Australian Government
Department of Agriculture, Water and the Environment

Conservation Advice for *Lophochroa leadbeateri leadbeateri* (eastern Major Mitchell's cockatoo)

This draft document is being released for consultation on the species listing eligibility and conservation actions

The purpose of this consultation document is to elicit additional information to better understand the eligibility of the species for listing and inform conservation actions, further planning and the potential need for a Recovery Plan.

The draft assessment below should therefore be considered **tentative** at this stage, as it may change as a result of responses to this consultation process.

Note: Specific consultation questions relating to the below draft assessment and preliminary determination have been included in the consultation cover paper for your consideration.

This document combines the approved conservation advice and listing assessment for the subspecies. It provides a foundation for conservation actions and further planning.

Major Mitchell's cockatoo © Copyright, Kristian Bell (from Shutterstock)

Conservation status

Lophochroa leadbeateri leadbeateri (eastern Major Mitchell's cockatoo) is proposed to be listed in the Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999.*

Lophochroa leadbeateri leadbeateri was assessed by the Threatened Species Scientific Committee to be eligible for listing under criterion as Endangered under criterion 1. The Committee's assessment is at Attachment A. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: A2bce: Endangered
- Criterion 2: Ineligible
- Criterion 3: Ineligible
- Criterion 4: Ineligible
- Criterion 5: Insufficient data

The main factors that make the species proposed for listing in the Endangered category is the severe reduction in population numbers. The population of the eastern Major Mitchell's cockatoos was estimated (with low reliability) to be 15,000 mature individuals in 2011, based on the AOO and a density of 1 pair per 30 km^2 (Garnett et al. 2011). In comparison to the estimated 50,000 mature individuals in 2000 (Garnett & Crowley 2000), it is a decrease of 67% in mature individuals within one generation, though the reliability of the population size has always been low (Garnett & Crowley 2000; Garnett et al. 2011; Hurley & Garnett 2021).

The longevity and generation period (three generations of 66 years; Bird et al. 2020) means that population decline estimates will need to encompass losses in the 1950s and 60s when there was no monitoring. Most land-use intensification occurred in western New South Wales in the late 19th century (Lunney 2001) and north-west Victoria from 1920 to 1940 (Fahey 2017), but legacy effects would have resulted in ongoing losses.

Based on the average reporting rates from a range of surveys in the subspecies' 10 core bioregions between 1977 and 2019, an average of 54% decline over three generations is estimated (see *Criterion 1 evidence*). Hence, the Committee considers that the subspecies has undergone a severe reduction in numbers over three generations. A decline in area of occupancy and quality of habitat is also evident from the ongoing loss and degradation of breeding habitat. Therefore, the subspecies has met the relevant element of Criterion 1 to make it eligible for listing as Endangered.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threat Database.

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Species information

Taxonomy

Scientific name *Lophochroa leadbeateri leadbeateri* (Vigors, 1831), they are commonly known as eastern Major Mitchell's cockatoo. The other recognised subspecies, *L. l. mollis*, can be found in central and western Australia. The species is also commonly placed under the genus *Cacatua*. Other common names for the species are pink cockatoo and Leadbeater's cockatoo.

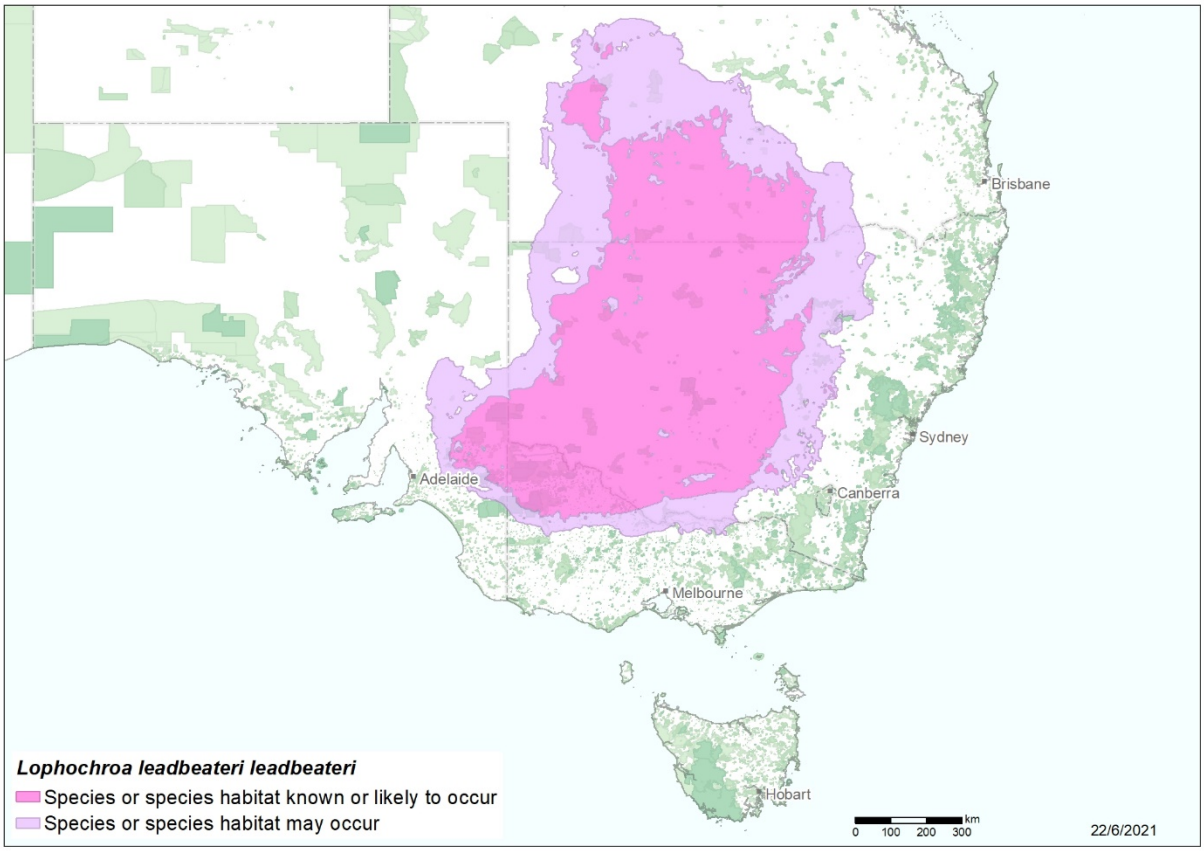
Description

The eastern Major Mitchell's cockatoo is a small, white and pink cockatoo with a long, forward-pointing, scarlet and yellow-banded crest. Birds are mostly white, washed salmon pink on sides of the head, grading to white on the lower belly. Their crest appears white when folded, with broad red and yellow bands through the centre when raised and spread. The narrow yellow band varies individually and between sexes. Adults weigh around 365-480 g, and have a body length of 39 cm (Higgins 1999; Menkhorst et al. 2017).

Distribution

The subspecies occur in the Murray-Darling, Eyre and Bulloo River basins, from Isisford and Roma in the north, through western New South Wales to north-west Victoria and west to eastern South Australia (Higgins 1999). The subspecies had disappeared from the Adelaide and Mt Mary Plains in South Australia by the 1950s (Boehm 1961). As much as its range remains uncleared rangeland, it is assumed that 20 to 30% is still occupied (Hurley & Garnett 2021).

Map 1 Modelled distribution of eastern Major Mitchell's cockatoo



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.
Caveat: The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.
Species distribution mapping: The species distribution mapping categories are indicative only and aim to capture (a) the habitat or geographic feature that represents to recent observed locations of the species (known to occur) or habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.

Cultural and community significance

The eastern Major Mitchell's cockatoo is known to occur on the lands of at least the following Indigenous Peoples: Adnyamathanha, Barapa Barapa, Barkindji, Bidjara, Boonthamurra, Budjiti, Dieri, Dja Dja Wurrung, Euahlayi, Gamilaraay, Gomeroi, Gungari, Iningai, Kooma, Kullilli, Kuungkari, Latji Latji, Malintji, Malyankapa, Mandandangi, Mardigan, Ngadjuri, Ngemba, Ngintait, Ngiyampaa, Nyeri Nyeri, Wadi Wadi, Wadigali, Wangaaypuwan, Wayilwan, Wemba Wamba, Wiljali, Wilyakali, Wiradjuri, Wongkumara, Yandruwandha, Yawarrawarrka, Yorta Yorta and Yuwaalaraay (Hurley & Garnett 2021).

The species has been known as Jakkulyakkul in Western Australia (Gould 1848), and wijugla (Wiradjuri language; Fraser & Gray 2013), kakalyalya (Pitjantjatjara dialect of Western Desert language), and gugalarin (Yuwaalaraay language) in New South Wales (Moonlit Sanctuary 2020). In South Australia, they have been known as kukkalulla (Kokatha dialect of Western Desert language), nkuna, ungkuna (Arrernte language), yangkunnu (Barngarla language), yangwina (Wirangu language) (Condon 1955).

Further research into the subject area may benefit the conservation of the subspecies by providing insights about traditional culture and land management. This statement of significance is not intended to be comprehensive, applicable to, or speak for, all Indigenous Australians and it is acknowledged that Indigenous groups and individuals are the custodians of this knowledge.

Relevant biology and ecology

Habitat

The eastern Major Mitchell's cockatoo lives in arid and semi-arid woodlands dominated by mulga (*Acacia aneura*), mallee and box eucalypts, slender cypress pine (*Callitris gracilis*) or belah (*Casuarina cristata*). The main requirements of the subspecies are trees with suitable nesting hollows and fresh surface water (Higgins 1999; OEH 2017), they often nest in hollows in cypress pines that are over 80 years old, preferably 130 to 140 years old (Gibson & Florentine 2008). Remnant vegetation surrounding agricultural land has also been used for nesting. In fragmented landscapes, they tend to travel along vegetated corridors to feeding sites, including roadside remnants (DSE 2004).

Eastern Major Mitchell's cockatoos generally prefer to nest in hollows with the following dimensions (Hurley & Harris 2014):

- average hollow entrance diameter of 13.3 x 27.7 cm (range 8-30 x 9-80, horizontal x vertical diameter);

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- average hollow depth of 53.9 cm (range 19 – 180);
- average nest chamber floor diameter of 18 cm (range 9-34 cm);
- average nest tree diameter at breast height of 72.5 cm (range 34-149).

A study of the Western Australian subspecies (Rowley & Chapman 1991) recorded similar ranges for these characteristics.

Diet

The eastern Major Mitchell's cockatoo's diet consist of seeds of native shrubs and trees, especially cypress pines, and sometimes roots, bulbs, insect larvae and seeds of crops and weeds (Higgins 1999; Moonlit Sanctuary 2020). They are often found feeding on the ground or near water sources (Moonlit Sanctuary 2020). They are normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant (OEH 2017).

Breeding

Unlike other threatened cockatoos, Major Mitchell's cockatoos do not like nesting close to other breeding pairs. Their nesting hollows are usually well-spaced, with an average distance of 444 m apart in Victoria and minimum of 50 m (Hurley 2006), and an average distance of 2732 m and 1 km minimum in the Western Australian subspecies (Saunders et al. 1985; Rowley & Chapman 1991). They have a home range of about 30 km^2 (OEH 2017).

Breeding pairs usually renest in the same area each season and stay together throughout the year. Their clutch size is usually three or four eggs (Rowley & Chapman 1911). They have an estimated generation length of 21.9 years (Bird et al. 2020).

Habitat critical to the survival

Eastern Major Mitchell's cockatoos inhabit a wide range of plant communities, mostly in arid and semi-arid woodlands, always within easy reach of surface water. Habitat critical to the survival of the eastern Major Mitchell's cockatoo should consist of:

- All known areas where the subspecies occur;
- Areas containing suitable habitat attributes that may be potential habitat for the subspecies, especially where the is a presence of suitable tree hollows; and
- Surrounding matrix of these areas for the role of providing movement corridors for dispersal across the landscape.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

Key considerations in environmental impact assessments

Assessments relevant to the eastern Major Mitchell's cockatoo must consider that the subspecies:

1) Nests occur in very old trees in large hollows, which take a long time to form (Gibson & Florentine 2008);
2) Has a specific set of preferences in nesting tree species and hollow characteristics (see *Habitat*);

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3) Breeding pairs have a relatively large home range (30 km^2) and do not nest near other Major Mitchell's cockatoos (see *Breeding*);

4) Requires large areas of intact vegetation and corridors for movement across the landscape (DSE 2004); and

5) Is a long-lived subspecies with a long generation length (21.9 years; Bird et al. 2020).

Habitat critical to the survival of the eastern Major Mitchell's cockatoo occurs across a range of land tenures. Habitat critical to the survival of the subspecies should not be destroyed or degraded, and all habitats should be maintained and/or increased. Actions that have indirect impacts on habitat critical to the survival should be minimised. Actions that compromise adult and juvenile survival should also be avoided.

Actions that remove habitat critical to the survival of this subspecies would interfere with the recovery and reduce the area of occupancy of the subspecies. It is important to retain suitable habitat and maintain connectivity between habitat patches. Actions should not be assessed in isolation and consideration must be given to existing and future activities that may impact the subspecies to ensure conservation outcomes on a landscape scale are achieved.

Threats

The main threat causing the decline of the subspecies is habitat loss and degradation. A major aspect of habitat loss is the loss of large hollow-bearing trees which provide nest sites. Hollow-bearing trees may be lost through natural tree fall, wildfires and land clearing. Additionally, there has also been a lack of regeneration due to grazing by invasive species (DSE 2004).

There has been increasing awareness of the importance of these hollows for hollow-dependant species as these large hollows take a long time to form (Gibson & Florentine 2008). When hollow availability is limited, competition for hollows increases. This is harmful in itself and also may amplify otherwise minor threats such as the transmission of diseases.

Under the changing climate, longer droughts (Evans et al. 2017), more frequent heatwaves (Herold et al. 2018), and more extreme fire weather (Di Virgilio et al. 2019; Dowdy et al. 2019) are expected to increase in the near future, which will increase the risk of individual survival and further habitat loss and degradation.

Table 1 Threats

Threats in Table 1 are noted in approximate order of highest to lowest impact, based on available evidence.

Threat	**Status** [a]	**Evidence**
Habitat loss and degradation		
Clearing of native vegetation and loss of hollow-bearing trees	• Timing: historical, current & future • Confidence: observed • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range	Historically, there was widespread land clearance for agriculture (DSE 2004). Though, minor clearance can still be authorised, along with the likelihood of small amount of illegal clearance, resulting in incremental habitat loss. The main threat impacting the subspecies persistence now is the loss and shortage of nesting hollows (Hurley & Garnett 2021), due to natural tree fall or wildfire (see

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Threat	Status [a]	Evidence
		Inappropriate fire regimes). Furthermore, there has also been a lack of natural regeneration and recruitment due to grazing by herbivores and stock (see *Grazing*). The shortage of nesting hollows will lead to an increase in competition for nesting sites (see *Competition for nest hollows*). Long-term monitoring of Major Mitchell's cockatoo nests between 1995 and 2013 has predicted that this critical resource within the Pine Plains in Wyperfeld National Park will be gone by 2024 (Hurley 2011 cited in Hurley & Harris 2014). Vegetation corridors also play an important role in providing remnant habitat in areas otherwise cleared. Major Mitchell's cockatoos often avoid flying across open areas (Rowley & Chapman 1991). Retaining intact vegetation will allow the subspecies to move between suitable habitat patches. Further removal of habitat without consideration of the impacts on the eastern Major Mitchell's cockatoo could result in significant habitat loss, fragmentation, and degradation, causing further decline of the subspecies.
Inappropriate fire regimes	• Timing: historical, current & future • Confidence: observed • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range	**Increase in frequency, scale and severity of wildfires** Wildfire can cause direct loss of birds and catastrophic loss of suitable habitat for the subspecies. It is one of the major contributions to the loss of hollow-bearing trees (Hurley & Garnett 2021). For example, the Lake Albacutya-Wyperfeld bushfire in 2014 destroyed 92% of cavity bearing trees within the 4,957ha burnt (Hurley & Harris 2014). Under the changing climate, the frequency, duration and intensity of wildfires is predicted to increase, as a result of longer heatwaves and longer droughts (see *Climate change*). **Inappropriate fire management** Inappropriate fire management (e.g., prescribed fires too intense or too frequent) may significantly impact the subspecies' habitat, rendering areas unsuitable for long periods of time or slowing the regeneration rate, or reducing food resources over large areas.
Grazing	• Timing: current & future • Confidence: observed • Likelihood: likely • Consequence: minor • Trend: static • Extent: across the entire range	Overgrazing by stock and grazing by rabbits (*Oryctolagus cuniculus*), feral goats (*Capra hircus*), and overabundant populations of kangaroos (*Macropus* spp.) has reduced the natural regeneration and recruitment of large hollow-bearing trees in the last century (DSE 2004; Hurley & Harris 2014; OEH 2017).
Shortage and competition for resources		
Competition for nest hollows	• Timing: historical, current & future • Confidence: observed • Likelihood: almost certain	A large proportion of Australian bird species use tree hollows as nesting sites (Saunders et al. 1982; Newton 1994), and almost all arboreal marsupials use tree hollows (e.g.,

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Threat	Status [a]	Evidence
	• Consequence: major • Trend: increasing • Extent: across the entire range	breeding site or shelter; Lindenmayer et al. 1991). As a result, inter-specific competition may be a common occurrence, especially with the decrease in hollow availability (see *Clearing of native vegetation and loss of hollow-bearing trees*). Potential hollow competitors include Galah (*Eolophus roseicapillus*) and European honeybees (*Apis melifera*) (DSE 2004). A 40% increase in the number of breeding Major Mitchell's cockatoo was observed after the removal of Galahs at Wyperfeld National Park (Hurley 2008, 2011 cited in Hurley & Garnett 2021). Nest boxes and artificial hollows are becoming an increasingly common management intervention to minimise the impacts of loss of nest sites for hollow-nesters (Griffith et al. 2008; Rueegger 2017; Fay et al. 2019). Studies from nest box programs for other threatened cockatoo species such as the Kangaroo Island glossy black-cockatoo, Carnaby's cockatoo (*Zanda latirostris*), Baudin's cockatoo (*Zanda baudinii*) and forest red-tailed black-cockatoo (*Calytorhynchus banksii naso*), may also assist in the development of a nest box program for the eastern Major Mitchell's cockatoo. It is important for nest box programs to be tailored to the targeted threatened species as studies have shown that simply setting up nest boxes mostly attract pest species rather than intended threatened species (Grarock et al. 2013; Lindenmayer et al. 2016, 2017). Furthermore, artificial nest sites cannot completely replicate resources that large, hollow-bearing trees provide (Le Roux et al. 2016), and they require ongoing maintenance and replacement. In general, nest boxes should only be considered where there is evidence that a shortage of natural hollows exists or is suspected. It would likely to be most effective as a short-term solution, provide nesting sites in the interim while natural hollows form, in sites managed for long-term retention and recovery of hollow-bearing trees but in which there may be a temporal gap in the availability of hollows. An emerging alternative to nest boxes is mechanically created artificial hollows (Rueegger 2017), which has been shown to increase visitation rate by hollow-dependent species (Griffiths et al. 2020). This has also been trialled in slender cypress pine (*Callitris gracilis murrayensis*), with some documented success (Hurley & Harris 2014; Hurley & Stark 2015). Finally, repairing damaged tree cavities is also possible and has been successfully implemented (Goldingay & Stevens; Saunders et al. 2014).
Climate change		

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Threat	Status [a]	Evidence
Increased likelihood of extreme events (e.g., wildfire, heatwave and drought)	• Timing: current & future • Confidence: estimated • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range	Average temperatures in Australia have increased by around 1.4°C in the past century (BOM & CSIRO 2020; IPCC 2021), and global temperatures are likely to exceed 1.5°C in the next 20 years if global greenhouse gas emissions are not reduced immediately (IPCC 2021). As more frequent and extreme heatwaves are projected across Australia (BOM & CSIRO 2020). Rainfall may also vary regionally under the changing climate (Evans et al. 2017), with lowest rainfall records in parts of Australia (BOM & CSIRO 2020). Which will lead to an increase in frequency and intensity of droughts (Evans et al. 2017) and heatwaves (Herold et al. 2018). This may severely impact the subspecies as they already occupy the tougher conditions of arid and semi-arid climates.
Anthropogenic threats		
Vehicle strike	• Timing: current & future • Confidence: inferred • Likelihood: likely • Consequence: minor • Trend: unknown • Extent: across part of its range	As the eastern Major Mitchell's cockatoo often feed on the ground or by a water source (see *Relevant biology and ecology*), a likely source of mortality to individuals is collision with vehicles. Although the extent of this threat to the subspecies is unknown. This is a significant threat to the Western Australian black cockatoos, the Carnaby's cockatoo (*Zanda latirostris*), Baudin's cockatoo (*Zanda baudinii*), and forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*), as birds congregate on roadside remnant vegetations in urban and agricultural areas to feed on spilt grains and drink water (EPA 2019).
Bird and egg collection	• Timing: historical, current & future • Confidence: suspected • Likelihood: unknown • Consequence: moderate • Trend: unknown • Extent: unknown	Like many other endangered parrots in Australia, the illegal trapping, and collection of nests for avian trade is a potential threat (DSE 2004; OEH 2017). The extent of this threat is unknown, but if active it may have severe consequences on the subspecies reproductive success.
Diseases		
Psittacine Beak and Feather Disease (PBFD)	• Timing: current & future • Confidence: suspected • Likelihood: possible • Consequence: minor • Trend: unknown • Extent: across the entire range	PBFD is a potentially fatal disease caused by psittacine circovirus, typically transferring between adults, nestlings and contaminated nest hollows (DEE 2016). Positive cases have been recorded in the eastern Major Mitchell's cockatoo (Peachey 2012). However, there is insufficient data to determine the status of this threat for the subspecies. With decreasing nesting hollows and intensified competition (see *Competition for nest hollows and lack of hollow-bearing trees*), it is possible that the likelihood of disease transmission could be greater in the future.

[a]Timing—identifies the temporal nature of the threat

Confidence—identifies the nature of the evidence about the impact of the threat on the species

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Likelihood—identifies the likelihood of the threat impacting on the whole population or extent of the species
Consequence—identifies the severity of the threat
Trend—identifies the extent to which it will continue to operate on the species
Extent—identifies its spatial context in terms of the range of the species

Categories for likelihood are defined as follows:
Almost certain – expected to occur every year
Likely – expected to occur at least once every five years
Possible – might occur at some time
Unlikely –known to have occurred only a few times
Unknown – currently unknown how often the threat will occur
Categories for consequences are defined as follows:
Not significant – no long-term effect on individuals or populations
Minor – individuals are adversely affected but no effect at population level
Moderate – population recovery stable or declining
Major – population decline is ongoing
Catastrophic – population trajectory close to extinction

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; the spatial extent, and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed using available literature.

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Table 2 Risk Matrix

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain				• Clearing of native vegetation and loss of hollow-bearing trees • Inappropriate fire regimes • Competition for nest hollows • Increased likelihood of extreme events (e.g., wildfire, heatwave and drought)	
Likely		• Grazing • Vehicle strike			
Possible		• Psittacine Beak and Feather Disease (PBFD)			
Unlikely					
Unknown			• Bird and egg collection		

Risk Matrix legend/Risk rating:

Low Risk	Moderate Risk	High Risk	Very High Risk

Priority actions have then been developed to manage the threats, particularly where the risk was deemed to be 'very high' (red shading) or 'high' (orange shading). For those threats with an unknown or low risk (blue and green shading respectively) research and monitoring actions have been developed to understand and evaluate the impact of the threats, where appropriate.

Conservation and recovery actions

Primary conservation objective

- Arrest the current decline and achieve a stable or increasing population trend.
- Increase nesting habitat availability within the subspecies' range.

Conservation and management priorities

Clearing of native vegetation and loss of hollow-bearing trees

- Protect, restore and enhance the quality of known suitable habitat and increase the extent of habitat for the subspecies across their range (both current and future) to maintain viability in response to threats, including climate change.
- Protect large old trees and smaller trees that contain large hollows, including those affected by fires. Ensure the recruitment of large old trees by retaining medium-sized trees, facilitating regeneration, and undertaking replanting.
- Maintain connectivity within and between regions:
  - At a local scale, ensure that birds can move safely between food, water and roosting resources via corridors that provide cover, and are preferably away from roadsides.
  - Enhance or restore regional corridors through strategic revegetation and other works that ensure the availability of food, shelter and water resources at regional scales.
- Ensure the year-round availability of surface water in close proximity to foraging and nesting habitat. Where necessary, install or maintain artificial water recourses to ensure continued access to food and nest sites during periods when natural surface water is absent.
- Maintain vegetation in proximity to water points, including the presence of smaller trees immediately adjacent to the water's edge, to provide cover and resting place for drinking birds.
- Identify important populations and engage stakeholders in the development and implementation of a local area management plan (a map-based document detailing the works necessary to secure the long-term viability of the population). Undertake baseline studies to support the preparation of these management plans.
- Manage total grazing pressure in rangelands and protected areas by controlling stock, rabbits, feral goats and kangaroos.

Inappropriate fire regimes

- Provide fire and land managers with specific advice to support decision making in wildfire prevention, preparation, response and recovery. Develop a landscape-scale fire management strategy which minimises the risk of extensive wildfire, whilst considering the ecological needs of the subspecies. For example:
  - Ensure fire suppression strategies also consider impacts on the population or its habitat.
  - Fire management activities to protect key sites and those identified as most at risk from wildfires should be prioritised.
  - Protect unburnt areas within or adjacent to recently burnt ground that may provide refuge, from planned burns, clearing and other disturbance until the burnt areas have recovered sufficiently to support the subspecies once again.
- Identify appropriate fire regimes and management practices for potential habitat, including under future fire risk scenarios due to climate change.

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- Implement appropriate fire planning and land management for conservation reserves and other public land with suitable habitat.
- Review proposed fire management plans at an appropriate interval to ensure remaining suitable habitat for the subspecies is protected.
- Apply adaptive management to inform future fire management plans and actions

Competition for nest hollows

- Continue to trial the use of artificial hollows, including the excavated/augmented hollow technique.
- Identify sites where hollows are limiting and develop and implement strategies to increase hollow availability that have clear objectives and include monitoring, maintenance, and reporting requirements.
- Protect individual regenerating *Callitris* pine from browsing and the resultant coppicing to enhance a stock of future single-trunked trees as potential hollow-bearing trees by applying silvicultural practices.

Stakeholder engagement/community engagement

- Educate stakeholders and landholders about the ecological and habitat requirements of the eastern Major Mitchell's cockatoo.
- Raise the profile of the subspecies and its important habitats with landholders and generate awareness of impacts of inappropriate grazing regimes.
- Raise awareness with the public and encourage submission of sightings to publicly available platforms (e.g., Atlas of Living Australia).
- Raise awareness with landholders and the public on the importance of large hollow-bearing trees.
- Promote and incentivise land management practices that produce, enhance and/or increase the extent of habitat and implement appropriate fire regimes on public and private land.

Survey and monitoring priorities

- Monitor population trends at key sites throughout the distribution, in order to track overall population trends, document the effectiveness of management actions, and identify sites requiring further management action.
- Monitor both fire-affected and unburnt areas to assess the impact of wildfire on the subspecies and identify refugia sites.
- Locate new feeding and breeding sites, and include them in the monitoring.
- Monitor changes in habitat extent and use over time and in response to threats and management actions.
- Ground-truth and refine mapping of habitat based on identified habitat characteristics and known feeding and breeding sites.
- Monitor for cases of PBFD. If active, work with local authorities and develop site-based management strategies.

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Information and research priorities

- Improve understanding of population demographics across range, patterns of dispersal and connectivity across subpopulations, in order to design management to retain and support landscape connectivity. This includes defining the habitat characteristics that allow birds to use areas as movement corridors.
- Improve knowledge of the impact of wildfire on the subspecies and its habitat, and their ability to re-colonise recently burnt areas.
- Use modelling techniques to investigate the potential impact of climate change on the subspecies, habitats critical for survival, and the availability of key resources.
- Conduct further research to examine the competition with other species (in particular introduced species), and the impacts on the eastern Major Mitchell's cockatoo.
- Enable the integration of Traditional Ecological knowledge into site-based management strategies.

Links to relevant implementation documents

- Threat abatement plan for competition and land degradation by unmanaged goats (DEWHA 2008).

This Conservation Advice is developed to be able to subsequently inform other planning instruments such as a Bioregional Plan or a multi-entity Conservation Plan.

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The Threatened Species Scientific Committee finalised this assessment on DD Month Year.

Attachment A: Listing Assessment for *Lophochroa leadbeateri leadbeateri*

Reason for assessment

This assessment follows provision of new information.

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. The definition of each of the parameters follows the Guidelines for Using the IUCN Red List Categories and Criteria.

Table 3 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	15,000	10,000	20,000	The population of the subspecies was estimated, with low reliability, to be around 15,000 mature individuals based on the AOO and a density of 1pair/30 km^2 (Garnett et al. 2011). There are no new estimates (Hurley & Garnett 2021). There are no new estimates, the longevity of the subspecies means that declines need to encompass losses in the 1950-1960s, when there was no monitoring (Hurley & Garnett 2021).
Trend	declining			
Generation time (years)	21.9	20.8	23	Bird et al. (2020)
Extent of occurrence	850,000 km^2	800,000 km^2	900,000 km^2	The subspecies occur in the Murray-Darling, Eyre and Bulloo River basins from Isisford and Roma in the north, through western New South Wales to north-west Victoria and west to eastern South Australia (Higgins 1999). They had disappeared from the Adelaide and Mt Mary plains in South Australia by 1950s (Boehm 1961), but is otherwise still extant across most of its historical range (Garnett et al. 2011).

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Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Stable			
Area of Occupancy	225,000 km^2	150,000 km^2	300,000 km^2	It is assumed that 20–30% of the subspecies range is still occupied (Hurley & Garnett 2021).
AOO is a standardised spatial measure of the risk of extinction, that represents the area of suitable habitat known, inferred or projected to be currently occupied by the taxon. It is estimated using a 2 x 2 km grid to enable comparison with the criteria thresholds. The resolution (grid size) that maximizes the correlation between AOO and extinction risk is determined more by the spatial scale of threats than by the spatial scale at which AOO is estimated or shape of the taxon's distribution. It is not a fine-scale estimate of the actual area occupied. In some cases, AOO is the smallest area essential at any stage to the survival of existing populations of a taxon (e.g. breeding sites for migratory species).				
Trend	Contracting			
Number of subpopulations	1	1	1	Hurley & Garnett (2021)
Trend	Stable			
Basis of assessment of subpopulation number	There are no major biogeographic barriers and therefore the population is assumed to be panmictic (Hurley & Garnett 2021).			
No. locations	>10			Hurley & Garnett (2021)
Trend	Not calculated			
Basis of assessment of location number	The spatial nature of the threats, even though stochastic in space and time, is such that there are more than 10 geographically or ecologically distinct areas where a single threatening event could affect all individuals of the subspecies present within a period of one generation (Hurley & Garnett 2021).			
Fragmentation	Not severely fragmented.			
Fluctuations	Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals.			

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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.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

Based on any of the following

(a) direct observation [except A3]
(b) an index of abundance appropriate to the taxon
(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Criterion 1 evidence

Eligible under Criterion 1 A2bce for listing as Endangered

The longevity and generation period (three generations of 65.7 years; Bird et al. 2020) means that population decline estimates will need to encompass losses in the 1950s and 60s when there was no monitoring. Most land-use intensification occurred in western New South Wales in the late 19th century (Lunney 2001) and north-west Victoria from 1920 to 1940 (Fahey 2017), but legacy effects would have resulted in ongoing losses.

The population of the eastern Major Mitchell's cockatoos was estimated (with low reliability) to be 15,000 mature individuals in 2011, based on the AOO and a density of 1 pair per 30 km^2 (Garnett et al. 2011). In comparison to the estimated 50,000 mature individuals in 2000 (Garnett & Crowley 2000), it is a decrease of 67% in mature individuals within one generation, though the reliability of the population size has always been low (Garnett & Crowley 2000; Garnett et al. 2011; Hurley & Garnett 2021).

Average reporting rates for 10-minute grid searches in the subspecies' 10 core bioregions were 14% during 1977-1981 (Garnett et al. 2003 cited in Hurley & Garnett 2021) and 4.1% for 2000-2019 (Birddata), a decline of 71% extrapolated to three generations (Hurley & Garnett 2021). Reporting rates declined for 2 ha 20 min surveys, and 500 m area searches, declined by 27% and 8% respectively from 2000-2019, which is equivalent to a decline of 66% and 25% if extrapolated to three generations (Hurley & Garnett 2021). The average of these extrapolated declines is 54% over three generations.

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A decline in the quality of habitat is also evident from the ongoing loss and degradation of breeding habitat. In the largest known nesting area in Victoria, the number of nest trees fell by 91% between 1995 and 2014 (Hurley 2011 cited in Hurley & Garnett 2021). Only 9% of the 63 nest trees monitored in 1995 were standing in 2014 (Hurley & Stark 2015), a trend likely to be representative across the subspecies' range (Gibson & Florentine 2008; Cheal et al. 2010). Fires in Pine Plains in Wyperfeld National Park destroyed 93% of the 83 known hollow-bearing trees in 2014 (Hurley & Harris 2014). Hollow recruitment has likely been curtailed due to ongoing habitat loss and degradation, including grazing by rabbits, feral goats and inflated populations of kangaroos, which have limited tree recruitment in the last century (Hurley & Garnett 2021).

The Committee considers that the subspecies has undergone a severe reduction in numbers over three generations and the reduction has not ceased, the cause has not ceased and is not reversible. Therefore, the subspecies has met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.

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

		Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1.	Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2.	Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:				
(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

Not eligible

The EOO and AOO of the subspecies is estimated to be 850,000 km² (range 800,000 – 900,000 km²) and 225,000 km² (range 150,000 – 300,000 km²), respectively (Hurley & Garnett 2021). Therefore, the Committee considers that the subspecies is not eligible for listing in any category under this criterion as neither the EOO or AOO are likely to be limited.

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

Not eligible

The subspecies' population is not limited as total number of mature individuals is 15,000 (range 10,000 – 20,000). Therefore, the subspecies has not met this required element of this criterion.

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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.[1] *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 km² or number of locations ≤ 5

[1] 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

Not eligible

The total population size for the subspecies is estimated to be around 15,000 mature individuals (range 10,000 – 20,000), which is not considered to be low. Therefore, the subspecies has not met this required element of this criterion.

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

Insufficient data to determine eligibility

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

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Adequacy of survey

There is sufficient evidence to support the assessment, some nest monitoring are occurring in Victoria and the subspecies is sufficiently widespread and abundant so birdwatcher records can provide meaningful trend data.

Public consultation

Notice of the proposed amendment and a consultation document is made available for public comment for a minimum of 30 business days. Any comments received relevant to the survival of the subspecies are considered by the Committee as part of the assessment process.

Listing and Recovery Plan Recommendations

A decision about whether there should be a Recovery Plan for this species has not yet been made. The purpose of this consultation document is to elicit additional information to help inform the decision.

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Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2022, *Conservation Advice for* Lophochroa leadbeateri leadbeateri *(eastern Major Mitchell's cockatoo)*, Canberra. 

This publication is available at the SPRAT profile for *Lophochroa leadbeateri leadbeateri* (eastern Major Mitchell's cockatoo).

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