

# Nature Conservation (Koala) Conservation Advice 2023

## Notifiable instrument NI2023–223

made under the

**Nature Conservation Act 2014, s 90C (Conservation advice)**

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### **1 Name of instrument**

This instrument is the *Nature Conservation (Koala) Conservation Advice 2023*.

### **2 Commencement**

This instrument commences on the day after its notification day.

### **3 Conservation advice for Koala**

Schedule 1 sets out the conservation advice for Koala (*Phascolarctos cinereus*).

### **4 Revocation**

The *Nature Conservation (Koala) Conservation Advice 2019* (NI2019-230) is revoked.

Arthur Georges  
Chair, Scientific Committee  
14 April 2023

# Schedule 1

(see s 3)

## CONSERVATION ADVICE

### KOALA

#### *Phascolarctos cinereus*

## 1. CONSERVATION STATUS

The Koala *Phascolarctos cinereus* (Goldfuss, 1817) is recognised as threatened in the following jurisdictions:

International	<b>Vulnerable</b> (species), International Union of Conservation of Nature (IUCN) Red List
National	<b>Endangered</b> (QLD/NSW/ACT populations), <i>Environment Protection and Biodiversity Conservation Act 1999</i> <b>Vulnerable</b> , The Action Plan for Australian Mammals 2012
ACT	<b>Endangered</b> , <i>Nature Conservation Act 2014</i>
NSW	<b>Endangered</b> , <i>Biodiversity Conservation Act 2016</i>
QLD	<b>Endangered</b> , <i>Nature Conservation Act 1992</i>

## 2. ELIGIBILITY

The Koala is listed as Endangered in the ACT Threatened Native Species List under IUCN Criterion A —A2(c) A4(c), due to a substantial population reduction at the national level (Attachment A). The Koala is estimated to have declined by greater than 50% over the past 20 years (three generations). This decline is expected to be greater as a result of the 2019-2020 bushfires and the decline is expected to continue into the future with the likelihood of additional compound impacts due to climate change (Attachment A) (DAWE 2022a). During the 2019–2020 bushfire season an estimated nine percent (>36,800 km<sup>2</sup>) of the QLD/NSW/ACT distribution was impacted by fire (DAWE 2021). This agrees with estimates generated by the NESP Threatened Species Recovery Hub of 9–11.4 percent (DAWE 2022a, Runge et al. 2021b).



## 3. DESCRIPTION AND ECOLOGY

The Koala – Gula (Winanggaay Ngunnawal Language Group) is a tree-dwelling, medium-sized marsupial with a stocky body, large ears, sharp claws and variable but predominantly grey-coloured fur. It is one of Australia’s most distinctive and iconic wildlife species (DoE 2012).

The Koala is an arboreal folivorous marsupial. It occurs in forests and woodlands, typically dominated by

Koala ([Roy McDowall – Canberra Nature Map](#))

*Eucalyptus* species. The Koala has a specialist diet, mostly limited to the foliage of *Eucalyptus* species, with occasional intake of leaves of other plant (mostly *Myrtaceous*) genera (Martin and Handasyde 1999, Moore and Foley 2000, 2005). The Koala is mostly solitary, but individuals have extensive overlap in home ranges.

Breeding is seasonal, with births (typically of single young) occurring in October–May. Females can produce young at annual intervals, but births per adult female per year average 0.3–0.8 (McLean 2003). Female Koalas reach sexual maturity between 2–3 years of age (McLean and Handasyde 2007). In the wild, longevity of 12 (for males) to 15 years (for females) has been reported (Martin and Handasyde 1999). Generation length is 6–8 years (Phillips 2000, Woinarski and Burbidge 2020) and, for the purposes of the listing assessment, is estimated, conservatively, at 6.5 years (Attachment A) (DAWE 2022a).

## 4. DISTRIBUTION AND HABITAT

The Koala is endemic to Australia and is widely distributed in coastal and inland areas from north-eastern Queensland to Eyre Peninsula in South Australia. The range extends over about one million square kilometres with populations separated into areas of suitable habitat (Martin and Handasyde 1999, NSW DECC 2008). Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by *Eucalyptus* species (Martin and Handasyde 1999).

The Australian Capital Territory (ACT) falls at the edge of the Koala’s natural range and the species was common in the region prior to European settlement (Phillips 1990). Anecdotal evidence suggests that Koalas occupied lowland areas that were largely lost to development and agriculture in the ACT. They were also hunted for their skins in the region, with hunting reported on Black Mountain (J. Calaby pers. comm.) and nearby in NSW at Gundaroo and Bungendore (Phillips 1990). By 1901, Koalas had become extremely rare in the region (Phillips 1990).

An assessment of habitat quality for Koala’s has been undertaken for the Mulligans Flat Sanctuary (Story 2020). Habitat quality within Mulligans Flat Sanctuary was found to be of low-moderate quality, and while habitat quality has not been formally assessed in other areas of the ACT, this is consistent with the ACT being located at the edge of the species range. Recent mapping of potential habitat in the ACT was undertaken by the NSW Department of Planning, Industry and Environment (NSW DPIE). The primary area of most suitable habitat identified in the ACT (Figure 1) is in the south-east, around the Clear and Booth ranges of Namadgi National Park, parallel with the Tinderry Range in NSW (NSW DPIE 2019).

A review of Koala records in the ACT and region found that most of the post-1980 records were close to the Orroral Valley and Bushfold Flats, where Koalas were released in 1978 (Lintermans and Crisp 1986). Escapees from releases at Tidbinbilla Nature Reserve in 1939, 1969-71 and 1984 were also the likely origin of Koala records prior to 1980 from outside this reserve (Lintermans and Crisp 1986). There are records of Koalas in the wild on Canberra Nature Map for the late 1980s to early 1990s, however, they were likely to be in low abundance. Koala records on the western border of the ACT were possibly dispersing animals from the Brindabella Ranges near Wee Jasper (Lintermans and Crisp 1986). No live animals were sighted in surveys after the 2003 bushfires with the remains of one animal found on the south-east slopes of the Gibraltar Creek valley (Carey et al. 2003).

Surveys undertaken in 2018 did not detect any Koalas (or evidence of Koala habitation such as scats or characteristic scratch marks) in the wild in the ACT, however, it is possible that Koalas

may still be present. While the best possible survey sites were selected for this study only a relatively small number of sites (42) and trees (1,260 in total) were surveyed and several sites of high quality/potential habitat were either not accessible or were on Commonwealth owned Defence land (Capital Ecology 2018). Limited post-fire thermal drone surveys were undertaken for Koalas in southern Namadgi National Park after the 2020 Orroral Valley fire, with no Koalas found.

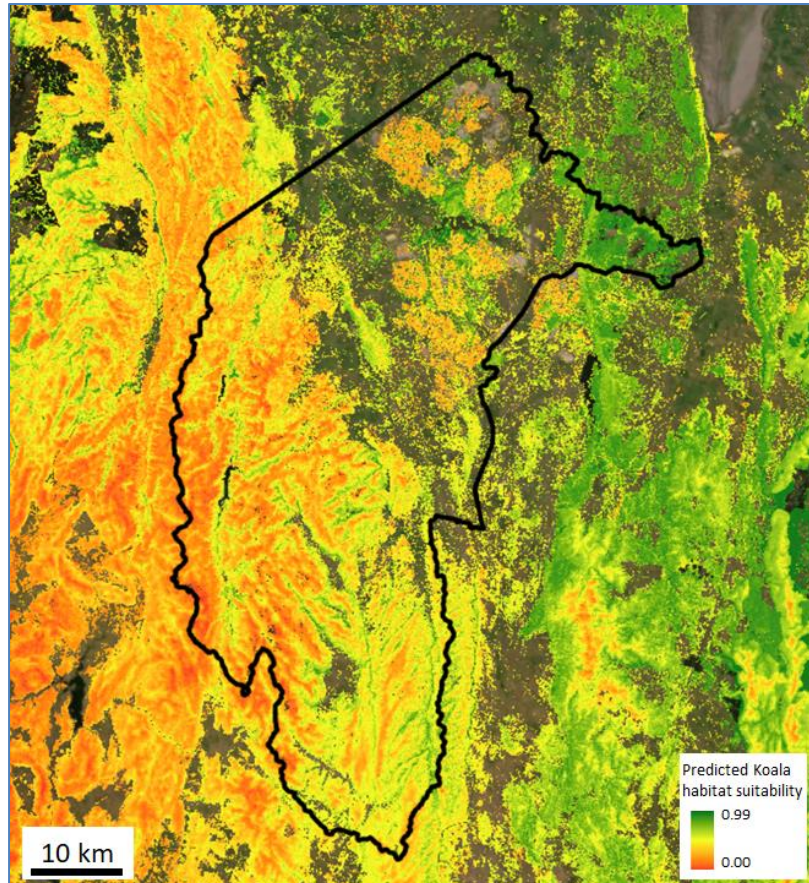


Figure 1: Koala habitat suitability based on modelling by the NSW DPIE (2019), with red indicating least suitable, yellow indicating moderately suitable and green indicating most suitable habitat, with the balance not suitable (e.g. exotic (agricultural) or native grasslands).

**Opportunistic sightings:** In 2014, reports of a Koala crossing the highway between Canberra Airport and Queanbeyan were made. It was believed the lone Koala was likely to be a young male pushed out of its home range in the Queanbeyan area by dominant adult males. In 2021 a Koala was observed in Oaks Estate (K. Ford pers. comm.) and another Koala was reported on a rural property near Tennent. Two recent confirmed sightings were made of wild Koalas in nearby NSW (Queanbeyan and Burra) through Canberra Nature Map (CNM 2022).

A captive population of Koalas exists at Tidbinbilla.

Outside of the ACT, Koala populations exist in nearby areas of NSW (Figure 2). Koala sighting records (NSW DPE 2022a) show that Koalas are occasionally seen in Queanbeyan and a population exists in forests from Tinderry Nature Reserve in the north to Dangelong Nature Reserve in the south. Koalas have also been observed north of the ACT near Yass, and north-east near Goulburn (NSW DPE 2022a).



As Koala populations exist near the ACT-NSW border and anecdotal evidence suggests the species was once common in the ACT, it is highly likely that the ACT supported healthy Koala populations prior to European settlement. Furthermore, habitat mapping indicates there is still habitat in the ACT capable of supporting Koalas (NSW DPIE 2019). Therefore, it is possible that through conservation action, Koala populations can be successfully re-established in carefully selected areas in the ACT.

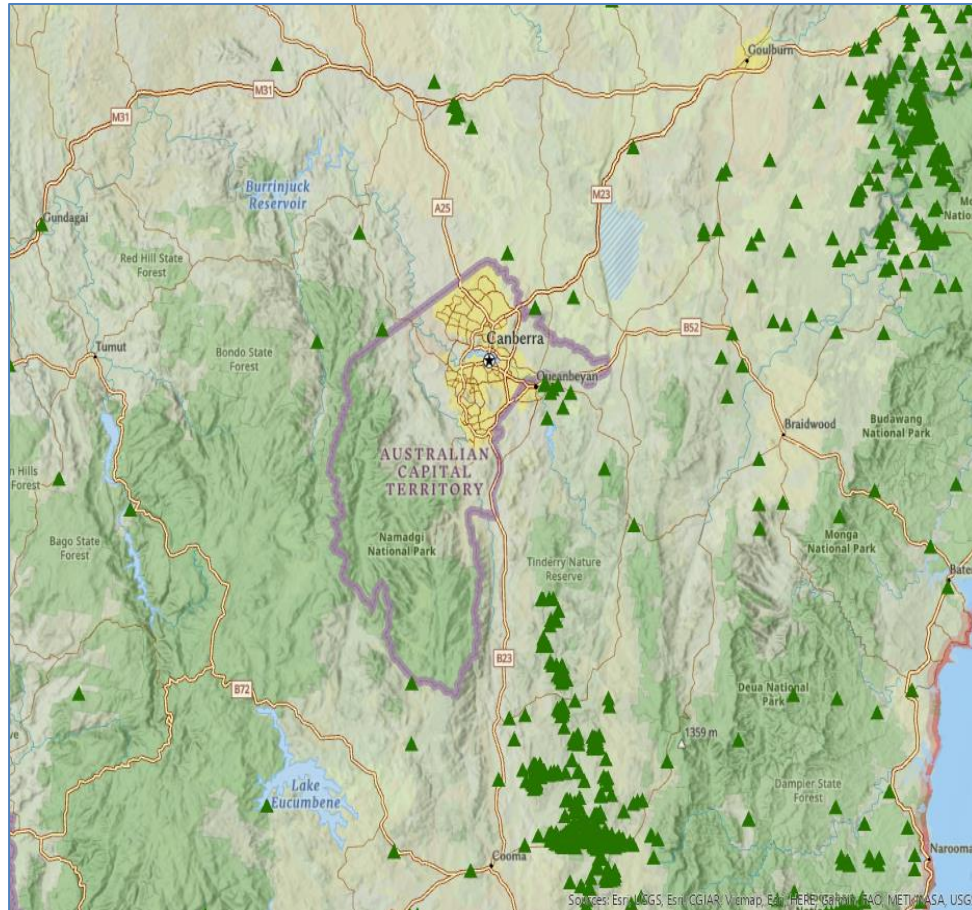


Figure 2: Koala sightings in NSW areas surrounding the ACT.

Data obtained from the NSW Department of Planning and Environment (NSW DPE) BioNet (Koala sightings) database (NSW DPE 2022a) (<https://datasets.seed.nsw.gov.au/dataset/nsw-bionet-data-collection-koala-sightings>)

## 5. THREATS

The main identified threats to this species are loss and fragmentation of habitat, vehicle strike, disease, and attack by dogs. Increased frequency and intensity of drought and incidences of extreme heat, large scale wildfire, and a shrinking climatically suitable area (Adams-Hosking et al. 2011, McAlpine et al. 2015, Runge et al. 2021b) are also known to cause very significant mortality. Post-drought recovery may be substantially impaired by the range of other threatening factors (DoE 2012) as climate change drivers are associated with increased levels of physiological stress in wild Koala populations (Narayan 2019).

The interaction of threats that affect the health of Koalas (including the health of trees) can increase the time Koalas need to spend on the ground and increase their exposure to dog attack (NSW DPE 2022b), especially by domestic dogs in and near urban areas. This does not necessarily translate to dingoes being a significant threat to healthy Koalas in quality habitat areas away

from urban areas. Dingo populations occurring in parts of Namadgi National Park (NNP) and Tidbinbilla Nature Reserve (TNR) are an important element of the native biodiversity and contribute to maintaining a balanced ecosystem function. While dingoes are not controlled in some areas of NNP and TNR, other areas neighbouring rural lands are managed for dingoes, wild dogs and foxes as part of a long-term established control program to prevent livestock depredation. Therefore, it is recommended that any future release of Koalas into areas with dingo populations be carefully monitored. If dingo predation becomes a limiting factor to successful establishment, then no further reintroductions should be undertaken in areas occupied by dingoes. Instead, reintroductions should be focused in other suitable areas in habitat corridors that provide connectivity to NSW where dingoes are not present and/or in areas where Koalas can be protected through existing measures of control of predators.

## 6. MAJOR CONSERVATION OBJECTIVE

The main objective in the ACT should be to maintain Koala habitat where feasible and to investigate the appetite and potential for reinstating the Koala as a viable population in the wild in the ACT at levels sustainable for the habitat.

## 7. CONSERVATION PRIORITIES

Recommended conservation priorities in the ACT include to:

- undertake baseline monitoring to confirm current distribution in the ACT
- assess habitat quality, quantity, and connectivity in the ACT, including the carrying capacity of habitat, to determine how many Koalas ACT habitat is capable of sustainably supporting (i.e., whilst ensuring ecosystems, particularly endangered vegetation communities, remain healthy)
- embed Ngunnawal vision and values in any project actions undertaken to restore Koala habitat and populations in the ACT
- maintain and restore habitat where feasible (e.g. along riparian areas and within the wildlife restoration corridors identified in other strategic documents e.g. the Woodlands Strategy (ACT Government 2019) and Doerr et al. 2014)
- investigate the option of changing the Tidbinbilla captive colony to individuals that are representative of local/regional genetic provenance
- support other jurisdictions (particularly NSW) including through involvement in the National Koala Monitoring Program (NKMP), the National Koala Recovery Team and Expert Technical Advisory Panel.

## 8. OTHER RELEVANT ADVICE, PLANS OR PRESCRIPTIONS

- [Commonwealth Conservation Advice](#) — Koala (DAWE 2022a)
- National Recovery Plan – Koala (DAWE 2022b)
- NSW Koala Strategy (NSW DPE 2022b)
- The Action Plan for Australian Mammals (Woinarski et al. 2014)

## 9. LISTING BACKGROUND

Initially, the NSW, Queensland and ACT population of the Koala *Phascolarctos cinereus* was listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 5 May 2016. In 2019, under the *Nature Conservation Act 2014*, the ACT Scientific Committee recommended the Koala be listed in the Vulnerable category in the ACT Threatened Native Species List to align with the EPBC Act listing.

The species was reassessed and listed as Endangered under the EPBC Act on 12 February 2022. In response, the ACT Scientific Committee recommended the Koala be transferred to the Endangered category in the ACT Threatened Native Species List under the *Nature Conservation Act 2014*, to align with the EPBC Act listing.

## 10. ACTION PLAN DECISION

The ACT Scientific Committee recommends that the Minister for the Environment should make the decision to not have an action plan for the species in the ACT under the *Nature Conservation Act 2014* at this time as there are no current wild Koala populations in the ACT that require management. An Action Plan or Native Species Conservation Plan (on stated land) might be required in the future if viable, wild populations are either found or re-established in the ACT. A five-year Koala research project is currently being planned with the Ngunnawal Community, with the aim to assess and, if appropriate, re-establish Koalas in the ACT.

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## 12. FURTHER INFORMATION

Further information on this species or other threatened species and ecological communities can be obtained from Environment, Planning and Sustainable Development Directorate (EPSDD).  
Phone: (02) 132281, EPSDD Website: <https://www.environment.act.gov.au/>

# ATTACHMENT A: NATIONAL LISTING ASSESSMENT (DAWE 2022a)

## THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

The Threatened Species Scientific Committee finalised this assessment on 07 September 2021.

### Attachment A: Listing Assessment for *Phascolarctos cinereus* combined populations of Queensland, New South Wales and the Australian Capital Territory

#### Reason for assessment

This assessment follows prioritisation of a nomination from the TSSC, initiated in response to the 2019/20 fires.

#### Assessment of eligibility for listing

This assessment uses the criteria set out in the [EPBC Regulations](#). The thresholds used correspond with those in the [IUCN Red List criteria](#) except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

#### Key assessment parameters

Table 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

**Table 3 Key assessment parameters**

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	92,184	86,863	92,184	<b>Past population data for the listed koala:</b>  2001 population estimate used in calculations: 184,7400 Data hindcast from the 2012 expert elicitation (Adams-Hosking et al. 2016).  2012 population estimate: 115,600 Data source: 2012 expert elicitation (Adams-Hosking et al. 2016).  2021 population estimate: 92,200. 2032 population estimate: 63,500. Data sources: 2012 expert elicitation (Adams-Hosking et al. 2016) and 2021 expert elicitation (Legge et al. 2021)
Trend	contracting			
Generation time (years)	6.5 years	6 years	7 years	Using conservative values of sexual maturity at 3 years and longevity 15 years, generation time is estimated to be approximately 6.5 years. Here the three generation period is considered to be 20 years.

<b>Extent of occurrence</b>	1,665,850 km <sup>2</sup>			Data provided by Department of Agriculture Water and Environment, Geoscience Australia and PSMA Australia.
<b>Trend</b>	contracting			
<b>Area of Occupancy</b>	19,428 km <sup>2</sup>			The area of occupancy is estimated at 19,400 km <sup>2</sup> . These figures are based on the mapping of point records from 2000 from state governments, museums and CSIRO. Due to the lack of recent surveys more recent data cannot be used to predict range contraction.
<b>Trend</b>	contracting Contracting due to climate related threats and habitat loss and land clearance.			
<b>Number of subpopulations</b>	>10			<p>Geographically isolated populations exist throughout the koala's range due to habitat fragmentation resulting from large scale land clearing, drought and bushfire impacts.</p> <p>Populations West of the Great Dividing Range are considered to be isolated from their eastern counterparts (DAWE 2021b). Koala habitat is patchy and fragmented and increasingly prone to threats from drought resulting in multiple subpopulations (n≥3).</p> <p>In Queensland, koala populations to the north (e.g., Wet Tropics), western inland arid regions (e.g., Mulga Lands) and southern end of the state (e.g., South East Queensland) are increasingly isolated due to habitat loss and fragmentation (DES 2020) (n≥3).</p> <p>In New South Wales, the east coast was heavily impacted by 2019-2020 bushfires. While the extent of bushfires was large, the fire intensity varied from low to high. Ongoing research indicates that areas of high intensity fire have zero koala occupancy in 2021. In contrast, low severity and moderate severity fire impacted areas are reported to have 100% koala occupancy (Pers comm., Natural Resources Commission 2021 koala Annual Forum). The high intensity fire impacts are likely to have the worst impact in poorly connected subpopulations (n≥5).</p> <p>Preliminary genetic analysis also confirms that there is no longer genetic exchange across the Clarence River in NSW, or from the north to</p>

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				the south of the Sydney basin (Eldridge & Lott 2020).
<b>Trend</b>	Declining The number of subpopulations is declining as climate suitable koala habitat shrinks.			
<b>Basis of assessment of subpopulation number</b>	The number of koala subpopulations is based on the available data and barriers to connectivity.			
<b>No. locations</b>	>10			
<b>Trend</b>	unknown			
<b>Basis of assessment of location number</b>	The spatial nature of the threats, although stochastic in time and space, is such that there are > 10 geographically or ecologically distinct areas where a single threatening event (e.g., drought or fire) could affect all of the individuals present within a single generation. The geographic location of non-impacted locations will vary between events, but there are always likely to be > 10.			
<b>Fragmentation</b>	Increasingly fragmented—e.g., by the 2019/20 fires.			
<b>Fluctuations</b>	Data deficient.			

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## Criterion 1 Population size reduction

Reduction in total numbers (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
A1	Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.		(a) direct observation [except A3]
A2			(b) an index of abundance appropriate to the taxon
A3			(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
A4			(d) actual or potential levels of exploitation
			(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Based on any of the following

## Criterion 1 evidence

### Eligible under Criterion 1 A2c, A4c for listing as Endangered

For the listed koala (Queensland, New South Wales and the Australian Capital Territory):

### Generation length

Female koalas reach sexual maturity between 2 and 3 years of age (McLean & Handasyde 2007). In the wild, longevity can be more than fifteen years for females and more than twelve years for males (Martin & Handasyde 1999). IUCN Guidelines (2019) provide the following as one method for estimation of generation length:

Age of first reproduction + [ $z$  \* (length of the reproductive period)], where  $z$  is a number between 0 and 1

For mammals, values of  $z$  have been estimated at 0.29 and 0.284 (Pacifi et al. 2013; Keith et al. 2015).

Using conservative values of sexual maturity at 3 years and longevity 15 years, generation time is estimated to be approximately 6.5 years. Here the three generation period is considered to be 20 years.

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## **Evidence - estimated**

### **A2 Past population reductions (2001-2021):**

The total number of koalas in Queensland, New South Wales, and the Australian Capital Territory in the year 2001 – the starting point for this assessment – was estimated to be between 184,748 and 170,335. This estimate was derived from bioregional population estimates for 2012 provided by Adams-Hosking et al. (2016). These bioregional estimates sum to a total population of 115,614 in 2012 (Adams-Hosking et al. 2016); a figure that is widely accepted by state governments, non-government organisations (NGOs) and researchers and builds on the 2012 EPBC listing advice (TSSC 2012). The 2012 bioregional population estimates were adjusted by Adams-Hosking et al.'s (2016) estimates of the rate of decline in each bioregion over the preceding three generations to yield bioregional population estimates for the year 1992. We then derived bioregional values for the year 2001 by assuming that the form of decline in each bioregion between 1992 and 2012 was either linear (giving the summed estimate of 184,748) or exponential (170,335); note that Adams-Hosking et al. (2016) did not specify the shape of the decline curve over the three-generation period. Total population estimates for the year 2021 were derived similarly, by projecting the bioregional declines from 1992-2012 forward to 2021. The resulting values for the total population in 2021 were 92,184 (linear decline) and 86,863 (exponential decline) (Table 4, Box 1).

Table 4 shows that that for the period 2001 to 2021 the estimated decline of the total population reaches the Endangered threshold of 50 percent under this Criterion. Whether the shape of the decline curve is exponential or linear has little effect on the outcome. Key bioregions (e.g., Mulga Lands) likely did not decline in a linear or exponential fashion, but rather were relatively stable until around 2000 then declined precipitously due to the Millennium Drought (Seabrook et al. 2011). If this “step change” were factored into the calculations in Table 4 it would have the effect of estimating a higher population at the beginning of the assessment period for Criterion A2, and thus a proportionally higher rate of decline.

Additionally, these data do not include the effects of the 2019/20 bushfires. While fire was considered as a threat in the elicitation exercise of Adams-Hosking et al. (2016), fires of the scale of 2019/20 were not anticipated in estimating declines that were likely to occur after 2012 (Hosking, Kavanagh, Lawler, Lunney, Melzer, Menkhorst, Moore pers comm April 2021). Thus again, this analysis likely underestimates the overall decline.

In a project run by the Threatened Species Recovery Hub in 2020-21, expert elicitation was used to estimate the likely mortality of koalas in low/med and high/very high severity fires. These estimates were then combined with spatial estimates of the proportion of the listed koala's range that was burned in those severity classes, to estimate the overall population reduction caused by the fire. It was estimated that populations declined by 10 percent (80 percent confidence 5.0 to 17 percent) by one year after 2019/20 fires, and that they would continue to decline thereafter without returning to their pre-fire population size. This analysis assumed uniform density of koalas across their range. However, the fires occurred predominantly in areas where koala densities are relatively higher than, for example, in large parts of their range west of the Great Divide, and thus this estimate likely underestimates the mortality due to the fires.

The estimated decline sits on the lower threshold for the Endangered category. Thus, while the effects of the “step change” due to drought and the similar sudden drop in numbers due to the 2019/2020 fires cannot be accurately quantified, it can confidently be concluded that they move

the estimate well into the Endangered range. They are unlikely to be of sufficient scale to reach the threshold for the Critically Endangered category, which would require an overall decline of  $\geq 80$  percent for this criterion (Table 4). Consequently, given that the koala is demonstrably close to the lower threshold of Endangered and that ongoing trends suggest further events likely to be sufficient to worsen the decline, the Committee considers that the koala is eligible for listing as Endangered under this subcriterion A2c.

**Table 4** – Estimated population sizes for bioregions containing koalas, calculated from the values provided in an expert elicitation study estimating koala sizes and trends +/- three generations from 2012.

Values for 2032 generated directly by applying three generation trends. Values for 2001 estimated by hindcasting three generations back to 1992 then calculated based on assuming either constant linear, or exponential, decline across the three generation period. Values for 2021 also based on constant linear, or exponential, decline between 2012 and 2032. Full details of these calculations are shown in Box 1 for the Brigalow Belt North bioregion as an exemplar.

Bioregion	2012	Past or future change (%) over 3 gens	Hindcast (ca 1992)	2001 linear	2021 linear	2001 exponential	2021 exponential decline	Forecast (ca. 2032)
				A2				A4
Cobar Penepplain & Riverina	2,354	-9	2,587	2,482	2,259	2,480	2,256	2,142
Darling Riverine Plains	964	-34	1,461	1,237	816	1,212	800	636
Mulga Lands (NSW)	711	-31	1,030	886	612	872	602	491
Murray Darling Depression	55	-12	63	59	52	59	52	48
New England Tablelands	2,771	6	2,614	2,685	2,846	2,683	2,845	2,937
NSW North Coast	8,367	-50	16,734	12,969	6,485	12,250	6,125	4,184
NSW South Western Slopes	2,310	-23	3,000	2,690	2,071	2,667	2,054	1,779
South Brigalow & Nandewar	11,133	-35	17,128	14,430	9,379	14,110	9,171	7,236
South East Corner	655	-46	1,213	962	520	919	496	354
South Eastern Highlands	1,363	-19	1,683	1,539	1,246	1,531	1,240	1,104
Sydney Basin	5,667	-4	5,903	5,797	5,565	5,796	5,564	5,440
Brigalow Belt North	15,179	-63	41,024	29,394	10,876	26,226	9,704	5,616
Brigalow Belt South	11,071	-56	25,161	18,821	8,281	17,389	7,651	4,871
Central Mackay Coast	8,857	-35	13,626	11,480	7,462	11,225	7,296	5,757
Desert Uplands	6,357	-20	7,946	7,231	5,785	7,187	5,750	5,086
Einiasleigh Uplands & Wet Tropics	4,750	-41	8,051	6,566	3,874	6,349	3,746	2,803
Mitchell Grass Downs	1,943	-39	3,185	2,626	1,602	2,550	1,556	1,185
Mulga Lands (QLD)	15,286	-73	56,615	38,017	10,264	31,408	8,480	4,127
South Eastern Queensland	15,821	-51	32,288	24,878	12,190	23,422	11,477	7,752
<b>TOTAL</b>	<b>115,614</b>		<b>241,312</b>	<b>184,748</b>	<b>92,184</b>	<b>170,335</b>	<b>86,863</b>	<b>63,549</b>
<b>Estimated decline over three generations</b>				<b>50%</b>		<b>49%</b>		<b>45%</b>

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**Box 1. Example of calculations used in calculating time-corrected estimates - Brigalow Belt North Bioregion**

**Notes:**

1. Because the estimated declines rates vary between bioregions, the calculations were made for each bioregion and summed across the relevant area to provide overall estimates. One bioregion is shown here as an exemplar.
2. For simplicity, numbers used below are rounded, but this was not the case when calculations were made on a spreadsheet and thus it may appear that there are minor discrepancies with Table 4.

Adams-Hosking et al. (2016) estimated that in 2012 the population of koalas in this bioregion was 15,179 and that the decline over the past, and future, three generations from 2012 was 63 percent.

**Hindcast to previous three generations from 2012 (i.e., approximately 1992)**

$$N_{2012} = N_{1992} * (100\% - 63\%)$$

$$N_{2012} = N_{1992} * 37\%$$

$$N_{2012} / 37\% = N_{1992}$$

$$N_{1992} = 15,179 / 37\% \\ = 41,024$$

**Forecast to following three generations from 2012 (i.e., approximately 2032)**

$$N_{2032} = N_{2012} * (100\% - 63\%)$$

$$= 15,179 * .37$$

$$= 5,616$$

**Estimating population at beginning of relevant three generation time period for Criterion A2 (i.e., approx. 2001)**

***Assuming linear decline***

$$N_{2012} = 15,179$$

$$N_{1992} = 41,024$$

$$\text{Decline/year} = (N_{2012} - N_{1992}) / (2012 - 1992)$$

$$= (41,024 - 15,179) / 20$$

$$= 25,845 / 20$$

$$= 1292$$

$$N_{2001} = N_{1992} - (\text{Decline/year}) * (2001 - 1992)$$

$$= 41,024 - (1292 * 9)$$

$$= 29,394$$

***Assuming exponential decline***

$$N_{1992} = 41,024$$

$$\text{Decline over 20 years} = 63\%$$

$$\text{Remaining} = 37\% = 0.37$$

$$\text{Decline/year} = 0.37^{(1/20)} = 0.952$$

$$N_{2001} = N_{1992} * 0.952^{(2001 - 1992)}$$

$$= N_{1992} * 0.952^9$$

$$= 41,024 * 0.639$$

$$= 26,226$$

**Estimating population at end of relevant three generation time period for Criterion A2 (i.e., approx. 2021)**

***Assuming linear decline***



$$\begin{aligned}
N_{2012} &= 15,179 \\
N_{2032} &= 5,616 \\
\text{Decline/year} &= (N_{2032} - N_{2012}) / (2032 - 2012) \\
&= (15,179 - 5,616) / 20 \\
&= 9,563 / 20 \\
&= 478 \\
N_{2021} &= N_{2012} - (\text{Decline/year}) * (2032 - 2012) \\
&= 15,179 - (478 * 9) \\
&= 10,786
\end{aligned}$$

***Assuming exponential decline***

$$\begin{aligned}
N_{2012} &= 15,179 \\
\text{Decline over 20 years} &= 64\% \\
\text{Remaining} &= 37\% = 0.37 \\
\text{Decline/year} &= 0.37^{(1/20)} = 0.952 \\
N_{2021} &= N_{2012} * 0.952^{(2021-2012)} \\
&= N_{2012} * 0.952^9 \\
&= 15,179 * 0.639 \\
&= 9,704
\end{aligned}$$

**A3 Population reductions (2021-2042):**

The Committee has determined that there are insufficient data to appropriately address Criterion A3 for the koala. As above, the primary data source from which to address both population size and trend is the paper by Adams-Hosking et al. (2016). As that paper addresses the period only until three generations into the future from 2012, extending the period until 2042 would require inappropriately extrapolating by approximately a decade.

**A4 Population reductions (2012-2032):**

Table 4 shows a decline rate of 45 percent over the relevant three generation moving window from 2012 to 2032 (without including effects of the 2019/20 bushfires). That this is a lower overall rate than the period 2000-2021 may seem counterintuitive. This is explained by the fact that several of the highest rates of decline within bioregions occur in those bioregions with the largest population size. In earlier years, those populations constitute a higher proportion of the overall population than in subsequent years and lead to a higher overall rate of decline because they decline faster than the overall population. Consequently, as they diminish in size, they contribute less to the overall population decline and this rate itself decreases.

When the 2019/20 bushfires are factored into the declines for relevant bioregions the result approaches or exceeds the Endangered threshold, but it is difficult to quantify this because of the different data structures used in the relevant studies, particularly the absence of partitioning by bioregion by the Threatened Species Recovery Hub analysis (Legge et al. 2021) .

The Committee must also judge the likelihood of an additional event in the next decade sufficient to increase ongoing decline to  $\geq 50$  percent. In this context, it is notable that Australia has experienced two severe droughts in the last 20 years (Millennium Drought, Big Dry), several large scale fire events (e.g. 2009 Victorian fires, 2019/20 bushfires) and that climate models suggest both phenomena will become both more common and more severe (Di Virgilio et al. 2019; Abram et al. 2021). Consequently, given that the koala is demonstrably close to the lower

threshold of Endangered and that ongoing trends suggest further events likely to be sufficient to worsen the decline, the Committee considers that the koala is eligible for listing as Endangered under subcriterion 1A4c.

**Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**

	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
<b>B1.</b> Extent of occurrence (EOO)	< 100 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
<b>B2.</b> Area of occupancy (AOO)	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
<b>AND at least 2 of the following 3 conditions:</b>			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

**Criterion 2 evidence**

**Eligible under Criterion 2**

**Not eligible**

The extent of occurrence (EOO) is estimated at 1,665,850 km<sup>2</sup> and the area of occupancy (AOO) is estimated at 19,428 km<sup>2</sup>. These figures are based on the mapping of point records from a 20-year period (2000–2020), obtained from state governments, museums, and CSIRO. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014 (IUCN 2019). The AOO is likely significantly under-estimated due to limited sampling across the occupied range (Woinarski et al. 2014).

The data presented above demonstrate the subspecies is not eligible for listing under this criterion as the EOO is > 20,000 km<sup>2</sup> and the AOO is > 2,000 km<sup>2</sup>.

### Criterion 3 Population size and decline

	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 - 100%	95 - 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

### Criterion 3 evidence

#### Eligible under Criterion 3

#### Not eligible

The estimated population size is > 10,000 mature individuals. The data presented above demonstrates that the koala is not eligible for listing under this criterion.

## Criterion 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2. <sup>1</sup> Only applies to the Vulnerable category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km <sup>2</sup> or number of locations ≤ 5

<sup>1</sup> The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the [common assessment method](#).

## Criterion 4 evidence Eligible under Criterion 4

### Not eligible

The data presented above demonstrates that the koala is not eligible for listing under this criterion. The number of individuals is > 1,000 and the AOO is > 20 km<sup>2</sup>, and there are > 5 locations.

## Criterion 5 Quantitative analysis

	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

## Criterion 5 evidence Eligible under Criterion 5 for listing as Insufficient data

### Insufficient data to determine eligibility

Population viability analysis has not been undertaken. Therefore, there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

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### **Adequacy of survey**

The survey and modelling effort has been considered adequate and there is sufficient scientific evidence to support the assessment.

### **Public consultation**

Notice of the proposed amendment and a consultation document was made available for public comment for 30 business days between 18 May 2021 and 30 July 2021.

### **Listing and Recovery Plan Recommendations**

The Threatened Species Scientific Committee recommends:

- (i) that the list referred to in section 178 of the EPBC Act be amended by transferring *Phascolarctos cinereus* from the Vulnerable category to the Endangered category.
- (ii) that there should be a recovery plan for this species.

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