

NSW Threatened Species Scientific Committee

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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 gang-gang cockatoo *Callocephalon fimbriatum* (Grant 1803) as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act; and as a consequence, to omit the listing of:

1. The gang-gang cockatoo *Callocephalon fimbriatum* (Grant, 1803) as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act.
2. The gang-gang cockatoo, *Callocephalon fimbriatum* (Grant), population in the Hornsby and Ku-ring-gai Local Government Areas as an ENDANGERED POPULATION on 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 *Callocephalon fimbriatum* (gang-gang cockatoo) Grant, 1803 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 DAWE (2022), the NSW Threatened Species Scientific Committee has made a decision to list the species as Endangered.

Summary of Conservation Assessment

Callocephalon fimbriatum was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.2 1(b) 2(b, c). The main reason for the species' eligibility is that the species has undergone a large reduction in population size, and the extent and quality of habitat.

The NSW Threatened Species Scientific Committee has found that:

1. The Gang-gang cockatoo (*Callocephalon fimbriatum*) is approximately 32–36 cm in length, 230–334 g in weight and have a wing length of 20–26 cm (Higgins 1999; Menkhorst et al. 2017). They are small, stocky cockatoos, which are primarily slate-grey in colour. Adult males are distinguished by their scarlet-coloured head and wispy, filamentous crest that curls forward (Higgins 1999). The remainder of their plumage is usually mid-grey, with feathers narrowly edged dull-white. Occasionally, males have pale-yellow or dull-orange feathering on their breast or abdomen (Higgins 1999). Adult females have entirely mid-grey plumage, including on their head (Simpson & Day 1996). The feathers of adult females are broadly fringed with yellow-orange, giving a barred effect. This effect is particularly prominent on the underparts of the bird. The birds' secondaries, undertail-coverts, tail, and underwing-coverts are variably barred pale grey-yellow. Both sexes have broad wings and short tails (Higgins 1999). Juveniles are similar in appearance to females; however, their crests are

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rudimentary, and they appear washed green, particularly on their underparts and upper wing (Higgins 1999).

2. *Callocephalon fimbriatum* is endemic to south-eastern Australia. The species is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (Higgins 1999). It is adapted to cooler conditions and has always been more common at higher elevations and more southern latitudes.
3. The species was once widespread and numerous in Sydney and its surrounding areas, but its population has been greatly reduced since first recorded. The last known breeding subpopulation within the Sydney metropolitan area now contains no more than 40 pairs (Smith & Smith 2019; NSW DPIE 2019), confined to the Hornsby and Ku-ring-gai Local Government Areas. This subpopulation was listed as an 'Endangered population' under the New South Wales *Threatened Species Conservation Act*, 1995.
4. An estimated 54% of the species' distribution occurs within New South Wales National Parks and Wildlife Service estates (NSW OEH 2017a). BirdLife Australia's Birddata (BirdLife Australia 2021) records indicate that *Callocephalon fimbriatum* is present in the Greater Blue Mountains World Heritage Area and Mid and Lower Central Coast. Older reports also suggest *Callocephalon fimbriatum* was historically widespread in eastern New South Wales, ranging from the central slopes and tablelands, east to the south coast and central-eastern New South Wales (Shields & Crome 1992). The species also occurs in the Australian Capital Territory. In Victoria, *Callocephalon fimbriatum* is widespread through northeast and southern regions, with some records in east Melbourne, Mornington Peninsula, and south-western Gippsland (Higgins 1999; Menkhorst et al. 2017).
5. During summer *Callocephalon fimbriatum* primarily inhabits mature, wet sclerophyll forests, typically dominated by eucalypts (Frith 1969; NSW Threatened Species Scientific Committee (TSSC 2008). Eucalypt dominated forest environments with dense, shrubby *Acacia* and *Banksia* understory support the highest density of birds (Higgins 1999). The species has also been reported in more open eucalypt assemblages, subalpine snow gum woodland, temperate rainforests, and occasionally regenerating forests (Forshaw 1989; Higgins 1999). Smith & Smith (1993) assessed the species as being frequent within blackbutt (*Eucalyptus pilularis*), Sydney red gum (*Angophora costata*), and turpentine (*Syncarpia glomulifera*) tall open forest and occasional in Sydney peppermint (*Eucalyptus piperita*) open forest.
6. During winter *Callocephalon fimbriatum* tends to range beyond montane forests to inhabit woodland assemblages at lower, drier altitudes. Most birds occur in open eucalypt assemblages during this period (Shields & Crome 1992; Higgins 1999). The species is also observed in suburban areas of cities, including within parks, gardens, and roadside tree plantations (Morcombe 1986; Higgins 1999). Occasionally during winter, the species also inhabits assemblages of river red gum (*Eucalyptus camaldulensis*), dense coastal thickets of *Leptospermum* or *Casuarina*, or heathland (Higgins 1999). Overlapping of winter and summer

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ranges is common, with some individuals choosing to winter at higher altitudes, and others remaining at lower altitudes during summer (Higgins 1999).

7. The EOO for the species is estimated at 380,000–410,000 km², and AOO at 22,700–40,000 km². (Cameron et al. 2021). The EOO is based on all records since 1990. The minimum AOO is the number of 2x2 km squares within which the species has been recorded since 1990 but, given the remoteness of much of the distribution, the real AOO is assumed to be at least twice that, and probably substantially greater (Cameron et al. 2021).
8. There are an estimated 17,600 – 35,200 mature individuals in the wild (Cameron et al. 2021). This estimate is based on known measured density in some sites, extrapolated across all suspected habitat in the species' range, and accounting for differences in presumed carrying capacity in different habitat types.
9. The population is estimated to have declined by approximately 69% between 1999 and 2019, until just before the 2019/2020 bushfires) (Cameron et al. 2021).
10. Following this continuous and major decline between 1999 and 2019, the species also suffered mortality and habitat loss during the 2019/2020 bushfires. An analysis based on expert elicitation estimated an overall population decline at one-year post-fire of 21%, and that three generations post-fire the population would still be 29% lower than the pre-fire population size, and possibly as much as 52% lower (Legge et al. 2021), indicating a poor recovery rate. These predictions assume no further extreme drought or extensive fire events; however, such events are likely to reoccur over the assessment period, which would worsen the extent of population decline.
11. *Callocephalon fimbriatum* feed in small groups of up to 25 individuals (M Mulvaney 2021. pers comm. 7 Sept). Foraging is mainly arboreal, occurring in the canopy of woodland assemblages (particularly within eucalypts) and less often within the understory (more often during *Acacia* seeding) (Higgins 1999). Feeding rarely occurs within shrubs and at ground-level (Higgins 1999). The species has a wide-ranging diet, feeding on at least 131 different plant taxa across 25 different plant families (M Mulvaney 2021. pers comm 7 Sept). The majority of these feeding records are from around Canberra, but when only sightings from native vegetation outside of Canberra are considered, only approximately 50 species are consumed (M Mulvaney 2021. Pers comm 7 Sept).
12. *Callocephalon fimbriatum* regularly feeds on flower buds and seed pods, but also on blossoms, leaf buds, fruits, and seeds from both native and introduced ornamental species (M Mulvaney 2021. pers comm 7 Sept). Whilst feeding on native vegetation, gang-gang cockatoos rely heavily on eucalypts and *Acacia*. Whilst feeding on introduced vegetation, the species primarily relies on species such as hawthorn (*Crataegus monogyna*), cotoneaster (*Cotoneaster glaucophyllus*) and *Pyracantha* berries. When occupying suburban areas, the species often feeds on seeds and berries found within gardens, particularly

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from ornamental trees, shrubs, and hedges (Higgins 1999). *Callocephalon fimbriatum* also feed on insect larvae (Menkhorst et al. 2017) and are one of only a few bird species that feed on Sawfly larvae (COG N.D.).

13. Estimates of the distribution impacted by fire range from 28 to 36% (Legge et al. 2020; Ward et al. 2020; Legge et al. 2021). The 2019/2020 bushfires may have reduced the carrying capacity of 40% of occupied grid cells by half and resulted in a 10% reduction in the overall population size (Cameron et al. 2021).
14. *Callocephalon fimbriatum* relies on stands of suitable hollow-bearing trees (NSW OEH 2017a; Davey & Mulvaney 2020), which are a key component of their breeding habitat. Habitat critical to the survival includes hollow bearing trees with known or potential *Callocephalon fimbriatum* hollow chambers that are generally around 15-24 cm, floor diameter, around 22–90 cm deep and occur between around 5–9.4 m above the ground (Davey & Mulvaney 2020; Davey et al 2021). Stands of trees within or adjacent to known breeding areas, that are likely to become hollow-bearing in future years, are also key components of this species' habitat.
15. *Callocephalon fimbriatum* favours old growth forest and woodland assemblages for nesting, loafing, and roosting. The species nests in the hollows of tree trunks and limbs, or within the dead sprout of large, living eucalypts (Higgins 1999; Gibbons 1999; Gibbons & Lindenmayer 2000). Nesting and roosting sites are often (but not always) near water (Beruldsen 1980), where larger hollow-bearing trees can be more common.
16. *Callocephalon fimbriatum* is monogamous. Breeding usually occurs between October and January (Higgins 1999); however, records exist of breeding events in late August, early September, and March (Higgins 1999). Clutch sizes of two eggs are typical, but occasionally one or three are laid. Both sexes incubate the eggs over a period of 3-4 weeks (Davey & Mulvaney 2020). The fledging period lasts for 7–8 weeks, and the young continue to be fed by parents for 4–6 weeks after fledging (Endersby & Endersby 2001).
17. Pairs utilise multiple nest trees over different years, which may be a way of minimising nest parasitism or predation. Only about half of known nest trees are utilised each year (Davey & Mulvaney 2020), but individuals may use the same roosting and nesting site for multiple years (Higgins 1999). On three occasions, *Callocephalon fimbriatum* has been recorded utilising hollows that have developed in planted urban trees around Canberra, the youngest tree being 58 years old (Davey & Mulvaney 2020). Multiple nests tend to be situated within a few hundred metres of each other.
18. The main threats to *Callocephalon fimbriatum* are loss of habitat, decline in habitat quality and increased mortality as a result of adverse fire regimes, decline in habitat quality and increased mortality as a consequence of increasing temperatures and declining rainfall driven by anthropogenic climate change, loss of habitat and decline in habitat quality as a result of land clearing, and competition with other species for dwindling nest sites. Of these *'High frequency fire resulting in the disruption of life cycle processes in plants and*

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animals and loss of vegetation structure and composition', 'Anthropogenic Climate Change', 'Clearing of native vegetation', and 'Removal of dead wood and dead trees' 'Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners, *Manorina melanocephala* (Latham, 1802)' 'Competition from feral honey bees, *Apis mellifera* L.' and 'Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations' are listed as Key Threatening Processes under the NSW Biodiversity Conservation Act.

19. Adverse fire management regimes threaten *Callocephalon fimbriatum* where fire is too frequent or infrequent, too severe, or very extensive. Adverse fire regimes result in the direct mortality of individuals, remove nesting sites, reduce the availability of quality foraging sites, and increase individuals' vulnerability to other threatening processes (e.g., predators, or competitors).
20. 2019/20 bushfires burnt approximately 28–36% (approximately 4,700,000 ha) of *Callocephalon fimbriatum* habitat (Ward et al. 2020; Legge et al. 2021), causing direct loss of habitat and individuals.
21. The 2019/2020 fires may have resulted in a direct 10% reduction in the overall population size of *Callocephalon fimbriatum*, and an estimated decline of 21% one-year post fire, from the combination of direct mortality and indirect post-fire mortality (Cameron et al. 2021). Analysis predicts that the population three generations post-fire would be 29% lower than the pre-fire population size, with recovery constrained by impacts of other underlying threats, as well as the impact of high severity fire on hollow availability (Legge et al. 2021).
22. Current and future climate change is expected to increase wildfire risk through more adverse fire weather, including an expected increase in the number of days of severe fire danger, and a potential lengthening of the fire season over much of the range of *Callocephalon fimbriatum* (Clarke 2015). Projected climate change will also lead to changes in fuel dynamics via changes to vegetation composition and structure (Clarke 2015). Fire frequency and severity have strong implications for tree hollow abundance in montane and subalpine eucalypt forests, with stand-level hollow abundance decreasing with more frequent fires (Salmona et al. 2018), hence reducing nest-hollow availability for *C. fimbriatum*.
23. *Callocephalon fimbriatum* is a cool temperate species and is vulnerable to increasing temperatures across their range. Temperature is projected to increase by approximately 2.1 degrees Celsius by 2079 throughout NSW and the ACT (Clarke 2015). The frequency of hot days is also projected to increase.
24. High rates of mortality have been observed in chicks during extreme temperature events, and chicks have been observed leaving or attempted to leave their hollows prematurely (Davey & Mulvaney 2020). This loss of chicks in high temperatures impacts overall reproductive success (McCreedy & van Riper 2015), resulting in population declines. Increasing frequency of hot days is also likely to substantially increase water consumption requirements for

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juvenile and adult birds and reduce survival rates for this temperature-sensitive altitudinal migrant (Higgins 1999).

25. Clearing of native vegetation poses a threat to *Callocephalon fimbriatum*, removing trees and shrubs required by the species for foraging and nesting (Nelson & Morris 1994; Cumming 1998). On cleared land now used for agricultural or urban development purposes, hollow-bearing trees suitable for nesting are largely restricted to remnant patches of woodland and individual trees within cleared sites (e.g., paddock trees). The replacement of lost hollow-bearing trees is virtually non-existent, given the long periods of time required for large hollows to form (del Hoyo et al. 1997).
26. *Callocephalon fimbriatum* has been shown to be adversely affected by clearfell forestry operations, which remove both foraging habitat and available nesting hollows, with the species being less abundant in regenerating forest for up to 10-15 years after timber harvesting (Higgins 1999). As well as the general loss of habitat with the removal of native forest, old, hollow-bearing trees have historically been specifically targeted for removal as they are unsuitable for timber production. Across south-east Australia, including in NSW, rates of native forest timber harvesting have reduced substantially over time, and continue to decline, but remain an ongoing threat.
27. *Callocephalon fimbriatum* is susceptible to Psittacine beak and feather disease, which reduces fitness in and contributes to mortality in infected individuals (Sarker et al. 2014). Beak and feather disease virus is highly prevalent in a range of abundant Australian psittacines (Martens et al. 2020). It is transmitted through feather dander, faeces, and saliva. The subpopulation of *C. fimbriatum* from the Hornsby and Ku-ring-gai local government area has a high prevalence of the disease (DPIE 2019). Prevalence in other subpopulations is unknown.
28. The ongoing loss and increasing shortage of nest hollows due to factors such as wildfire and land clearance can increase competition for nest hollows with other species, reducing the number of hollows available to *Callocephalon fimbriatum*. Competitors may include feral honeybees (*Apis mellifera*), brushtail possums (*Trichosurus vulpecula*), and other bird species such as sulphur-crested cockatoos (*Cacatua galerita*), rainbow lorikeets (*Trichoglossus moluccanus*), little corella (*Cacatua sanguinea*), long-billed corella (*Cacatua tenuirostris*), and common mynas (*Acridotheres tristis*). Further research is required to better define the species which pose the greatest level of competition for nesting hollows.
29. Colonies of feral honeybees frequently occupy large hollows in trees. Such hollows are removed from the pool of hollows available to native species such as *Callocephalon fimbriatum* (NSW DPE 2019). Due to the long time-periods required for hollow formation and the long residence times of bees, occupation by bees represents a long-term loss of a critical resource (NSW DPIE 2019). Feral honeybees also invade artificial nest-boxes and may result in nest failures (Trainor 1995).

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30. Over-abundant noisy miners (*Manorina melanocephala*) and bell miners (*Manorina melanophrys*) can aggressively exclude *Callocephalon fimbriatum* from woodland habitat and nesting hollows (NSW OEH 2017b).
31. Invasion of nesting hollows and predation of eggs and young by the common brushtail possum (*Trichosurus vulpecula*) could lead to a decline in *Callocephalon fimbriatum* population numbers in some parts of their range (Garnett et al. 1999). Rates of predation by possums are elevated when habitat becomes fragmented following fires and land clearance (Hradsky et al. 2017). Without protection of eggs and young from possums, recruitment of *C. fimbriatum* to the adult population may be minimal (Garnett et al 1999; Garnett et al. 2011). Reproductive success of other cockatoo species (e.g., *Calyptorhynchus lathami*) has been improved by preventing possums from entering nest hollows (Garnett et al. 2011).
32. *Callocephalon fimbriatum* (gang-gang cockatoo) is not eligible to be listed as a Critically Endangered species.
33. *Callocephalon fimbriatum* (gang-gang cockatoo) Grant 1803 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*:

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Assessment against Biodiversity Conservation Act criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Endangered under Clause 4.2 1(b) 2(b, c)

Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

Assessment Outcome: Endangered 4.2 1(b) 2(b, c)

(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: Not Met

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,

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	(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: Not Met

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

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(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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Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Department of Agriculture, Water and the Environment (DAWE) (2022). Conservation Advice for *Callocephalon fimbriatum* (gang-gang cockatoo). Canberra: Department of Agriculture, Water and the Environment

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