Publication date: 13 December 2024

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 the herb *Brachyscome mittagongensis* P.S.Short (Asteraceae) as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act. Listing of Endangered species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Brachyscome mittagongensis P.S.Short (Asteraceae) was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3 (b)(d)(e i,ii,iii,iv) and Clause 4.4 (b)(e i,ii,A(II)) because: 1) the species has a highly restricted geographic distribution with populations and habitat severely fragmented including a projected or continuing decline in abundance, geographic distribution, habitat quality and the number of populations; and 2) there are low numbers of mature individuals with a continuing decline in the number of mature individuals including very low numbers of individuals in each population.

The NSW Threatened Species Scientific Committee has found that:

1. *Brachyscome mittagongensis* is a small, rhizomatous perennial forb in the Daisy family, Asteraceae. The species was described by Short (2009) as a "Perennial, rhizomatous herb with prostrate to ascending branches to c. 50 cm long, glabrous except for very occasional multicellular, conical glandular hairs c. 0.1–0.15 mm long. Leaves basal and cauline, alternate, lowermost leaves sometimes tapering to a petiole-like base but most leaves manifestly sessile and often subamplexicaul, somewhat narrowly oblong or narrowly elliptic or sometimes ovate-lanceolate to lanceolate or rarely a few oblanceolate, 11–38 mm long, 3.5–11 mm wide, leaf apices usually truncate and 3-dentate, the teeth of about equal length and width, rarely the apex tapering to a single point, leaf margins otherwise entire or sometimes with 1 or 2 additional short, narrow lateral lobes on each margin and these often about ½ way along the length of the lamina, all leaves glabrous or margins with very occasional stalked glandular hairs less than c. 0.1 mm long. Capitula c. 6 mm diam., on scapes manifestly exceeding the upper leaves. Bracts in 1 row, overlapping, ovate to lanceolate or elliptic to narrowly lanceolate, 2.2–2.5 mm long, 0.7–0.8 mm wide, subobtuse, mainly thinly herbaceous but with very narrow hyaline margins, glabrous or almost so except for scattered, mostly glandular hairs on the margins; stereome divided. Receptacle subconical, areolate, glabrous. Ray florets c. 40 in largest capitula; corolla c. 8.5 mm long, 1.2–1.3 mm wide, white, with 4 veins converging at the apex; apex unlobed or with 2 or 3 barely discernible lobes; style c. 1.45 mm long. Disc florets perhaps c. 80 or more in largest capitula; corolla with tube 2.1–2.45 mm long, externally with scattered, long, glandular hairs, 5-lobed, yellow, lobes lacking apical hairs, veins extending into and joining at the apex of the lobes. Stamens 5; filament collar almost straight or dilating towards the base; anthers 1.25–1.36 mm long,

microsporangia 1.04–1.09 mm long, apical appendages 0.2–0.27 mm long, endothecial tissue radial. Style c. 2 mm long; arms c. 0.7 mm long, the triangular appendage slightly exceeding the length of the stigmatic part. Cypselas flat, obovate, 1.3–1.5 mm long, 0.8–0.9 mm broad, lateral surfaces with two, non-swollen ridges on each lateral surface, uniformly brown; lateral surfaces of cypsela body conspicuously tuberculate, the tubercles with short, straight to apically curved to slightly incurled, biseriate eglandular hairs, multicellular glandular hairs uncommon and only noted on immature fruit; ribs smooth, wings absent; carpopodium seemingly present and annular but inconspicuous. Pappus a whitish crown of c. 20 basally united bristles c. 0.2 mm long. Chromosome number: n = 9."

2. *Brachyscome mittagongensis* can be distinguished from other closely related species of *Brachyscome* "in having the largest lower and mid-cauline leaves not tapering towards a petiole-like base but being manifestly sessile and often subamplexicaul while their apices are usually truncate and 3-dentate, with the teeth small and of about equal size." (Short 2009).

3. *Brachyscome mittagongensis* is endemic to New South Wales where it is known from the Sydney Basin and South Eastern Highlands Bioregions. It is currently known primarily from Wingecarribee Shire in the Central Tablelands (Moss Vale and Burragorang Subregions), with two collection records in Upper Lachlan Shire in the Southern Tablelands (Bungonia Subregion).

4. Contemporary records and field observations suggest 20 distinct sites remain across the species range. The western extent of the currently known distribution of the species is Tarlo River National Park; the northern extent is the locality of Soapy Flat, and Aylmerton near Mittagong; the eastern extent is Avoca/Lower Mittagong/Kangaloon; and the southern extent is Bundanoon. There are no collections or observations of the species between its western extent in Wingecarribee Shire (Canyonleigh east) and Tarlo River NP, though flora survey effort in potential habitat in that area is relatively low, with almost all land in that area freehold. It is considered highly likely that the species occurs between those populations, most likely in swampy sites, potentially associated with Paddy's River, the Wollondilly River and their confluence (NSW OEH 2017, S. Douglas *in litt*. Feb. 2019–Mar. 2020).

5. Historically *Brachyscome mittagongensis* has been collected from western and south-western Sydney (Cumberland Subregion: three records from mid-late 1800s) and from a William Baeuerlen collection at 'Shoalhaven', (possibly in the Braidwood (upper Shoalhaven) or Mittagong region, or on the coastal lowlands near Bomaderry (lower Shoalhaven), as Baeuerlen collected in both areas (Wilson 1990; e.g.: MEL 1526777A)). Subpopulations at all of these historical collection sites are presumed extinct based on a combination of their age, the land use type and intensity at the named collection localities, and the lack of subsequent records.

6. *Brachyscome mittagongensis* occurs in and near moist areas but can extend well away from watercourses where soils have good moisture retention, or where groundwater seepage may be a factor. Habitats range from riverflat and

creekflat forest, riparian wetland/floodplain communities, edges of heathy montane swamps, through to grassy woodland and grassy tall forest.

7. *Brachyscome mittagongensis* is associated with a variety of substrates. Records are most strongly associated with Wianamatta Group shales (primarily Bringelly and Ashfield Shales) but include clayey components of the Mittagong Formation. A small percentage of sites are influenced by Tertiary basalt, and one site is associated with a basalt/shale transition and may receive groundwater seepage. The species also occurs on Quaternary alluvium in riverflat/creekflat forest and in the vicinity of upland swamps. Most such sites occur on or downstream of Wianamatta Group shale-dominated landscapes, however those from Tarlo River National Park are in catchments dominated by Ordovician sedimentary rock of the Abercrombie Formation, and Permian sedimentary rock in the form of Tallong Conglomerate. It is also considered likely to occur on or downslope of Jurassic microsyenite and allied intrusive substrates associated with the Mount Gibraltar complex of the Southern Highlands.

8. Contemporary records and field observations indicate that the species is associated with vegetation characterised in the canopy by *Eucalyptus macarthurii* (Endangered), *E. ovata, E. radiata, E. cypellocarpa, E. globoidea*, and less often with *E. viminalis, E. smithii, E. pauciflora* and *E. stellulata*. Habitat modelling suggests it may also be associated with *E. aggregata* (Vulnerable; Endangered Population in Wingecarribee Shire), *E. amplifolia* and *E. tereticornis*. Short (2009) noted associated species on herbarium records as *Solenogyne bellioides*, *Plantago varia*, *Dichondra repens*, the weed *Hypochaeris radicata* and various grasses. There are multiple records of the species from Threatened Ecological Communities (TECs) that have been extensively cleared and fragmented. These TECs include Southern Highlands Shale Woodland; Werriwa Tablelands Cool Temperate Grassy Woodlands; Montane Peatland & Swamps; and Tablelands Basalt Forest.

9. The species' distribution is considered to be severely fragmented. More than 50% of the remnant area occupied by the species is unlikely to be viable due to land-use changes associated with intensifying rural residential land use. Subpopulations are separated by distances over which dispersal and successful recolonisation is highly unlikely. Pollination and fruit dispersal, and the relative isolation and connectedness of populations have not been formally described.

10. Extent Of Occurrence (EOO) is estimated to be 1,003 km^2 based on a minimum convex polygon enclosing all known occurrences of the species with sufficient spatial accuracy for this purpose. This represents a 43–80% reduction in EOO since the species was first collected, depending on the locality of Bauerlen's Shoalhaven collection. Area Of Occupancy (AOO) is estimated to be 180 km^2 based on the species occupying 24 (2 x 2 km) grid cells. This represents a 2–6% reduction in AOO since the species was first collected. Estimates use the spatial scale of assessment recommended by IUCN (2022).

11. No formal population census has been undertaken for the species. Extrapolation from database records and field observations provide an estimate of 1,000–2,500 mature individuals across the species' range.

12. Based on the species being a rhizomatous perennial, generation time is estimated to be between 10 and 20 years (L. Murray pers. comm. March 2019).

13. *Brachyscome mittagongensis* flowers "from about February to May" (Short, 2009). Pollinators and breeding system are not known. Pappus bristles being c. 0.2 mm long are unlikely to assist in wind dispersal, which is likely to occur passively over shorter distances than Asteraceae species with plumed pappus. Tubercles and eglandular hairs on the achene may contribute to zoochory. Uncertainty over fruit dispersal mechanism make accurately defining populations problematic.

14. The main threats to *Brachyscome mittagongensis* are loss of habitat and changed hydrology, reduction of habitat quality, fragmentation of habitat and populations, and loss of mature individuals as a result of land clearing and development, adverse land management practices, changing fire regimes, competition with invasive weeds, damage to habitat through recreational use. Of these 'Clearing of Native Vegetation', 'Invasion and establishment of exotic vines and scramblers', 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' and 'Invasion of native plant communities by exotic perennial grasses' are Key Threatening Processes under the *Biodiversity Conservation Act 2016*.

15. Land clearing and development pose a significant threat to *Brachyscome mittagongensis* across its range. Much of the historical habitat for the species has been cleared for agriculture or urban development and infrastructure. Most extant records of the species are from the Southern Highlands where urbanisation continues to expand in extent and intensity, including in potential or former habitat for this species. Rural-residential land use has also spread and intensified, and manifests as subdivisions of primarily rural land into relatively smaller lots often referred to as 'hobby farms' or 'lifestyle properties'. In some cases, this change from semi-commercial rural to lifestyle-based rural-residential use may benefit the species where livestock grazing intensity is reduced. However, harmful effects occur where there is a conversion from grazing of native or mostly native pastures to intensive horticulture or to more intensive grazing on non-native and fertilised pasture. 'Clearing of Native Vegetation' is a Key Threatening Process under the *Biodiversity Conservation Act 2016*.

16. 'Pasture improvement' (i.e. the replacement of native grasses and forbs with non-native grasses and legumes, often supported by fertilisers) is a significant threat to *Brachyscome mittagongensis* and is likely a major driver of its apparent widespread loss from affected former habitat. Non-native landscaping is also common in rural-residential land use, including expansive and intensively managed lawns and gardens. Such activities are likely to be detrimental to this species. 'Invasion of native plant communities by exotic

perennial grasses' is a Key Threatening Process under the *Biodiversity Conservation Act 2016*.

17. Roadworks such as grading, widening, drainage, deposition of spoil, and inadvertent spreading of weeds through these actions, are associated with habitat loss and degradation for *Brachyscome mittagongensis*. Urbanisation and rural-residential land use lead to an increase in the number of roads, greater use of formalised drainage structures, including concrete kerb and guttering. These roadworks impact *B. mittagongensis*, which has been seen to survive on roadsides in drains where road management is less intense. *Brachyscome mittagongensis* is inferred to be threatened by the intensification of road drainage management. 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is a Key Threatening Process under the *Biodiversity Conservation Act 2016*.
18. Low frequency (and possibly low severity or out-of-season) fires threaten *Brachyscome mittagongensis*, with the species habitat degraded by increased shrub cover occurring in long unburnt areas. Agricultural and urban land use is likely to reduce the frequency and severity of fire across the range of *B. mittagongensis*. *Brachyscome mittagongensis* can both resprout from underground stems and swollen roots and flower within months of fire (R. Moule pers. comm. December 2023) and can be well established and flowering two years post-fire (T.L. Collins pers. comm. January 2022). The time required for juvenile *B. mittagongensis* plants to develop the ability to resprout after fire has been observed to be less than six months (R. Moule pers. comm. December 2023).

19. Weeds are a significant threat to *Brachyscome mittagongensis* across its range, competing for habitat and resources, and restricting germination. Weeds are a significant concern at most sites, although the specific weed species and severity of threat differ between sites. Non-native grass species including *Paspalum dilatatum* (paspalum), *Holcus lanatus* (Yorkshire fog), *Anthoxanthum odoratum* (sweet vernal grass), *Phalaris aquatica* (phalaris) and *Dactylis glomerata* (cocksfoot) are of particular concern and are found at all sites. Other weed threats include the vines/scramblers *Lonicera japonica* (Japanese honeysuckle), *Rubus anglocandicans* (blackberry), *Vinca major* (greater periwinkle); the shrubs *Berberis vulgaris* (common barberry), *Ligustrum sinense* (small-leaved privet), and the trees *Pinus radiata* (radiata pine), *Crataegus monogyna* (hawthorn), and *Pittosporum undulatum* (a highly invasive native mesophyll species that readily colonises comparatively fertile sites where cattle and fire are absent or rare/low intensity). '*Invasion and establishment of exotic vines and scramblers*', and 'Invasion of native plant communities by exotic perennial grasses' are Key Threatening Processes under the *Biodiversity Conservation Act 2016*. The strong overall association between the occurrence of *B. mittagongensis* and weeds is driven by the preference of *B. mittagongensis* for moist and relatively fertile soils, which are substantially modified by agriculture, roads and settlements across its range.

20. Disease-causing rust fungi were recently observed infecting *Brachyscome mittagongensis* leaves and stems. The rust fungi are characterised by chlorotic

spotting, further developing into yellow pustules causing severe lesions and necrosis of stems and the developing infructescence.

21. *Brachyscome mittagongensis* P.S.Short (Asteraceae) is not eligible to be listed as a critically endangered species.

22. *Brachyscome mittagongensis* P.S.Short (Asteraceae) is eligible to be listed as an Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in Australia in the near 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: Endangered under Clauses 4.3(b)(d)(e i,ii,iii,iv) and Clause 4.4(b)(e i,ii, A(II)).

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: Endangered under Clause 4.3(b)(d)(e i,ii,iii,iv).

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: Endangered under Clause 4.4(b)(e i,ii, A(II)).

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: Not met.

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.

Professor Caroline Gross
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Douglas, S. (2022) Conservation Assessment of *Brachyscome mittagongensis P.S. Short (Asteraceae*). NSW Threatened Species Scientific Committee.

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Expert Communications

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