high-frequency fire regime (repeat fire occurring before seedlings have regenerated and replenished the soil seed bank, or resprouting plants have developed sufficient organs to withstand fire, estimated to be repeat fires within 10 years; P.I. Forster pers. comm. April 2022; ELA pers. comm. April 2022) will adversely affect population persistence and seedling establishment of *Philotheca obovatifolia*. As fire frequency and severity are predicted to continue to increase due to climate change (Dowdy *et al*. 2019; Bureau of Meteorology and CSIRO 2020; van Oldenborgh *et al.* 2021), *Philotheca obovatifolia* may decline in the future, as fire-free intervals continue to shorten (Enright *et al*. 2015). However, there is insufficient evidence to project continuing decline in *P. obovatifolia* due to these threats at this time. 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition', and 'Anthropogenic Climate Change' are listed as Key Threatening Processes under the Act.

10. *Philotheca obovatifolia* (Bayly) P.I.Forst. is not eligible to be listed as an Endangered or Critically endangered species.

11. *Philotheca obovatifolia* (Bayly) P.I.Forst. is eligible to be listed as a Vulnerable species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a high risk of extinction in Australia in the medium-term future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Assessment against *Biodiversity Conservation Regulation* 2017 criteria
The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Vulnerable under Clause 4.5 (c) and Clause 4.7.

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Data Deficient.

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population

			size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 – Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)
Assessment Outcome: Data deficient.

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted.
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species.
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 – Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion Clause C)
Assessment Outcome: Data deficient.

The estimated total number of mature individuals of the species is:				
	(a)	for critically endangered species		very low, or
	(b)	for endangered species		low, or
	(c)	for vulnerable species		moderately low.
and either of the following 2 conditions apply:				
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):		
		(i)	for critically endangered species	very large, or
		(ii)	for endangered species	large, or
		(iii)	for vulnerable species	moderate,

	(e)	both of the following apply:				
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and			
		(ii)	at least one of the following applies:			
			(A)	the number of individuals in each population of the species is:		
				(I)	for critically endangered species	extremely low, or
				(II)	for endangered species	very low, or
				(III)	for vulnerable species	low,
			(B)	all or nearly all mature individuals of the species occur within one population,		
			(C)	extreme fluctuations occur in an index of abundance appropriate to the species.		

Clause 4.5 – Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)
Assessment Outcome: Vulnerable under Clause 4.5 (c).

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 – Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data Deficient

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 – Very highly restricted geographic distribution of species– vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Vulnerable under Clause 4.7.

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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