

## 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 Red Goshawk *Erythrotriorchis radiatus* (Latham, 1801) as an ENDANGERED SPECIES in Part 2 of Schedule 1 of the Act and, as a consequence, to omit reference to the Red Goshawk *Erythrotriorchis radiatus* (Latham, 1801) from Part 1 of Schedule 1 (Critically Endangered species) 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 the Red Goshawk *Erythrotriorchis radiatus* (Latham, 1801) has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method (DCCEEW 2023). The acceptance of this assessment is provided for by Part 4.14 of the Act.

The NSW Threatened Species Scientific Committee accepts the assessment outcome of the Commonwealth Threatened Species Scientific Committee in its Conservation Advice for the Red Goshawk *Erythrotriorchis radiatus* of Endangered under Criterion 3: C2a(ii) (DCCEEW 2023).

## Summary of Conservation Assessment

Red Goshawk *Erythrotriorchis radiatus* (Latham, 1801) was found to be Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.4 (b)(e i,ii(B)). because (i) the estimated number of mature individuals is low (900-1,400 mature individuals in the wild), (ii) there is an inferred continuing decline as a consequence of habitat loss, and (iii) all individuals exist in one subpopulation spread over an extremely large area.

The NSW Threatened Species Scientific Committee has found that:

1. The Red Goshawk is a large, swift, and powerful hawk, rufous-brown in colour, and growing to a length of 45–60 cm, with a wingspan of 100–135 cm. It is one of the most sexually dimorphic raptors in the world (Baker-Gabb 1984), with females (1100 g) nearly twice as heavy as males (630 g). Adult males are boldly mottled and streaked, with rufous scalloping on the back and upperwings, rufous underparts, bold bars on the underwings, and with large yellowish legs and feet (Marchant and Higgins 1993). Adult females are more powerfully built, paler and more heavily streaked below, and showing some white on the underbody. Juveniles have redder upperparts, and the head and underparts are rich rufous with fine dark streaks. The rufous head of the juvenile distinguishes it from adults (Marchant & Higgins 1993).

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2. Red Goshawks are uncommon but widespread. They are currently known to breed from the Kimberley, east to Cape York Peninsula, and on the Tiwi Islands (MacColl *et al.* 2023). They may still breed at very low densities in the Wet Tropics and Einasleigh Uplands though record data are scarce (MacColl *et al.* 2023). Birds recorded from far outside the breeding range in central Australia (Aumann 2001) and the Pilbara (MacColl *et al.* 2023) include both dispersive juveniles (Aumann 2001) and seasonal migrants from further north. This inference is based on data from satellite-tagged adult females completing their non-breeding migration, which have covered distances of greater than 1000 km to more southerly non-breeding home ranges (MacColl *et al.* 2021).
3. MacColl *et al.* (2021) estimated the Extent of Occurrence (EOO) for the Red Goshawk to be 3,800,000 km<sup>2</sup> (range 3,300,000– 4,600,000 km<sup>2</sup>), based on all records since 1990. The Area of Occupancy (AOO) is estimated to be 134,000 km<sup>2</sup> (range 90,000–140,000 km<sup>2</sup>). Both the EOO and AOO have contracting trends (MacColl *et al.* 2021). The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2 x 2 km grid cell method, based on the IUCN Red List Guidelines (2022).
4. There are currently estimated to be 900-1,400 mature Red Goshawks, with a declining trend (S Garnett pers comms. 2022 in DCCEE 2023; MacColl *et al.* 2021) and some evidence that this is an overestimate (Noske & Briggs 2021; MacColl *et al.* 2023). There were estimated to be 700 pairs of Red Goshawks in 2012 (including 100 pairs on the Tiwi Islands; DERM 2012).
5. Red Goshawks occur as a single panmictic population based on satellite tracking (DERM 2012; MacColl *et al.* 2022). It was previously thought that the Gulf Plains bioregion separated the Northern Territory and Queensland populations, and the channel between the Tiwi Islands and the mainland separated these two populations. Species experts now agree that there is likely one single population comprising 100% of the mature individuals, as the Gulf Plains bioregion is now considered surmountable by the species based on satellite tracking data (MacColl *et al.* 2021). Satellite tracking also revealed adults and juveniles from the Northern Territory and Queensland soared above 1000 m, suggesting the Tiwi Islands population is also unlikely to be isolated by the narrow water barrier to the mainland (~27 km) (MacColl *et al.* 2021).
6. The Red Goshawk has been extirpated from around 27% of its historical distribution since European colonisation (Ward *et al.* 2022). The breeding range of the Red Goshawk has significantly contracted, by about 34%, since 1980, particularly in Eastern Australian temperate forests (MacColl *et al.* 2023). The species gradually declined to near extinction in New South Wales over the 1980s and 1990s (Cooper *et al.* 2014) and there have been no records there since 2012 (MacColl *et al.* 2023). Populations in southeast Queensland largely disappeared before 2010 (Seaton 2014). Apart from the satellite-tracked birds, records south of the Tropics over the last decade are increasingly scant, although some places where the species has been recorded historically have not been surveyed recently (MacColl *et al.* 2021; MacColl *et al.* 2023).

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7. Red Goshawks are usually observed alone, but occasionally in pairs or family groups. Some pairs remain within the nesting territory year-round whilst some adult females are known to migrate from northern Australia to more southerly home ranges when not breeding (Debus and Czechura 1988; Aumann and Baker-Gabb 1991; MacColl *et al.* 2021). In the southeast of their distribution, some adults appeared to migrate down from the ranges to lowland winter territories (Czechura 1996, 1997). Juveniles may disperse widely and are probably responsible for the bulk of the sightings outside the core breeding areas (Debus and Czechura 1988b). Tracking of two Red Goshawk adults fitted with radio transmitters established that the female flew 5–7 km from the nest and the male 7–10 km during the critical phases of the breeding season (i.e. whilst provisioning young). The breeding home range was determined to be 120 km<sup>2</sup> and 200 km<sup>2</sup> for the female and the male respectively (Aumann and Baker-Gabb 1991). Czechura (1996) recorded Red Goshawks flying 6–10 km to hunting areas. Recent satellite-tracking studies have also shown Red Goshawks travelling distances over 1500 km and soaring to heights of >1000 m (MacColl *et al.* 2021).
8. Red Goshawks typically breed in trees >20 m tall (range 18.5–40.5 m) with an open limb and canopy structure (Aumann and Baker-Gabb 1991; Debus 2017; C MacColl pers. comm. May 2022 in DCCEEW 2023), though there is anecdotal evidence of birds using trees 14 m in height (C. MacColl pers. comm. May 2022 in DCCEEW 2023). Red Goshawk breeding pairs maintain the same territories (including nest sites) year after year (Hollands 1984; Aumann and Baker-Gabb 1991). There can be multiple alternative nests used throughout the territory in successive breeding seasons, but they are typically within 200 m of one another and sometimes >800 m apart. Breeding generally occurs in spring in the southeast, with egg laying occurring from August to October (Debus and Czechura 1988b), and in the dry season May to October in the north (Aumann and Baker-Gabb 1991). Breeding activities are spread over many months; in the north, courtship begins in April and the young do not leave their natal territory until the end of the year (Aumann and Baker-Gabb 1991). The age at which the Red Goshawk first breeds is not well known, nor is the life expectancy. The generation length is estimated at 7.5 years (Bird *et al.* 2020).
9. The Red Goshawk inhabits coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers, and the edges of rainforests (Marchant and Higgins 1993). Resident pairs prefer intact, extensive woodlands and forests with a mosaic of open vegetation types that are suitable for fast manoeuvring flight (Marchant and Higgins 1993). Favoured areas appear to contain permanent water, as they are relatively fertile and biologically rich, and support large populations of bird prey species and are more likely to have nesting trees. In partly cleared parts of eastern Queensland the species is associated with gorge and escarpment country (Czechura and Hobson 2000; Czechura *et al.* 2010). Wetlands also constitute important foraging habitat particularly during the winter months when birds begin to congregate as waterbodies begin to dry out.

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10. Red Goshawks hunt live prey with medium to large sized birds making up 95% of the species' diet, although they also take mammals, reptiles and insects (Czechura and Hobson 2000). Males mostly capture birds the size of the Rainbow Lorikeet (*Trichoglossus haematodus*) and Bar-shouldered Dove (*Geopelia humeralis*), while females commonly kill birds the size of the Red-tailed Black-cockatoo (*Calyptorhynchus banksii*) and Blue-winged Kookaburra (*Dacelo leachii*) (Cupper and Cupper 1981; Aumann and Baker-Gabb 1991). A Red Goshawk primarily captures its prey by short-stay perch hunting beneath the canopy but may also launch in a falcon-style stoop from high in the air.
11. The major threats to the Red Goshawk population are land clearing and fragmentation resulting in habitat loss, disturbance and modifications to suitable habitat, and adverse fire regimes that cause decline in biodiversity. Habitat degradation caused by domestic livestock grazing presents a moderate threat to the Red Goshawk, while minor threats include habitat loss through draining and degradation of wetlands, secondary poisoning and Psittacine Beak and Feather Disease.
12. Land clearing and habitat fragmentation is a major threat to Red Goshawks. Foraging and breeding habitats have been impacted by the historic and ongoing clearing and fragmentation of native forests and woodlands for agriculture (Hollands 1984; Debus and Czechura 1988; Aumann and Baker-Gabb 1991; Debus 1993; Czechura 1996; Czechura and Hobson 2000; MacColl *et al.* 2021), forestry (Woinarski *et al.* 2003; Woinarski *et al.* 2007; Baker-Gabb 2009), mining, and urbanisation (ACF 2020). Since European colonisation, the species is thought to have lost around 36 million hectares of potential habitat. Additionally, nearly 15,000 ha of Red Goshawk habitat has been destroyed in urban areas between 2000 and 2017 (ACF 2020). Widespread deforestation, particularly of lowland and riverine forests, has caused the species to decline in NSW and Queensland, and will impact the northern part of the range as clearing continues and previously intact habitat is fragmented by greenfield development (ACF 2020). Nests are particularly vulnerable to habitat clearing as Red Goshawks usually nest in the tallest trees, which are exposed to storm damage and other disturbance when surrounding vegetation is removed. Research by Baker-Gabb (2013) demonstrated that breeding success declines when a threshold level of greater than 25% of forest is cleared within 4 km of nesting birds. Debus and Searle (2014) also suggest the removal of actual or potential nest trees is detrimental to their ongoing persistence in an area, particularly as they select for the tallest stands in a given area. Ongoing clearing of coastal forests for urban development in eastern Australia will reduce numbers further unless critical habitat is protected and restored (ACF 2020)
13. Adverse fire regimes on mainland northern Australia may have changed habitat structure, impacting the availability of Red Goshawk prey species (MacColl *et al.* 2021), and presents a major likely threat to the species. Reduced fire frequencies (for example, due to loss of cultural burning or inappropriate burning seasonality) has led to vegetation thickening across some parts of the savannahs of the species' range mostly within Cape York Peninsula. This is likely to impede the species' ability to forage because birds require a canopy of large, widely spaced trees and an open understorey to hunt (DERM 2012). High intensity fires may

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destroy nesting trees and/or reduce breeding success as nests can be abandoned or nestlings killed in the nest by fires that scorch the canopy (DERM 2012; Aumann and Baker-Gabb 1991)

14. Habitat degradation caused by livestock grazing is a moderate threat to the Red Goshawk. Grazing by hard-hoofed stock can lead to a reduction or removal of understorey habitat (Willson and Bignall 2009), which can reduce the abundance of Red Goshawk prey. Impacts to riparian vegetation have been observed in the Kimberley region leading to the decline of the Purple-crowned Fairy-wren (*Malurus coronatus*) (Skroblin and Legge 2012). This is critical breeding habitat for the Red Goshawk in that region and other rangeland areas, therefore degradation of these systems poses a high risk to the species persistence there.
15. Since European settlement, there has been extensive degradation and/or clearing of native ecosystems for agriculture and urbanisation (Finlayson and Rea 1999). This has ultimately led to the loss of natural wetlands across much of Australia. Habitat loss through draining and degradation of wetlands is a threat to the Red Goshawk. Given that the presence of permanent fresh water is an essential component of Red Goshawk habitat, the degradation of rivers and wetlands utilised by potential prey species may reduce prey availability, impacting foraging and breeding success (Czechura 1996; Czechura and Hobson 2000).
16. The use of persistent pesticides (for example organophosphates, organochlorine or rodenticide products) may result in pesticide contamination of prey species and cause secondary poisoning of Red Goshawks (Debus 2012). For example, the Red Goshawk is likely susceptible to secondary poisoning from rodenticides if it consumes the flesh of another animal that has ingested a poison (Debus 2012). Other chemicals such as DDT likely threatened the species in the past, reducing eggshell thickness and breeding success (as inferred by studies on Grey Falcon *Falco hypoleucos*; Olsen 1993). However, DDT has now been banned in Australia. The impacts of new chemicals on Red Goshawks are not known.
17. Psittacine Beak and Feather Disease (Pbfd) is a minor, possible threat to the Red Goshawk. Pbfd is a widespread, lethal disease, typically transferring between adults and nestlings (DEE 2016). While it is mostly associated with parrots, raptors are susceptible to Pbfd (Raidal and Peters 2018). A recent analysis of a sample taken from a dead Red Goshawk found under a nest in Cape York by C MacColl (pers. comm. 2022 in DCCEEW 2023) tested positive for Pbfd; however, it is not known how Pbfd impacts Red Goshawk survival at a population level.
18. Red Goshawk *Erythrotriorchis radiatus* (Latham, 1801) is not eligible to be listed as a Critically Endangered species
19. Red Goshawk *Erythrotriorchis radiatus* (Latham, 1801) is eligible to be listed as a Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a 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 Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

**Overall Assessment Outcome: Endangered under Cause 4.4 (b)(e i,ii (B))**

### Clause 4.2 – Reduction in population size of species

**(Equivalent to IUCN criterion A)**

**Assessment Outcome: Not met.**

<b>(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:</b>			
	(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.
<b>(2) - The determination of that criteria is to be based on any of the following:</b>			
	(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.**

<b>The geographic distribution of the species is:</b>			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted.
<b>and at least 2 of the following 3 conditions apply:</b>			
	(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.

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## Clause 4.4 – Low numbers of mature individuals of species and other conditions

(Equivalent to IUCN criterion Clause C)

**Assessment Outcome: Endangered under Clause 4.4 (b)(e i,ii (B)).**

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.

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## 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:

DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2023). Conservation Advice for *Erythroriorchis radiatus* (Red Goshawk). Australian Government, Canberra, ACT.

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