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Notice 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 tree *Callitris oblonga* subsp. *corangensis* K.D.Hill as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 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 *Callitris oblonga* subsp. *corangensis* K.D.Hill 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 Critically Endangered.

Summary of Conservation Assessment

Callitris oblonga subsp. *corangensis* K.D.Hill 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)(f i) because: 1) the taxon has a very highly restricted maximum extent of occurrence (EOO) of 48 km^2; 2) the taxon is known from a single threat-defined location; 3) continuing decline is inferred in the number of mature individuals and the area, extent and quality of habitat due to adverse fire regimes and increased occurrences of droughts and floods due to climate change; and 4) the population of *C. oblonga* subsp*. corangensis* is known to undergo extreme fluctuations.

The NSW Threatened Species Scientific Committee has found that:

1. *Callitris oblonga* subsp. *corangensis* K.D.Hill (family Cupressaceae) is a small tree or shrub growing to five metres in the Cupressaceae family. The species has dense erect branches and dark green or bluish-green foliage. Leaves are usually four–five millimetres long with leaf scales distinctly keeled. The bark is hard and compacted. The species is monoecious having male and female flowers and fruits (cones) on the same plant. Female cones occur singly, or in dense clusters on stalks, or short fruiting branchlets, and remain until after maturity. Female cones are 14–18 millimetres long and 10–15 millimetres in diameter with thick scales, each tapering above to an apex usually thickened by a short dorsal point. Male cones are oval-shaped and occur singly or in clusters of two-five and are up to two millimetres long. The scales on male cones alternate and are approximately half as long as the intervening scales. The columella (vegetated stalk) is short and often tri-angled. Seeds are dark brown and numerous, with two or three wings and are approximately two millimetres wide. Seeds are endospermic (contains an endosperm in the mature seed) (DEE 2008; New South Wales Flora Online 2021; Wood 2021).

2. *Callitris oblonga* subsp. *corangensis* is confined to the Southern Tablelands of NSW and occurs along the floodplains and banks in the mid-reaches of the Corang River, north of Braidwood (NPWS 2001), between the confluence with the Shoalhaven River in the north, and south to just past Smilers Creek. The taxon is absent in steep gorge country downstream from Nadgengutta Creek (Appleby and

Wright 2021). The majority of the population is downstream from Morton National Park (NPWS 2001) on private land and fewer than 1,000 individuals were estimated to be reserved within the National Park prior to the 2019–20 fire (Briggs and Leigh 1996). The population is also found on Crown Lease and Crown Reserve land. Surveys indicate that the population does not extend significantly below 500 m in altitude (NPWS 2001).

3. The population is considered to be a single population along an approximately 20 km section of the Corang River (DEE 2008). Some localities have been recorded to reach densities of over 800 trees in an area of less than 0.5 ha (DAWE 2021). However, the density of plants is likely to vary across the area. The total population was estimated to consist of, at least, 5,000 mature individuals; however, a full census of the population had not been carried out prior to the 2019–20 fires (DCCEEW 2023). The population range based on the species' management plan was estimated at 2,500 to 10,000 individuals before the 2019–20 fires (NPWS 2001).

4. The geographic distribution of *Callitris oblonga* subsp. *corangensis* is very highly restricted. The Area of Occupancy (AOO) of *C. oblonga* subsp*. corangensis* is estimated to be 48 km^2, calculated using record data from 2000–2001 and using 2 x 2 km grid cells, the scale recommended by IUCN (2022). The Extent of Occurrence (EOO) has been estimated to be 12 km^2 (Thomas 2013). However, where EOO is less than or equal to AOO then IUCN guidelines recommend EOO estimates be changed to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO (IUCN 2022). Therefore, the EOO for *C. oblonga* subsp*. corangensis* is also estimated to be 48 km^2.

5. The most serious plausible threats to *Callitris oblonga* subsp. *corangensis* are an increased risk of frequent bushfires and an increased risk of flooding events, as a consequence of climate change. Both kinds of disturbance events cause mortality of standing plants and variable post-disturbance seedling recruitment responses that may or may not compensate mortality. A single flood event would impact the whole population. Similarly, a single bushfire event could impact the entire population (DCCEEW 2023). This means that the population of *C. oblonga* subsp. *corangensis* can be considered a single threat-defined location, as per the IUCN definition (IUCN 2022).

6. *Callitris oblonga* subsp. *corangensis* grows in rocky riverine shrubland dominated by *Leptospermum polygalifolium* (Tantoon), *Callistemon paludosus* (River Bottlebrush) *Hakea dactyloides* (Dogwood Hakea), *Lomatia myricoides* (River Lomatia) and *Lomandra longifolia* (Spiny-head Mat-rush). Habitat occupied by the species includes rocky benches that receive high flows and broad sandy flood plains, especially on outside bends (NPWS 2001). It is absent where the riverine shrubland is taller than two metres (NPWS 2001). On flatter, fine grained alluvial sections of river, *C. oblonga* subsp*. corangensis* occurs with emergent *Eucalyptus viminalis* (Manna Gum), and naturalised Radiata Pine *(Pinus radiata)* (NPWS 2001). It has also been observed to occur with other associated shrubland and/or riparian species such as *Acacia melanoxylon* (Australian Blackwood), *Bursaria spinosa* (Blackthorn), *Melaleuca parvistaminea* (Small-flowered Honey-myrtle), and *Allocasuarina* spp. (AVH 2021). *Callitris oblonga* subsp. *corangensis* is mostly

found growing near the flood debris line (strand line), rarely more than eight metres above the low flow water height. However, the height of the debris line and associated species varies depending on the river's cross section (NPWS 2001). For example, in steep gorge sections, the plant may be associated with hillslope species such as *E. pauciflora* (Snow Gum) and *E. dives* (Broad-leaved Peppermint) (NPWS 2001).

7. *Callitris oblonga* subsp. *corangensis* is an evergreen monoecious conifer. Pollen is released from the small male cones. Female cones produce seeds which mature and enlarge over several seasons before becoming woody and ceasing to grow (TSS 2016). Mature seeds are thus retained in the plant canopy (serotinous) (Merritt *et al.* 2014), as opposed to male cones which are ephemeral (Harris and Kilpatrick 1991). All *Callitris* species are wind pollinated. Seed is only released in response to death of the tree or the branches that support it, usually by extreme stressful events (fire or flood) (TSS 2016). Seeds can be transported downstream by water flow and by wind, with the majority moving over very short distances (<5 m; TSS 2016). *C. oblonga* subsp. *corangensis* seedlings have been observed growing in piles of flood debris (NPWS 2001).

8. *Callitris oblonga* subsp. *corangensis* is slow growing with post-fire growth measured between one to 12 cm, 12–17 months following fire (Appleby and Wright 2021). Plants become reproductive between one to two metres in height; however, their age at that stage is unknown (K. McDougall pers comm 14 September 2021 in DCCEEW 2023). Mature individuals of *Callitris* species have been aged between 70-170 years, depending on species and region (Pearson *et al.* 2016). A life expectancy for *C. oblonga* subsp. *oblonga* (South Esk Pine) is estimated at 70 years (TSS 2016) and *C. oblonga* subsp. *corangensis* is assumed to have a similar lifespan (DCCEEW 2023).

9. Recent post-fire surveys have shown that *Callitris oblonga* subsp. *corangensis* is an obligate seeder because mature individuals are killed by fire and the taxon does not resprout via epicormic growth following scorch by fire (Appleby and Wright 2021). Stochastic events (fire or flood) facilitate regeneration. In the event of fire, large amounts of seed are released and result in recruitment near the parent plant (TSS 2011). Recruitment is dependent on post-fire rainfall to trigger and promote germination (NPWS 2001). The number of seeds estimated for *C. oblonga subsp. corangensis* is 40 per cone (NPWS 2001) and large individuals of the related *C. oblonga* subsp. *oblonga* can have thousands of cones per mature individual (Harris and Kilpatrick 1991), so the number of seeds released can be in the thousands to millions per stand. Higher severity fires are known to maximise recruitment by increasing the availability of nutrients, light and space. Despite this, the absence of fire over prolonged time periods is unlikely to pose a threat to the species (TSS 2016; DPIE 2021).

10. Continuing decline in the number of mature individuals of *Callitris oblonga* subsp. *corangensis* is inferred. It is estimated that approximately 4,457 mature *C. oblonga* subsp. *corangensis* trees were killed in the 2019-20 bushfires, with 84 percent of the taxon's habitat being burnt at high severity (Appleby and Wright 2021). In excess of 76,000 seedlings were counted in the burnt areas following the 2019–20 fire (Appleby and Wright 2021) but recruitment was patchy and not all burnt adults produced seedlings, making it difficult to predict population change at this time.

However, not all seedlings are expected to survive to reach maturity because of threats from fire, flood, weeds, herbivory, and habitat disturbance (DCCEEW 2023). Further, climate change is projected to increase the risk of fire, drought and flood events and the interactions between these threats, and with other threats (fire*flood, fire*drought, fire*herbivory, fire*weeds), which are likely to have major impacts on seedling survival. The time to maturity for *C. oblonga* subsp. *corangensis* is unknown but *C. oblonga* subsp. *oblonga* requires 5-10 years from germination to reach sexual maturity (TSS 2016) and any fire that occurs before a substantial seed bank accumulates would likely result in the loss of mature and juvenile plants that could not be compensated by seedling recruitment. The Corang pine habitat has had a long fire-free period before the 2019–20 fires. Fires have not been recorded in the area since at least 1920, according to the NSW fire history register (DPIE 2021). Future climate change projections for southeast Australia in the temperate forested region, where the taxon occurs, include an increase in the number of days of elevated temperatures and an increase in the Forest Fire Danger Indices (FFDI), which increase bushfire risk and are useful indicators of increased drought (Clarke 2015; Dowdy *et al.* 2019; BOM and CSIRO 2020). This indicates an increased risk from high-fire frequency*et al*. 2015; Gallagher 2020; Gallagher *et al*. 2021). Therefore, although it is not possible to estimate the number of seedlings that will reach maturity as a proxy for population decline, decline in the number of individuals is inferred because of the increased risks of threats due to climate change projections (DCCEEW 2023).

11. Continuing decline is also inferred in the quality of *Callitris oblonga* subsp. *corangensis* habitat. Severe fires are capable of removing the humic layer which prevents the growth of vegetation following fire (DCCEEW 2023). Areas of severely scorched habitat with no subsequent growth were still evident 12–18 months following the 2019–20 fires (Appleby and Wright 2021). Severe floods also scoured the riparian zone in some sections which removed vegetation and reduced opportunity for seedling recruitment (Appleby and Wright 2021). Persistent drought is also capable of drying drainage lines that feed into the Corang River, and is likely to deplete groundwater in adjacent riparian bench and floodplain habitat. Drought is likely to be the cause of the poor health and mortality of several individuals in the vicinity of Oallen road, near Nerriga bridge (Appleby and Wright 2021). Severe and more frequent fires and floods, and drought, are predicted in *C. oblonga* subsp. *corangensis* habitat (Clarke 2015; Dowdy *et al*. 2019; BOM and CSIRO 2020).

12. *Callitris oblonga* subsp. *corangensis* is a serotinous obligate seeder which releases seed *en masse* from a canopy seedbank during fire and relies on rain following fire to trigger seed germination (DCCEEW 2023). This canopy-stored seedbank is exhaustible by a single event and is therefore prone to extreme fluctuations according to IUCN Red List Guidelines (IUCN 2022). Based on its serotinous obligate seeding life history, and potential effect of floods and droughts on seedling recruitment success (DCCEEW 2023), the population of *C. oblonga* subsp. *corangensis* may undergo extreme fluctuations in the number of mature individuals.

13. *Callitris oblonga* subsp. *corangensis* K.D.Hill 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: Critically Endangered under Clause 4.3(a)(d)(e i,iii)(f i).

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: Critically Endangered under Clause 4.3(a)(d)(e i,iii)(f i).

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: Vulnerable under Clause 4.4(c)(e i, ii B,C).

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: 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.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2023) Conservation Advice for *Callitris oblonga* subsp. *corangensis* (Corang pine). Department of Climate Change, Energy, the Environment and Water, Canberra, Australia.

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Gallagher RV, Allen A, Mackenzie BDE, Yates CJ, Gosper CR, Keith DA, Merow C, White MD, Wenk E, Maitner BS, He K, Adams VM, Auld TD (2021) High fire frequency and the impact of the 2019–2020 megafires on Australian plant diversity. *Biodiversity Research* 27, 1166–1179.

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