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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 the shrub, *Olearia rugosa* subsp. *distalilobata* Hawke ex Messina 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.

The NSW Threatened Species Scientific Committee is satisfied that *Olearia rugosa* subsp. *distalilobata* Hawke ex Messina 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 Endangered.

Summary of Conservation Assessment

Olearia rugosa subsp. *distalilobata* Hawke ex Messina 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) because it has a highly restricted geographic distribution (the estimates for extent of occurrence and area of occupancy are 1,717 km^2 and 32 km^2, respectively), and the total population occurs within only three threat-defined locations. In addition, a continuing decline in the number of mature individuals; the geographic distribution; the area, extent and quality of habitat; and the number of subpopulations of this subspecies is inferred based on the threats posed by timber harvesting and the increasing frequency and severity of fires, including interactions with drought (driven by anthropogenic climate change).

The NSW Threatened Species Scientific Committee has found that:

1. *Olearia rugosa* subsp. *distalilobata* Hawke ex Messina (family Asteraceae) (CANBR 2024) is a spindly shrub, growing up to 2.5 m (Messina et al. 2013, 2014). It has leaves that are bright green on top and grey-brown underneath with many small white flowers in late spring (October–November). This subspecies is distinguished from other subspecies of *O. rugosa* primarily based on geographic distribution and the following characteristics: “Leaves subentire or lobed only in the distal half; elliptic, oblong or obovate, sometimes broadly so; base attenuate” (Messina *et al.* 2013, 2014).

2. *Olearia rugosa* subsp. *distalilobata* is currently known to occur in 3–5 subpopulations (this range reflects that three of the subpopulations are within 10 km of each other) from three broad areas on the lands of the Ngarigo, Jaitmatang, Bidwell and Kurnai people: the East Gippsland Uplands and Snowy River areas in Victoria, and at Mount Imlay (Balawan) in New South Wales (NSW). The subspecies is known exclusively from National Parks (NP) and State Forests including roadside areas. Historically (between 1948 and 1984), it was recorded in three additional subpopulations in Victoria: the Yalmy area and Mount Bowen in Snowy River NP, and the Ada Divide Track in Errinundra NP. Extensive searches

have been unable to relocate these historical subpopulations (Messina *et al.* 2013; A. Messina *in litt.* November 2019), and as such, the subspecies is presumed locally extinct at these localities. Additionally, several older records exist with indistinct locality information (DCCEEW 2023).

3. The number of mature individuals of *Olearia rugosa* subsp. *distalilobata* is unknown, but an estimation of 400 (conservatively assuming all plants are, or will become, mature) from the known subpopulations has been made (DCCEEW 2023). The most recent estimation of the NSW subpopulation at Mount Imlay (Balawan) was 85 plants, all resprouting post-fire (DPIE 2021). The largest Victorian subpopulation, which is in the Snowy River area, has "several hundred" plants, and there are an additional 20–100 individuals at Mount Kaye (AVH 2022). The other subpopulations are small or only contain single individuals.

4. *Olearia rugosa* subsp. *distalilobata* has an estimated extent of occurrence (EOO) of 1,717 km^2, based on a minimum convex polygon, the method of assessment recommended by IUCN (2022). The area of occupancy (AOO) is estimated to be 32 km^2, based on 2 km x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2022). The estimates of EOO and AOO encompass the five extant subpopulations of this subspecies and exclude the three subpopulations where it is presumed extinct (Messina *et al.* 2013). A contracting trend in both the EOO and AOO is inferred based on the potential local extinction of subpopulations due to timber harvesting (Messina *et al.* 2013), and the loss of suitable habitat and potentially direct mortality after the 2019–2020 bushfires.

5. *Olearia rugosa* subsp. *distalilobata* occurs in montane sclerophyll forest at elevations of 500–900 m above sea level and is often found in depressions and gullies (Messina *et al.* 2013). The subspecies has also been recorded from relatively dry, rocky sites on sandy or loamy soils, often with an easterly aspect; as well as from ridgelines, roadside cuttings, the edges of walking trails and old (abandoned) forestry tracks (AVH 2022). In Victoria, it usually occurs in damp sclerophyll forest, particularly in association with *Eucalyptus sieberi* (Silvertop Ash) (Messina *et al.* 2013). At Mount Imlay (Balawan) in NSW, the subspecies occurs in a slight depression dominated by *Sticherus lobatus* (spreading fan fern), within '*E. obliqua* (Messmate Stringybark)–*E. sieberi*–*E. muelleriana* (Yellow Stringybark) open forest' (DPIE 2020).

6. *Olearia rugosa* subsp. *distalilobata* is a perennial shrub. Based on inference from the broader *O. phlogopappa* complex, flowering is likely to occur from the second year onwards, with propagules likely to be short-lived, yet able to establish both after disturbance and in a mature community (Messina *et al.* 2013). There is evidence of recruitment in *Olearia rugosa* subsp. *distalilobata* in the absence of disturbance, with mixed-age stands present at known sites (DPIE 2020). It is not known how long plants live for, but observations suggest it is likely to be at least 5–20 years, and possibly up to 50–100 years, given the longevity of some other *Olearia* species (DPIE 2020; Falster *et al.* 2021). Based on the method in IUCN (2022): "age of first reproduction + [*z* * (length of the reproductive period)]" and assuming '*z*' = 0.21 (Fung and Waples 2017), its generation length is estimated to be 3–12 years, with the maximum plausible value based on a longevity of 50 years.

There is considerable uncertainty in this estimate as the subspecies has not been monitored over time.

7. The pollinators of *Olearia rugosa* subsp. *distalilobata* are unknown, but the Asteraceae family is not known for its pollinator specificity. The showy white flowers of this subspecies are likely to attract a range of insects (Armstrong 1979). With a pappus of approximately 5 mm, seeds are likely to be wind dispersed and may also spread when attached to browsers, such as species in Macropodidae (*e.g.*, wallabies) (DPIE 2020). For pappus-bearing Asteraceae, dispersal ability varies based on achene dispersal architecture (Tabassum and Bonser 2017). The dispersal distance of *O. rugosa* subsp. *distalilobata* is unknown but it is considered likely that it can disperse considerable distances under strong winds.

8. The fire tolerance of *Olearia rugosa* subsp. *distalilobata* is not well understood but, assuming favourable conditions, at least some individuals are likely to resprout after fire. This has been observed in surveys following the 2019–2020 bushfires (DPIE 2021).

9. It is inferred that *Olearia rugosa* subsp. *distalilobata* has been adversely affected by activities associated with timber harvesting, and the increasing frequency and severity of fires, including interactions with drought (driven by climate change). 'Clearing of native vegetation', 'Anthropogenic Climate Change', and 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' are listed as Key Threatening Processes under the Act.

10. Bushfire is the greatest single threatening event that could rapidly affect all individuals of *Olearia rugosa* subsp. *distalilobata* in a location. On this basis, the subspecies occurs in three distinct threat-defined locations (1) Snowy River; (2) Mount Imlay (Balawan); and (3) the group of three subpopulations concentrated in Coopracambra NP and Drummer State Forest (separated by fewer than 10 km).

11. Failure to locate several historical subpopulations of *Olearia rugosa* subsp. *distalilobata* in Victoria has been attributed to timber harvesting activities (Messina *et al.* 2013). Decline due to timber harvesting may be a result of several factors associated with these operations, including the adverse effects of harvest or snigging, disturbance from heavy machinery, localised impacts on moisture availability and exposure, and prescribed coupe regeneration burns. These combined disturbances can cause the death of mature individuals and seedlings and reduce the regenerative capacity of subpopulations by depleting stored (root) carbohydrate reserves and destroying the soil seedbank. While all reserved subpopulations of *O. rugosa* subsp. *distalilobata* (including the occurrence in NSW on Mount Imlay) are currently not threatened by timber harvesting, it is inferred that timber harvesting has contributed to the continuing decline in the geographic distribution; the area, extent and quality of habitat; and the number of subpopulations of this subspecies. In NSW, the potential for the protected Mount Imlay (Balawan) subpopulation to expand into neighbouring areas in East Boyd State Forest may be limited in persistence by timber harvesting.

12. Approximately 98% of the modelled distribution of *Olearia rugosa* subsp. *distalilobata* is estimated to have burnt in the 2019–2020 fire season (Gallagher 2020, 2022) with high severity fire recorded across all but the Snowy River subpopulation. High severity fires are associated with exposure to lethal heat shock and high mortality in plants (DAWE 2022). High soil heating during severe fires may adversely affect the underground organs and life stages of resprouting species like *O. rugosa* subsp. *distalilobata* (DAWE 2022). After high severity fire at Mount Imlay (Balawan), only 42% of previously recorded *O. rugosa* subsp. *distalilobata* were observed to be resprouting (DPIE 2021). It is inferred that future fires of similar severity will contribute to the continuing decline of this subspecies.

13. If fire intervals are short relative to the timing of the life history processes of *Olearia rugosa* subsp. *distalilobata*, they may disrupt its post-fire recovery, causing population declines (DAWE 2022). For a facultative resprouter (*i.e.*, a plant that both recruits from the seedbank and has the ability to resprout after fire) such as *O. rugosa* subsp. *distalilobata*, high frequency fire may exhaust the plants' ability to resprout, reach reproductive maturity and replenish the seedbank. Based on known tolerances of closely related species in the *O. phlogopappa* complex, it has been suggested that a fire interval of between 3–5 years or less would be detrimental to *O. rugosa* subsp. *distalilobata* (DPIE 2020). As such, it is inferred that high fire frequency will contribute to the continued decline in the number of mature individuals of this subspecies.

14. Drought can cause plant mortality as well as limiting seed production, germination, seedling establishment, and the internal resources that underpin resprouting ability. Drought susceptibility of *Olearia rugosa* subsp. *distalilobata* is largely unknown. However, surveys of this subspecies at Mount Kaye and Mount Imlay (Balawan) under drought conditions in 2019 recorded minimal floral display, and it was inferred that poor seed set was likely with ongoing drought (DPIE 2020), as was observed in other Asteraceae at that time. Drought can interact with fire regimes to create a cumulative risk to subpopulations by promoting more frequent and more severe fires. In addition, pre-fire drought can be detrimental to plants because their reduced physiological condition cannot sustain them through a further reduction in resource availability (DAWE 2022). Similarly, post-fire seedling recruitment can be diminished in drought with seedlings prone to desiccation in the establishment phase (DAWE 2022). For these reasons, it is inferred that future droughts will contribute to continuing decline in the number of mature individuals of *O. rugosa* subsp. *distalilobata*.

15. Climate change is resulting in higher average temperatures throughout the year, more frequent dry periods and droughts, and overall worse fire weather, which is contributing to an increase in fire severity, frequency and changes to seasonality (Williamson *et al.* 2016; Abram *et al.* 2021). Within the region where *Olearia rugosa* subsp. *distalilobata* occurs, time spent in drought is projected, with medium confidence, to increase over the course of the century, whilst a harsher fire-weather climate in the future is projected with high confidence (CSIRO 2022). It is in this way, and with the knowledge of the adverse effects of drought and fire on the subspecies (described above), that anthropogenic climate change is inferred to contribute to continuing decline in the number of mature individuals of *O. rugosa* subsp. *distalilobata*.

16. *Olearia rugosa* subsp. *distalilobata* Hawke ex Messina is not eligible to be listed as a Critically Endangered species.

17. *Olearia rugosa* subsp. *distalilobata* Hawke ex Messina 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 Clause 4.3 (b)(d)(e i, ii, iii, iv)

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: 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.		

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.

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Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

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