

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 *Pherosphaera fitzgeraldii* (F.Muell.) F.Muell. ex Hook.f. as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act and, as a consequence, to omit reference to *Pherosphaera fitzgeraldii* (F.Muell.) F.Muell. ex Hook.f. from Part 2 of Schedule 1 (Endangered species) of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that *Pherosphaera fitzgeraldii* (F.Muell.) F.Muell. ex Hook.f. 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 (2025), the NSW Threatened Species Scientific Committee has made a decision to list the species as Critically Endangered.

Summary of Conservation Assessment

Pherosphaera fitzgeraldii (F.Muell.) F.Muell. ex Hook.f. was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.3(a)(d)(e i,iii). The main reasons for this species being eligible are: 1) it has a very highly restricted geographic distribution with an extent of occurrence of 28 km²; 2) it occurs in one threat-defined location; and 3) continuing decline is estimated and inferred in the area, extent and quality of habitat and number of mature individuals due to climate change driven increases in drought frequency and severity, and range shifts in the species' climatic niche.

The NSW Threatened Species Scientific Committee has found that:

1. *Pherosphaera fitzgeraldii* (F.Muell.) F.Muell. ex Hook.f. (family Podocarpaceae) is described as an “ascending or erect shrub with drooping branchlets to 1 m high or sometimes with straggling branches and to 2 m diam. Leaves 2.5–3.5 mm long, narrow, slightly incurved, whitish on the upper surface; green and shining below, shortly decurrent. Male cones ovate to globose, c. 6 mm long. Female cones c. 3 mm long with 4–8 scales” (PlantNet 2025).
2. *Pherosphaera fitzgeraldii* is endemic to the upper Blue Mountains, New South Wales (NSW), where it is restricted to the spray zones and seeps around waterfalls on the southern side of the central plateau (Brown 2020; Brown *et al.* 2021, Brown *et al.* 2023). The distribution of *P. fitzgeraldii* occurs on the traditional lands of the Dharug and Gundungurra people (AIATSIS 1996; BMACRC 2025). The westernmost extent of the species' range is the eastern edge of the Elphinstone/Radiata Plateau, the southernmost extent is at Narrow Neck, and the easternmost extent is Wentworth Falls. Most of the known subpopulations occur in Blue Mountains National Park and Ngula Bulgarabang Regional Park.
3. The extent of occurrence (EOO) is estimated at 28 km², on the basis that EOO must be equal to or greater than the area of occupancy (AOO), as per IUCN

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Guidelines (2024). The AOO is estimated to be 28 km² and was calculated using 2 x 2 km grid cells, the scale recommended by IUCN (2024).

4. *Pherosphaera fitzgeraldii* is known from 10 sites, although the estimate of subpopulations depends on genetic exchange. Population genetics has shown that *Pherosphaera fitzgeraldii* has two distinct genetic groups, with one group comprising the Wentworth Falls and Undercliff subpopulations, and the second group comprising all other subpopulations (McMaster *et al.* 2023). Gene flow is generally restricted, and there are signs of inbreeding and genetic depletion due to historical limited gene exchange and a small population size (McMaster *et al.* 2023). Therefore, there is an estimated two to ten subpopulations.
5. The maximum estimate of number of plants across all known subpopulations was 768 in 2022 (Brown *et al.* 2023). Surveys following the 2019–2020 bushfires found declines at the fire-affected subpopulation of Narrow Neck. Furthermore, declines have been recorded across four other subpopulations that were not affected by the 2019–2020 bushfires, with the largest of these declines recorded at Wentworth Falls.
6. *Pherosphaera fitzgeraldii* occurs at elevations of 680–1050 m above sea level (DCCEEW 2025) on wet rock ledges where organic matter accumulates within the spray zone of waterfalls, typically on the eastern side of the falls where they receive spray carried by the prevailing westerly winds in the area (Smith 1981). The plants do not occur in areas with the heaviest water flows from the falls, instead occurring on the periphery where spray is lighter (Smith 1981). The species is also known to grow on ledges behind waterfalls, which receive spray caused by deflection of falling water (Smith 1981). Occasionally, the species can be found in caves beside waterfalls where they depend on seepage through the rock rather than spray from the falls (Smith 1981). Soil at the sites is mostly absent or thin and patchy and most plants are rooted on solid rock or amongst rock rubble and moss (DCCEEW 2025).
7. *Pherosphaera fitzgeraldii* can be killed by fire (Brown 2020), and it is unclear whether the species has any adaptations to support recovery post-fire, beyond re-colonising from outside the burnt area (Brown 2020). Surveys in 2022 found resprouting of seven fire-affected plants along their stems (Brown *et al.* 2023). The species appears to persist *in situ* through most disturbances, such as rockfalls and landslides; however, observations following such events indicate that plants typically do not persist at ground level if they are dislodged from their cliff habitat by such events (Brown *et al.* 2021).
8. *Pherosphaera fitzgeraldii* is threatened by climate change effects (including increased frequency of extreme temperatures, droughts and fire weather, and changes in precipitation), adverse fire regimes (particularly high frequency fire and high severity fire), the interaction of drought and fire, rockfalls and landslides, and weed invasion. Dieback associated with *Phytophthora cinnamomi* and other pathogens, runoff and water pollution, and track, road and other works and recreational activity are potential threats. 'Anthropogenic Climate Change', 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition', 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants', 'Invasion and establishment of exotic vines and scramblers', and

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'*Infection of native plants by Phytophthora cinnamomi*' and are listed as Key Threatening Processes under the Act.

9. *Pherosphaera fitzgeraldii* occurs at one threat-defined location as per the IUCN (2024) definition, due to increases in drought frequency and severity or temperature increases driven by regional climate change.
10. Continuing decline is inferred in the area, extent and quality of habitat based on climate change driven increases in drought frequency and severity, and range shifts in the species' climatic niche. Continuing decline is also estimated in the number of mature individuals based on repeated surveys which found evidence at several sites of reduced numbers of established plants without compensatory levels of recruitment from seedlings or resprouting individuals. Declines have been recorded at almost every monitored subpopulation with the causes not always being apparent or well understood.
11. The number of plants in a monitored subset of the total population declined from 159 in 2004 to 121 in 2021, a decline of 24% over 17 years. For the sister species, *Pherosphaera hookeriana*, ages of 250 to over 300 years have been estimated for plants with stem diameters of 3 to 6 cm on Mawson Plateau (Minchin 1983), with maximum ages in excess of 500 years likely (Threatened species section (2016). Therefore, the generation length of *Pherosphaera fitzgeraldii* is inferred to be at least multiple decades' duration. It is therefore inferred that there has been a population decline of at least 20% over a two-generation timeframe through adverse effects of fire on individuals and a potential reduction of habitat quality and extent through the reduced spray mist conditions at occupied sites.
12. Climate change projections indicate a future trend of increased frequency of severe fire weather and more frequent fires (Abatzoglou *et al.* 2019; Dowdy *et al.* 2019; Jones *et al.* 2022). The Metropolitan Sydney region is projected to become hotter, have more hot days over 35°C, have more dangerous fire weather days, and have a longer fire season by 2079 (BOM and CSIRO 2024; AdaptNSW 2025). Regionally, it is projected with high confidence that climate change will result in a harsher fire-weather climate in the future (CSIRO 2024). It is plausible that these changes will lead to more frequent and prolonged droughts, and more frequent and severe fires, which will in turn adversely affect the *Pherosphaera fitzgeraldii* population in the future.
13. *Pherosphaera fitzgeraldii* (F.Muell.) F.Muell. ex Hook.f. is eligible to be listed as a Critically Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate 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: *Pherosphaera fitzgeraldii* was found to be Critically Endangered under Clause 4.3(a)(d)(e i,iii).

Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

Assessment Outcome: Data Deficient

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(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: Critically Endangered under Clause 4.3(a)(d)(e i,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,
		(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: Endangered under Clause 4.4(b)(d ii)

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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.

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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.
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NSW Threatened Species Scientific Committee

Supporting Documentation:

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2025) Conservation Advice for *Pherosphaera fitzgeraldii* (dwarf mountain pine). DCCEEW: Canberra.

References:

Abatzoglou JT, Williams AP, Barbero R (2019) Global emergence of anthropogenic climate change in fire weather indices. *Geophysical Research Letters* **46**, 326–336.

AdaptNSW (2025) Interactive climate change projections map [Online]. Available at: <https://www.climatechange.environment.nsw.gov.au/projections-map> (accessed 14 August 2025)

AIATSIS (Australian Institute of Aboriginal and Torres Strait Islander Studies) (1996) Map of Indigenous Australia [Online]. Available at: <https://aiatsis.gov.au/explore/map-indigenous-australia> (accessed 14 August 2025)

BMACRC (Blue Mountains Aboriginal Culture and Resource Centre) (2025). Blue Mountains Aboriginal Culture and Resource Centre [Online]. Available at: <https://www.bmacrc.org.au/> (accessed 14 August 2025)

BOM and CSIRO (Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation) (2024) State of the Climate 2024. Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation, Commonwealth of Australia (Online). Available at: <http://www.bom.gov.au/state-of-the-climate/2024/documents/2024-state-of-the-climate.pdf> (accessed 14 August 2025)

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- Brown I (2020) Narrow Neck site of *Pherosphaera fitzgeraldii* - impact on population from bushfire. A report to the NSW Department of Planning Industry and Environment.
- Brown I, Delaney R, Delaney S (2021) Partial re-survey of the *Pherosphaera fitzgeraldii* in the upper Blue Mountains. A report to the NSW Department of Planning Industry and Environment.
- Brown I, Delaney R, Delaney S, Bate M (2023) Dwarf mountain pine (*Pherosphaera fitzgeraldii*) – collection of plant material, soil samples & monitoring of populations in the Blue Mountains. A report to the NSW Department of Planning Industry and Environment.
- CSIRO (Commonwealth Scientific and Industrial Research Organisation) (2024) Climate Change in Australia: East Coast South projection summaries (Online). Available at: <https://www.climatechangeinaustralia.gov.au/en/projections-tools/regional-climate-change-explorer/sub-clusters/?current=ECSC&tooltip=true&popup=true> (accessed 14 August 2025)
- Dowdy AJ, Ye H, Pepler A, Thatcher M, Osbrough SL, Evans JP, Di Virgilio G, McCarthy N (2019) Future changes in extreme weather and pyroconvection risk factors for Australian wildfires. *Scientific Reports* **9**(1), 10073.
- IUCN Standards and Petitions Subcommittee (2024) Guidelines for Using the IUCN Red List Categories and Criteria. Version 16 [Online]. Available at: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> (accessed 14 August 2025)
- Jones MW, Abatzoglou JT, Veraverbeke S, Andela N, Lasslop G, Forkel M, Smith AJ, Burton C, Betts RA, van der Werf GR, Sitch S (2022) Global and regional trends and drivers of fire under climate change. *Reviews of Geophysics* **60**(3), e2020RG000726.
- McMaster ES, Yap J-YS, Chen SH, Rossetto M (2023) Conservation genomics of *Pherosphaera fitzgeraldii* in support of management. Research Centre for Ecosystem Resilience, Royal Botanic Garden Sydney.
- Minchin, P.R. (1983). A Comparative Evaluation of Techniques for Ecological Ordination using Simulated Vegetation Data and An Integrated Ordination – Classification Analysis of the Alpine and Subalpine Plant Communities of the Mt. Field Plateau, Tasmania. Ph.D. Thesis, University of Tasmania, Hobart.
- PlantNet (2025) *Pherosphaera fitzgeraldii* (F.Muell.) F.Muell. ex Hook.f. [Online]. Available at: <https://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Pherosphaera~fitzgeraldii> (accessed 14 August 2025)
- Smith J (1981) The distribution and conservation status of a rare conifer, *Microstrobos fitzgeraldii* (Podocarpaceae). *Cunninghamia* **1**(1), 125–128.
- Threatened Species Section (2016) Listing Statement for *Pherosphaera hookeriana* (mount mawson pine), Department of Primary Industries, Parks, Water and Environment, Tasmania.