

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 shrub *Persoonia glaucescens* Sieber ex Spreng as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act and, as a consequence, to omit reference to *Persoonia glaucescens* Sieber ex Spreng from Part 2 of Schedule 1 (Endangered species) of the Act. Listing of Vulnerable species is provided for by Part 4 of the Act.

Summary of Conservation Assessment

Persoonia glaucescens Sieber ex Spreng was found to be Vulnerable in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clauses 4.3(c)(d)(e)(ii)(iii) + 4.4(c)(e)(i)(ii)(A)(III)

The main reasons for this species being eligible are:

- i) it has a highly restricted geographical range (EOO 1,005 km²),
- ii) it exists at 7 threat-defined locations,
- iii) it has a small population size (c. 2,200 individuals), and
- iv) there is an inferred continuing decline from vegetation clearing and degradation on private and roadside land and browsing of seedlings by deer, and a projected continuing decline from high fire frequency, high fire severity and habitat loss resulting from climate change.

The NSW Threatened Species Scientific Committee has found that:

1. *Persoonia glaucescens* Sieber ex Spreng. (Proteaceae), also known as Mittagong Geebung, is a medium to tall woody shrub (PlantNET 2022). It is described by PlantNET (2022) as an “erect shrub, young branchlets moderately hairy. Leaves oblanceolate or narrow-spathulate, 3-8 cm long, 4-18 mm wide, flat, sparsely hairy and strongly pruinose when young, glabrescent when mature, smooth. Inflorescences growing on into a leafy shoot, flowers mostly subtended by leaves, pedicels 1-3 mm long, erect, moderately hairy. Tepals 11-12 mm long, acuminate to caudate, sparsely to moderately hairy. Ovary glabrous. It is found in woodland to dry sclerophyll forest on sandstone; from Picton to Berrima”.
2. *Persoonia glaucescens* is endemic to the Bargo and Southern Highlands regions of NSW with the northern limit at Couridjah (Schlunke 2022) and the southern limit near Berrima. The distribution of *P. glaucescens* has both a linear extent and width of approximately 40 km.
3. *Persoonia glaucescens* has a highly restricted geographic distribution, with an Extent of Occurrence (EOO) of 1,005 km² and an Area of Occupancy (AOO) of 284 km². The AOO is based on 2 x 2 km grid cells, the scale recommended for assessing area of occupancy by IUCN (2022). The EOO is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022).

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4. The total population size for *Persoonia glaucescens* is estimated to be approximately 2,200. The estimated population size is more than double the estimate of “as low as 805” made in the 2002 Final Determination (NSW Scientific Committee 2002). This larger estimated population size reflects new information from surveys and not an increasing trend over time. *Persoonia glaucescens* has been fragmented by past and ongoing vegetation clearing and many of the recorded *P. glaucescens* sites are small with only a few individuals. The largest clusters of *P. glaucescens* have been recorded in bushland west of Bargo and at Jellore, Braemar and Upper Nepean. In 2002 the population was considered “highly fragmented” (NSW Scientific Committee 2002), however new information indicates the species has a more continuous distribution.
5. Over one-third of the population of *Persoonia glaucescens* is known from conservation reserves (Nattai NP, Bargo SCA, Bargo River SCA, Upper Nepean SCA and Crown Land reserves in Berrima, Mittagong, Hill Top and Bargo) or the Sydney drinking water catchment Special Area land. One-third of the population occurs on unreserved Crown Land and one-third occurs on private, roadside, railway and other unreserved land.
6. The Mittagong Geebung occurs on the traditional lands of the Dharug, Gundungarra and Tharawal people. Geebung is an Aboriginal name for *Persoonia*. Geebung holds cultural significance to Indigenous Australians for food and medicine. The chewy fruits of some species were a favoured food of Indigenous communities (Nash 2004; Packer *et al.* 2012). Indigenous Australians likely dispersed these plants long distances. Other NSW species of *Persoonia* have been used by Indigenous Australians as a treatment of skin infections and other skin disorders including psoriasis (Pengelly 2018).
7. *Persoonia glaucescens* grows on ridge-tops, plateaux and upper slopes in open woodland (NSW NPWS 2000a; Rymer and Ayre 2006). *Persoonia glaucescens* is commonly associated with the canopy species *Corymbia gummifera*, *Eucalyptus sieberi*, *E. oblonga*, *E. piperita*, *E. radiata*, *E. racemosa* as well as *E. pauciflora* at higher altitudes west of Mittagong. Associated understorey species include *Acacia terminalis*, *A. brownii*, *A. ulicifolia*, *Banksia spinulosa*, *B. serrata*, *Bossiaea obcordata*, *Eriostemon australis*, *Hakea sericea*, *H. dactyloides*, *Isopogon anemonifolius*, *Lambertia formosa*, *Leptospermum trinervium*, *Petrophile pedunculata*, *P. sessilis* and *Pimelea linifolia* (Douglas, pers. obs. in NSW NPWS 2000a; J. Schlunke in litt. August 2022; Wasley 1997). *Persoonia glaucescens* has been found to occur on clayey and gravelly laterite soils associated with the Mittagong Formation (passage beds between Wianamatta Shale and Hawkesbury Sandstone) and represented by the Lucas Heights soil landscape (NSW NPWS 2000a). *Persoonia glaucescens* seems to prefer the interface between Lucas Heights and the Hawkesbury and Gynea soil landscapes (NSW NPWS 2000a). Some occurrences of *P. glaucescens* appear to be clustered around past disturbances such as track and road margins and powerline easements (NSW NPWS 2000b; Schlunke 2018; Wasley 1997).

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8. *Persoonia glaucescens* is a long-lived shrub that is estimated to live for at least 20 years (NSW NPWS 2000b). It is likely to mature at the same age, between 6-12 years, as the taxonomically similar *P. lanceolata* (Auld *et al.* 2007). As such, the minimum generation length for *P. glaucescens* is 13-16 years.
9. *Persoonia glaucescens* flowers in late summer and autumn with tubular, yellow flowers that are distinctive to the genus. *Persoonia* flowers are primarily adapted to bee pollination (Armstrong 1979; Michener 1965) but are also pollinated by many other insect species (Bernhardt and Weston 1996). Native specialist bees in the genus *Cladocerapis* are considered the main pollinator of *Persoonia* spp., and forage exclusively for and pollinate flowers of *Persoonia* spp. (Michener 1965). Honeybees have been thought to disrupt the pollination of this species (Bernhardt and Weston 1996; Rymer *et al.* 2005), however recent conservation genetic studies of *P. hirsuta* suggests otherwise (Haynes and Gregory 2021). *Persoonia glaucescens* is an obligate outcrossing species and therefore movement by pollinators between individuals is essential for successful pollination (Rymer *et al.* 2005). *Persoonia glaucescens* has low levels of pollination success, with one study finding less than one fifth of flowers maturing into fruit (Rymer *et al.* 2005).
10. *Persoonia glaucescens* produces a firm, elliptical, fleshy fruit (drupe) which is bright green and partially red in colour when they drop at maturation in late spring (Rymer 2006). *Persoonia* seeds are held mechanically dormant by the woody endocarp and some species are also physiologically dormant. Dormancy in *Persoonia* spp. seeds is difficult to break artificially and is not well understood (Myerscough *et al.* 2001). *Persoonia* seeds which drop to the ground may end up in close vicinity to the adult plant, but some can be moved over 10 km by animals (macropods, rats, possums, wombats, deer and large birds such as currawongs and native parrots) (Auld *et al.* 2007; Buchanan 1989; Paplinkska *et al.* 2019; Rymer *et al.* 2005; Rymer 2006). Historically, Indigenous Australians would have played a role in seed dispersal through its use as a food (Packer *et al.* 2012).
11. *Persoonia glaucescens* is a fire sensitive obligate seeder, with adults killed by fire and regeneration solely from seed (Schlunke 2018, 2019, 2021, 2022). Recruitment appears to be influenced by multiple interacting factors, including fire, burn temperature, rainfall, disturbance and season (Haynes and Gregory 2021; Schlunke 2021). Fire plays an important, but not essential, role in stimulating the germination of *P. glaucescens* seeds. Post-fire germination levels are variable, sometimes low and not related to the number of mature individuals before a fire (Schlunke 2021; Wasley 1997). A widespread recruitment event occurred in 2021 that was likely triggered by an extended period of above average rainfall and more seedlings were found at long unburnt sites than those recently burnt (Schlunke 2021). Mechanical disturbance of the seedbank and/or the reduced competition and increased light associated with such disturbance appears to promote seedling germination, as is found with many *Persoonia* species, (NSW NPWS 2000a; Schlunke 2018; Wasley 1997).

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12. *Persoonia glaucescens* is threatened by ongoing vegetation clearing and degradation. The background loss of habitat is thought to be significant for this species due to development for housing and other infrastructure as many of the past records were likely the result of impact assessment surveys prior to urban development (Schlunke 2022). Most of the *P. glaucescens* records on private land are of very small numbers of plants (except at the Tahmoor mine where over 150 seedlings were recorded in 2020 and 2022) and represent much of the north-eastern and southern extent of this species. The pressures on the habitat of *P. glaucescens* from urban, rural and semi-rural development are increasing with a rapidly growing regional population. The number of people living in the Bargo and Southern Highlands regions has increased over 20% in the ten years 2011-21 with population growth accelerating in more recent years and is projected to increase a further 20% in the next 20 years (Australian Bureau Statistics 2022; Wingecarribee Shire Council 2020, 2022).
13. High frequency fire in a fire-sensitive obligate seeder like *Persoonia glaucescens* can disrupt the replenishment of seed banks, which are essential to post-fire recruitment and population persistence (Auld *et al.* 2007; Enright *et al.* 2015; Gallagher *et al.* 2021). A narrowing of the favourable interval between fires may cause population decline or local extinction by depleting or exhausting seedbanks (Enright *et al.* 2015). The minimum fire interval to maintain *P. glaucescens* is estimated to be 13-15 years (McKenna 2007). A second fire in the decade before the current cohort of *P. glaucescens* seedlings mature and set seed may threaten local occurrences of the species. While fire ecology studies of other Sydney Basin *Persoonia* spp. have found large and persistent soil seedbanks capable of withstanding multiple fires (Auld *et al.* 2007; Ayre *et al.* 2009; Emery & Offord 2018), this may not be the case for all *P. glaucescens* sites. The Bargo SCA and Upper Nepean sites have histories of high frequency fire followed by a long period without fire and have lower levels of seedling germination compared to sites very long unburnt. *Persoonia glaucescens* sites with a seedbank depleted by multiple fires may need a greater interval between fires than the recommended 13-15 years for the seedbank to recover. 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the Act.
14. High fire severity is likely to increase seed and seedling mortality in *Persoonia glaucescens*, reducing recruitment success. *P. glaucescens* seed is mainly stored in the litter layer, where it may be at risk of high mortality during fire (Wasley 1997). High fire severity has been observed to kill all seeds near the soil surface in the mid-north coast species *P. katerae* (G. Phillips pers. comm. July 2022), where viable seeds were only found on the cooler fire edge and nearby non-burnt area. Seed which becomes more deeply buried in the soil is more likely to survive high temperatures associated with fire (Wasley 1997). In *P. hirsuta*, seedling dieback and mortality were significantly higher in monitoring plots exposed to high fire severity (Andres *et al.* 2022).

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15. Projected long-term changes to fire conditions under ongoing climate change, of larger, more frequent, more severe fires (Abatzoglou *et al.* 2019; Bowman *et al.* 2020; Jones *et al.* 2022) have the potential to deplete *Persoonia glaucescens* seedbanks through multiple episodes of high frequency fire and seed mortality during episodes of high severity fire. Changes to severe fire weather are not predicted to occur across the distribution of *P. glaucescens* until the second half of this century, when significant increases to fire magnitude and length of fire season are predicted (AdaptNSW 2022; Clarke and Evans 2019; Clarke *et al.* 2011). High fire frequency is not typical of most *P. glaucescens* sites; therefore, it is likely that it will be many decades before possible climate induced changes to fire extent and severity reduces subpopulation size. Occurrences around the urban fringe or isolated in farmland are unlikely to experience high frequency fire.
16. *Persoonia glaucescens* is thought to be a species highly sensitive to climate change as it has a high degree of habitat specialisation, a limited range size and limited capacity to move (Andres *et al.* 2021). For the current distribution of *P. glaucescens*, ongoing climate change is predicted to increase average mean temperatures and decrease average dry month precipitation, reducing the extent of suitable habitat of *P. glaucescens*. Under warmer, drier conditions, *P. glaucescens* is inferred to experience increased mortality, decreased recruitment and may be a less competitive understory species. An intolerance of drier conditions is supported by a drought related mature plant mortality of 30% recorded in unburnt monitoring plots at Mt Alexandra near Mittagong. 'Anthropogenic climate change' is listed as a Key Threatening Process under the Act.
17. Seedling browsing by deer is an inferred, ongoing threat to *Persoonia glaucescens* in the Upper Nepean subpopulation, where seedling recruitment is very poor. Fallow Deer are resident in the south Upper Nepean SCA and nearby parts of the Metropolitan Special Area land (Wong 2021).
18. *Phytophthora cinnamomi* is an inferred, ongoing threat to *Persoonia glaucescens*, because it affects other *Persoonia* species (Department of the Environment and Energy 2018). 'Infection of native plants by *Phytophthora cinnamomi*' is listed as a Key Threatening Process under the Act.
19. The tendency of *Persoonia glaucescens* to occur on disturbance margins makes it particularly susceptible to peripheral weed invasion and competition. Weeds have the potential to compete with *P. glaucescens* plants of any age for space and light. Weed competition is an inferred, ongoing threat in urban interface and farmland areas.
20. *Persoonia glaucescens* Sieber ex Spreng is not eligible to be listed as an Endangered or Critically endangered species

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21. *Persoonia glaucescens* Sieber ex Spreng 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:

Persoonia glaucescens was found to be Vulnerable under Clauses 4.3(c)(d)(e)(ii)(iii) + 4.4(c)(e)(i)(ii)(A)(III)

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: Vulnerable under Clause 4.3(c)(d)(e)(ii)(iii)

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,	

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	(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 C)

Assessment Outcome: Vulnerable under Clause 4.4(c)(e)(i)(ii)(A)(III)

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.	

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**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: Not met**

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.
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Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Wong V (2022) Conservation Assessment of *Persoonia glaucescens* Sieber ex Spreng (Proteaceae). NSW Threatened Species Scientific Committee.

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