Species-specific research for onshore renewables: South-eastern Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*)

Literature review and research report

I. Veltheim, R. Hill, P.D. Moloney, D.I. Rogers, P.V. Macak, R.J. Douma, G.E. Lewis and L.F. Lumsden

June 2026

Arthur Rylah Institute for Environmental Research Report



Australian Government
Department of Climate Change, Energy, the Environment and Water

Arthur Rylah Institute for environmental research

VICTORIA State Government
Energy, Environment and Climate Action

Arthur Rylah Institute for Environmental Research
Department of Energy, Environment and Climate Action
PO Box 137, Heidelberg, Victoria 3084
Phone (03) 9450 8600
Website: www.ari.vic.gov.au

Citation: Veltheim, I., Hill, R., Moloney, P.D., Rogers, D.I., Macak, P.V., Douma, R.J., Lewis, G.E. and Lumsden, L.F. (2026). Species-specific research for onshore renewables: South-eastern Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*). Literature review and research report. Arthur Rylah Institute for Environmental Research. Department of Energy, Environment and Climate Action, Heidelberg, Victoria.

Front cover photo: South-eastern Red-tailed Black-Cockatoo female (Mike Sverns)

ISBN 978-1-76176-840-8 (pdf/online/MS word)



© The State of Victoria Department of Energy, Environment and Climate Action June 2026

Creative Commons

This work is licensed under a Creative Commons Attribution 4.0 International licence, visit the Creative Commons website (http://creativecommons.org/licenses/by/4.0/).

You are free to re-use the work under that licence, on the condition that you credit the State of Victoria as author. The licence does not apply to any images, photographs or branding, including the Victorian Coat of Arms, and the Victorian Government, the Department and the ARI logos.

Accessibility

To receive this document in an alternative format, phone the Customer Service Centre on 136 186, email customer.service@deeca.vic.gov.au, or contact the National Relay Service on 133 677. Available at the DEECA website (www.deeca.vic.gov.au).

Species-specific research for onshore renewables: South-eastern Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*)

Literature review and research report

Inka Veltheim[1], Richard Hill[2], Paul D. Moloney[1], Danny I. Rogers[1], Phoebe V. Macak[1], Renee J. Douma[3], Grace E. Lewis[1] and Lindy F. Lumsden[1]

[1] Arthur Rylah Institute for Environmental Research
Department of Energy, Environment and Climate Action
123 Brown Street, Heidelberg, Victoria 3084

[2] Department of Energy, Environment and Climate Action
30 Little Malop Street, Geelong, VIC 3220

[3] School of Biological Sciences, Monash University
Wellington Road, Clayton, VIC 3800

Arthur Rylah Institute for Environmental Research

Project contributions

This project involved collaboration between researchers at the Arthur Rylah Institute for Environmental Research (ARI) and the Department of Energy, Environment and Climate Action (DEECA) Geelong regional office. Significant data contributions were made by the South-eastern Red-tailed Black-Cockatoo Recovery Team members (see Acknowledgements).

Project contributions were as follows:

- Project coordination; contract management; Department of Climate Change, Energy, the Environment and Water (DCCEEW) liaison: Lindy Lumsden, Tracey Regan, Inka Veltheim
- Project design and development: Richard Hill, Inka Veltheim
- Field data coordination and collection: Inka Veltheim, Renee Douma
- Writing of the literature review: Inka Veltheim, Richard Hill, Danny Rogers
- Preparation of data for analysis: Inka Veltheim, Renee Douma, Grace Lewis
- Analysis for the research report: Inka Veltheim, Paul Moloney
- Writing of the research report: Inka Veltheim, Richard Hill, Paul Moloney, Danny Rogers, Phoebe Macak

Acknowledgements

This project was funded by the Australian Government under the Renewables Environmental Research Initiative (RERI). We thank multiple staff in the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for facilitating the funding and stakeholder consultation, and for providing reviews of drafts. We thank the RERI team in particular for facilitating this funding and for providing project support.

Hayley Bignell (ARI) provided project and administrative support and assisted with the preparation of this report. Additional project support and advice was provided by Tracey Regan (ARI).

We thank BirdLife Australia, particularly Rachel Farran, for providing access to data on South-eastern Red-tailed Black-Cockatoo sightings and for landholder liaison. We thank the private landholders for access onto their properties. We thank the South-eastern Red-tailed Black-Cockatoo Recovery Team for providing a habitat distribution map. We thank Kristin Campbell for helpful information on field methods prior to the surveys. We thank Rohan Clarke for useful discussions about flight height data collection, and Ben Fanson for discussion about sampling design. We thank Peter Copley of the South-eastern Red-tailed Black-Cockatoo Recovery Team for an expert review of the report, Emmi van Harten for an internal ARI review, and Martine Maron for additional comments.

Disclaimer

This publication may be of assistance to you but the State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

The views and opinions expressed in this publication do not necessarily represent the views of the Australian Government or the portfolio ministers for the Department of Climate Change, Energy, the Environment and Water.

The Australian Government acting through the Department of Climate Change, Energy, the Environment and Water has exercised due care and skill in assisting in preparing the information and data in this publication. Notwithstanding, the Department of Climate Change, Energy, the Environment and Water, its employees and advisers disclaim all liability, including liability for negligence and for any loss, damage, injury, expense or cost incurred by any person as a result of accessing, using or relying on any of the information or data in this publication to the maximum extent permitted by law.

This document is designed to be an additional source of information. It is not a statutory document or policy statement. If information diverges, the information in the statutory document(s) and policy statement(s) take precedence over this document. This document should be used in parallel with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance, relevant conservation advices, recovery plans and/or referral guidelines and guidance.

Contents

EXECUTIVE SUMMARY 1

LITERATURE REVIEW 3

1 Introduction 3

2 Species description and identification 4

2.1 Taxonomy 4
2.2 Description 4
2.3 Identification 4

3 Conservation status 5

4 Distribution and population size 6

4.1 Distribution 6
4.2 Population size and trend 8

5 Traits, population dynamics, and demographic parameters 9

5.1 Traits relevant to collision risk 9
5.2 Population dynamics and demographic parameters 10

6 Habitat requirements 13

6.1 Diet and foraging behaviour 13
6.2 Nutrition and energetics 13
6.3 Roosting 13
6.4 Drinking 13
6.5 Breeding and nesting 13
6.6 Non-breeding habitat 14
6.7 Important foraging habitat features 14
6.8 Important and critical habitat 16

7 Movement behaviour 17

7.1 Daily activity patterns 18
7.2 Nocturnal activity patterns 18
7.3 Social behaviour patterns 18
7.4 Home ranges, ranging behaviour, and dispersal 18
7.5 Long-distance movements and dispersal 18
7.6 Flight height 19

8 Threats 20

8.1 Historical 20
8.2 Current 20
8.3 Future and emerging 21

9 Conservation actions 22

9.1 Habitat protection 22
9.2 Habitat supplementation 22

10 Risks associated with renewable energy and critical minerals development 23

10.1 Wind 23

10.1.1 Collision 23
10.1.2 Avoidance 23
10.1.3 Attraction 23
10.1.4 Habitat loss 23
10.2 Solar 24
10.2.1 Avoidance 24
10.2.2 Attraction 24
10.2.3 Habitat loss 24
10.3 Critical minerals 24
10.3.1 Avoidance 24
10.3.2 Attraction 24
10.3.3 Habitat loss 24
10.4 Current, proposed and likely projects within the South-eastern Red-tailed Black-Cockatoo range 24
10.4.1 Wind 24
10.4.2 Solar 25
10.4.3 Critical minerals 25
10.5 Renewable energy development impacts on the South-eastern Red-tailed Black-Cockatoo 25
10.5.1 Population-level impacts 25
10.5.2 Cumulative impacts 25
11 Managing renewable energy impacts—measures for avoiding, mitigating and offsetting 26
11.1 Avoiding impacts 26
11.2 Mitigating impacts 27
11.2.1 Turbine collision 27
11.2.2 Roads, tracks and structures 28
11.2.3 Tailings dams 28
11.3 Offsetting impacts 28
12 Survey and assessment methods 29
12.1 Current assessment standards and guidelines—presence surveys 29
12.2 Annual counts—flock presence and abundance surveys 29
12.3 Survey and risk assessment approaches for renewable energy projects 29
12.4 Information needs for renewable energy surveys and risk assessment 30
12.4.1 Detection and occupancy 30
12.4.2 Population and abundance 30
TARGETED RESEARCH 31
13 Background and context 31
13.1 Aims 31
14 Methods 32
14.1 Study area and site selection 32
14.2 Selection of observation points 32
14.3 Tree height data and flight height calibration 32
14.4 Data collection 33
14.4.1 Timing of flight height data collection 33
14.4.2 Flights over cleared land and treed habitat 33

14.4.3 Habitat use and general movement behaviour 33
14.4.4 Tree heights 33
14.5 Data analysis methods 34
14.5.1 South-eastern Red-tailed Black-Cockatoo flight heights 34
14.5.2 Probability of flights within the rotor-swept height zone 34
14.5.3 Tree heights 34
15 Results 36
15.1 Proportion of flights over cleared land 36
15.2 South-eastern Red-tailed Black-Cockatoo flight height 36
15.3 Tree heights 38
15.4 Habitat use and general movement behaviour 39
16 Discussion 40
16.1 South-eastern Red-tailed Black-Cockatoo flight heights and collision risk 40
16.2 Tree height and relationship to flight heights 41
16.3 Habitat use and general movement behaviour 42
16.4 Study limitations 42
16.5 Conclusions and summary of implications 42
KNOWLEDGE GAPS AND RESEARCH RECOMMENDATIONS 44
17 Knowledge gap summary 44
17.1 Renewable energy and critical minerals 44
17.2 Relevant information on other congeneric black-cockatoos for filling knowledge gaps 46
17.3 Recommendations and further research 46
References 48
Appendices 52
Appendix 1: Field sites visited 52
Appendix 2: Flight height data collection 54
Appendix 3: Model parameter estimates 55
Appendix 4: Movement distances recorded 58

Tables

Table 1. South-eastern Red-tailed Black-Cockatoo morphometric data relevant to collision risk modelling. ... 9
Table 2. South-eastern Red-tailed Black-Cockatoo behavioural data relevant to collision risk modelling. 10
Table 3. South-eastern Red-tailed Black-Cockatoo population dynamics relevant to collision risk modelling. 11
Table 4. South-eastern Red-tailed Black-Cockatoo flight data relevant to collision risk modelling. 19
Table 5. Number of Red-tailed Black-Cockatoo flights over cleared land and treed habitat. 36
Table 6. Knowledge gaps relevant to conservation of South-eastern Red-tailed Black-Cockatoos. 44

Figures

Figure 1. Known range and mapped extent of the South-eastern Red-tailed Black-Cockatoo. 7
Figure 2. Estimated South-eastern Red-tailed Black-Cockatoo flight height across locations and time of day from the posterior distributions. 37
Figure 3. Estimated posterior distribution for South-eastern Red-tailed Black-Cockatoo flight height across locations and time of day 38
Figure 4. Estimated tree height across locations and habitats. 39

EXECUTIVE SUMMARY

Purpose

The Australian Government's Renewables Environmental Research Initiative (RERI) supports a more efficient transition to renewable energy while helping Australia meet net-zero targets and protecting biodiversity. A key component of this initiative, led by the Department of Climate Change, Energy, the Environment and Water (DCCEEW), is improving understanding of how renewable energy development may affect 36 priority threatened species.

This report focuses on one of those species, the South-eastern Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*)—a threatened and restricted subspecies of the Red-tailed Black-Cockatoo that is vulnerable to impacts that lead to habitat loss, poor breeding success and increased mortality.

The report is intended for renewable energy proponents and consultants, regulators, researchers, birdwatchers, those involved in the subspecies recovery, and anyone interested in the potential impacts of renewable energy development on the subspecies. The objective is to support faster, better-informed decisions regarding renewable energy development under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Methods

Prior to the commencement of this project, a stakeholder consultation workshop was held on 3 September 2025 to engage and seek feedback on the proposed literature review and targeted research flight height study. Comments and feedback were incorporated into the design of the research undertaken.

The literature review used multiple sources to identify scientific papers, reports, and high-quality unpublished information, including all unpublished documents held by the South-eastern Red-tailed Black-Cockatoo Recovery Team on the ecology and behaviour of the South-eastern Red-tailed Black-Cockatoo.

Flight height was identified as a key knowledge gap in assessing wind turbine collision risk for this species. The targeted research focused on addressing this knowledge gap through a field study, which collected flight height data to improve our understanding of how frequently this species may fly at turbine blade height, and of how often turbine collisions may occur. The study focused on two sites in the Edenhope area: Yallakar State Forest (Yallakar) and Jilpanger Nature Conservation Reserve (Jilpanger). Flight height data was collected visually in the field by observers estimating flight heights of South-eastern Red-tailed Black-Cockatoo. Estimation of flight heights was by comparison with objects of known height (determined using a laser rangefinder). Tree heights for the habitats at each location were also determined, to evaluate the potential influence of canopy height on flight heights. The flight height data from the two locations were used to model South-eastern Red-tailed Black-Cockatoo flight heights.

The final section of this report is a summary of the knowledge gaps that remain and an outline of the additional research that is recommended for a more comprehensive understanding of South-eastern Red-tailed Black-Cockatoo ecology, behaviour and demographics. This knowledge is needed to assist with decision-making around wind, solar and critical minerals development assessments under the EPBC Act.

Findings

The main risks to this subspecies from renewable energy development are turbine collision risk from wind energy projects and removal of habitat or exposure to toxic drinking water in tailings dams through critical minerals mining.

Based on current knowledge, South-eastern Red-tailed Black-Cockatoos may commute up to 5 km between nesting, roosting and foraging habitats on a daily basis, with the timing of these flights being regular and predictable, related to sunrise, sunset, and civil twilight times. Much less is known about their nomadic, longer-distance movements, or about their movement and flight behaviour at other times of the day or year. On occasion they are known to move large distances throughout their range in search of food. Anecdotal observations of these flights suggest that birds will fly over cleared land during the day, but the frequency and timing of this behaviour is not known.

In this study, a total of 692 flights of South-eastern Red-tailed Black-Cockatoos were recorded when birds were flying between roosting sites and the foraging habitat in the mornings and evenings. Of these flights, 46% were over cleared land and 54% were in or over the canopy of woodland habitat. These findings are similar to those of a previous flight study in the Edenhope area.

Avoiding habitat loss in all projects is an important measure for avoiding and minimising development-related population impacts and further declines of the South-eastern Red-tailed Black-Cockatoo. Mitigation

measures for reducing turbine collision risk for the South-eastern Red-tailed Black-Cockatoo are untested and require further investigation. However, knowledge on the daily movement distances and flight heights of the subspecies can inform avoidance and mitigation measures. Using the data collected, the model predicted that, on average, for both study sites, South-eastern Red-tailed Black-Cockatoo flights over cleared land will be at or below 15 m above the ground, which is below the lowest rotor-blade-tip heights. However, variability in the flight height results between the two study sites (Yallakar and Jilpanger) suggests that collision risk is behaviour-, site- and context-dependent. These findings indicate that potential collision impacts around nesting, foraging and roosting could be minimised or reduced by excluding turbines from within 5 km of roosting and foraging habitats. If turbines are located within 5 km of suitable South-eastern Red-tailed Black-Cockatoo habitat, stopping blades from spinning in the morning and evening when the birds are moving between roosting and foraging habitat could also reduce collision risk. Great uncertainty remains about the collision risk during long-distance flights (any flights >5 km). Positioning blades above 65 m from the ground, or ideally from the height of the tree canopy, is likely to greatly reduce the collision risk (though a small number of flights may occur above 65 m). Although untested, automated turbine shutdowns on demand using technology that can reliably detect South-eastern Red-tailed Black-Cockatoos may be effective in reducing the collision risk; however, research to determine the efficacy of this strategy in reducing the collision risk for this subspecies is needed.

Flight height study limitations

The flight study was undertaken in spring (20–24 October and 26–30 October) 2025. The study focused on understanding short-distance, daily flight behaviour at two sites at which frequent flights between roost and feeding areas were known to occur only in the morning and evening. The study increased understanding of daily flight behaviour for non-breeding flocks of the subspecies, and results were consistent with those from a similar previous study in the same part of the subspecies' distribution (Biosis 2020). The main limitations of this study were the short duration of the data collection period, the limited number and spatial extent of the survey sites, and the incomplete survey coverage across the diurnal and annual cycles. Due to the study limitations, generalisations beyond the survey area, for other times of the day, for other times of the year, and for other years, are not possible.

Study of the longer-distance flights that can occur throughout the year, as the subspecies moves to access changing food resources and nesting trees, was outside the scope of this project. The South-eastern Red-tailed Black-Cockatoo may also disperse long distances during or after bushfires, and study of that flight behaviour was also outside the scope of the current study. Due to the nomadic behaviour of the subspecies, and the unpredictable and irregular movements caused by bushfires, information on long-distance flights is very difficult to collect using observational field studies. Similarly, other flights throughout the day (including flights between habitats, circling, or when being flushed by birds of prey) may be more difficult to predict and study using such methods. Based on current knowledge from the literature and anecdotal observations, flight behaviour is also likely to be different when water sources in and around the forest tracks dry up.

How to use this report

This report has three key components:

- Literature review: This provides detailed background information and summarises current knowledge on the ecology and behaviour of South-eastern Red-tailed Black-Cockatoos in relation to the main likely impacts of collision risk from wind turbines and of habitat loss from wind, solar, and critical minerals development.
- Targeted research: This research collected important flight height data for South-eastern Red-tailed Black-Cockatoos relevant to renewable energy planning and assessment.
- Knowledge gaps and research recommendations: This section documents the knowledge gaps identified in the literature review and remaining after the targeted research, and outlines further research required for a more comprehensive understanding of South-eastern Red-tailed Black-Cockatoo ecology, behaviour and demographics. It ties together the findings from Part A (the literature review) and Part B (the targeted research) that are most relevant when considering, assessing, avoiding, mitigating and offsetting impacts from renewable energy development on the South-eastern Red-tailed Black-Cockatoo.

Together, these components provide practical information to guide development, planning, and conservation management that can assist with assessing wind, solar, and critical minerals development proposals under the EPBC Act in relation to the South-eastern Red-tailed Black-Cockatoo.

LITERATURE REVIEW

1 Introduction

The South-eastern Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*) is a threatened and restricted subspecies of the Red-tailed Black-Cockatoo (*Calyptorhynchus banksii*). It is restricted to south-eastern Australia on the border of Victoria and South Australia. It is listed as 'Endangered' nationally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and characterised by a small population size, low reproductive output, nomadic movements, flocking behaviour and a strong dependence on a limited and spatially fragmented set of food resources. These biological, behavioural and ecological traits, combined with a restricted range, increase the subspecies' vulnerability to anthropogenic impacts, including those associated with renewable energy and related infrastructure developments.

Renewable energy development is expanding across the subspecies' range, with one operational wind farm currently located in South Australia and additional wind projects approved but not yet constructed in Victoria. The primary risks to the South-eastern Red-tailed Black-Cockatoo from renewable energy developments include mortality associated with collision with wind turbines and the loss, degradation or fragmentation of foraging, nesting, roosting and drinking habitats during their construction and operation. There is also potential for disturbance and displacement, with possible flow-on consequences for individual fitness, survival and breeding success, if birds are excluded from, or constrained in their access to, critical habitat resources. Additional risks may arise from their use of artificial water sources, such as toxic tailings dams, which the subspecies may use for drinking in modified landscapes.

The ecological characteristics of the South-eastern Red-tailed Black-Cockatoo present particular challenges for impact assessment. The subspecies forms large flocks and undertakes daily and longer-term nomadic movements across a highly fragmented agricultural landscape, frequently flying at heights that may intersect with the rotor-swept zone of wind turbines (Biosis 2020). However, empirical data on flight height, movement pathways, and habitat connectivity remain limited, and such behaviours are difficult to detect or quantify using conventional bird habitat utilisation surveys or short-term targeted survey methods. The subspecies may be absent from otherwise suitable habitat in some years and present in others, depending on the availability of key food resources, resulting in low detectability and thus high uncertainty when interpreting the survey results for development assessments.

Given these uncertainties, a better understanding of the ecology of the South-eastern Red-tailed Black-Cockatoo is essential for assessing the risks associated with renewable energy developments and for informing mitigation, avoidance, and impact management measures. This literature review synthesises the available published and unpublished information relevant to the ecology of the South-eastern Red-tailed Black-Cockatoo, with a particular focus on traits and behaviours relevant to collision risk, habitat loss and fragmentation, disturbance, and displacement. In doing so, it responds to a knowledge gap identified by the Department of Climate Change, Energy, the Environment and Water (DCCEEW), drawing on information from across the *Calyptorhynchus* genus where species-specific data are limited, with any such extrapolations clearly identified.

2 Species description and identification

2.1 Taxonomy

The Red-tailed Black-Cockatoo (*Calyptorhynchus banksii*) is a large black-cockatoo with coloured tail panels, a rounded erectile crest and loud rolling flight calls. Genomic analyses have identified five strongly demarcated subspecies in Australia (Ewart et al. 2020), including:

- South-eastern Red-tailed Black-Cockatoo (*C. banksii graptogyne*) (south-west Victoria and south-east South Australia)
- Northern Red-tailed Black-Cockatoo (*C. b. banksii*) (northern Australia and the Queensland coast)
- Forest Red-tailed Black-Cockatoo (*C. b. naso*) (forested south-western Australia)
- Inland Red-tailed Black-Cockatoo (*C. b. samueli)* (disjunct populations in western New South Wales, western Queensland and central Australia)
- Western Red-tailed Black-Cockatoo (*C. b. escondidus*) (northern wheatbelt of Western Australia, the Murchison and the Pilbara).

Saunders and Pickup (2023) reviewed the taxonomy of Australia's endemic Calyptorhynchinae black-cockatoos. Based on their morphology, ecology, biology, vocalisations and distributions, they proposed elevating the five Red-tailed Black-Cockatoo subspecies to full species. However, this taxonomic revision has not been widely adopted or reflected in current Australian threatened species listings (e.g. AviList Core Team 2025). The South-eastern Red-tailed Black-Cockatoo is the smallest subspecies of Red-tailed Black-Cockatoo. Compared with the other subspecies, it has a proportionately smaller bill, and it lacks a step in the cutting edge of the upper mandible. The adult females are more brightly marked than the adult females of the other subspecies (Higgins 1999).

2.2 Description

This species description is based on Higgins (1999).

Adult male: Glossy black with broad, bright red panels in tail, conspicuous when taking off or landing but otherwise normally visible only from below. Bill, dark grey; ring around the eye, dark grey.

Adult female: Plumage is duller black than that of males. The head, neck and inner upperwing coverts are marked with pale yellow spotting. The underparts and leading underwing coverts are barred with pale orange-yellow. The tail contains large yellow panels, in some individuals grading to pale orange-yellow towards the tip; these panels are narrowly and irregularly barred with black and may show fine black speckling. The bill is off-white.

Juvenile: Similar to adult female, but the yellow barring of the underparts is narrower and fainter, and the ring around the eye is whitish.

Immature: Post-juvenile moult of body feathers occurs in the first year, and for the next two or so years, immatures are extremely difficult to distinguish from adult females. Analogy with other subspecies suggests they may have slightly darker bills and subtle differences in patterning of breast feathers until approximately 3 years old (Higgins 1999), but these ageing characters are unconfirmed in the *graptogyne* subspecies, and not visible in field views. Males develop full adult plumage (including the black bill) when 3–4 years old.

2.3 Identification

Within their range, Red-tailed Black-Cockatoos can be confused with Yellow-tailed Black-Cockatoos (*Zanda funerea*). Both species are large black-cockatoos with long tails, buoyant flight, and slow deep wingbeats. However, their flight calls are diagnostic: Red-tailed Black-Cockatoo calls are a loud and somewhat metallic '*kree*' or '*kruurr-rr*'; Yellow-tailed Black-Cockatoo calls are a slow and wailing '*whee-la*'. If visible, the species have obvious differences in plumage. The Yellow-tailed Black-Cockatoo has large yellow cheek patches and large yellow tail panels, and they lack the red tail panels of the male South-eastern Red-tailed Black-Cockatoo. Female, juvenile and immature South-eastern Red-tailed Black-Cockatoos have characteristic yellow spotting on the head, which Yellow-tailed Black-Cockatoos lack, which can be a distinguishing feature even at a distance.

3 Conservation status

The South-eastern Red-tailed Black-Cockatoo is listed as Endangered nationally under the Commonwealth EPBC Act, and Endangered under the Victorian *Flora and Fauna Guarantee Act 1988* and the South Australian *National Parks and Wildlife Act 1972*. It is also deemed Endangered in the Action Plan for Australian Birds (Hill et al. 2021), due to its small population size, habitat loss, and low recruitment in recent years. A national recovery plan for the South-eastern Red-tailed Black-Cockatoo has been prepared (Commonwealth of Australia 2007). An updated recovery plan for 2022–2027 exists in draft form (Koch et al. 2022).

4 Distribution and population size

4.1 Distribution

The South-eastern Red-tailed Black-Cockatoo is restricted to a small area of approximately 18,000 km^2 in south-eastern Australia (Figure 1), and it occupies approximately 28% of this area (Burnard and Hill 2002). Its range extends either side of the Victorian and South Australian border, within an area bounded by the regional towns of Portland and Horsham (Victoria), and Bordertown and Mount Gambier (South Australia) (Commonwealth of Australia 2007).

South-eastern Red-tailed Black-Cockatoos breed throughout their range wherever suitable nest trees persist (Figure 1). They nest in old trees with large hollows, using trees in continuous forest or isolated trees in paddocks (Joseph et al. 1991). Cockatoos are more likely to nest in areas with a greater extent of stringybark feeding habitat within 2–5 km (Hill and Burnard 2001; SERTBC RT unpublished). The distribution of feeding habitat for South-eastern Red-tailed Black-Cockatoo has been modelled by Newell et al. (2016).

The non-breeding range of the South-eastern Red-tailed Black-Cockatoo is defined as all suitable habitat within the known range (Figure 1). Extra-limital records outside the known range do occur from time to time but are not clustered (e.g. Joseph 1982; Baird 1986).

The distribution of the South-eastern Red-tailed Black-Cockatoo appears to be limited by its requirement for the seeds of both Brown Stringybark (*Eucalyptus baxteri*) and Desert Stringybark (*E. arenacea*) (Hill unpublished). Brown Stringybark is widely distributed throughout southern Victoria and south-eastern South Australia (Costermans 2009), but it does not occur in adjacent areas north of the subspecies' range (Koch 2003). Desert Stringybark has a localised distribution north to the Big Desert in Victoria and the upper south-east mallee (Brooker and Kleinig 1990), and it extends as far south as Casterton (Koch 2003). Baird (1986) suggested that the former range of the South-eastern Red-tailed Black-Cockatoo extended east almost to Melbourne on the basis of two 19th-century records between the Grampians and Melbourne, but that suggestion was made before Desert Stringybark and its importance as food for South-eastern Red-tailed Black-Cockatoos had been described. The South-eastern Red-tailed Black-Cockatoo requirement for both species of stringybark makes this suggestion of a historical range far more eastward unlikely. Records of this species well outside their current normal range probably do not indicate a much more extensive former range, but rather occasional nomadic foraging movements, as suggested by Joseph (1982).

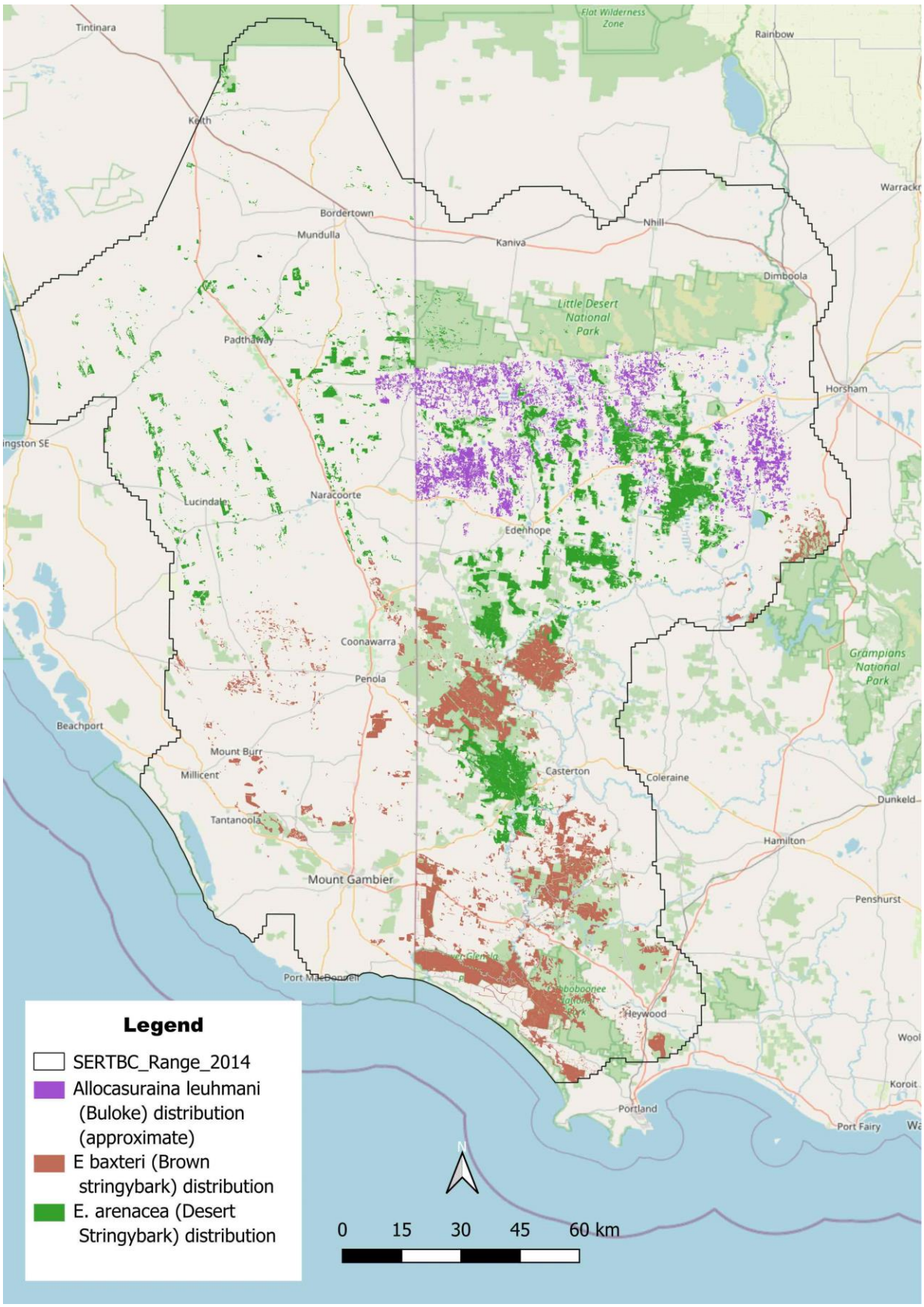


Figure 1. Known range and mapped extent of the South-eastern Red-tailed Black-Cockatoo.

The map primarily shows stringybark feeding-habitat extent, noting that all Buloke and suitable dead and live hollow-bearing eucalypts within the South-eastern Red-tailed Black-Cockatoo range are suitable habitat. Buloke mapping in this figure shows regions where they occur as scattered trees rather than contiguous habitat (Source: SERTBC RT unpublished).

4.2 Population size and trend

The South-eastern Red-tailed Black-Cockatoo exists as a single population within its distributional range, and there are believed to be about 1400 individuals remaining (Russell et al. 2017). The population is assumed to have declined over time due to the loss of both the amount and quality of stringybark and Buloke habitat.

The population trend measure used for the South-eastern Red-tailed Black-Cockatoo is the proportion of barred birds within flocks each autumn. In 'flock counts', the proportions of male plumage birds and of barred individuals are determined. Barred individuals include all females, juveniles and subadults. This provides an index of the level of successful breeding in the three preceding years (during which period juveniles and subadults are indistinguishable from adult females). Increased production of juveniles should cause an increase in the proportion of barred individuals within flocks. There was a significant decline in the mean proportion of barred birds in flock counts of South-eastern Red-tailed Black-Cockatoos between 2002 and 2021 (Hill and McPherson 2022; Koch et al. 2022). This could be explained by declining proportions of juveniles and subadults up to 3 years of age (after which males assume adult plumage), declines in adult female numbers, or both scenarios. The results indicate an ongoing decline in total population size, with an increased rate of decline between 2015 and 2022 (Koch et al. 2022).

5 Traits, population dynamics, and demographic parameters

Morphometric traits, behavioural patterns, and demographic information are important considerations for assessing the risk of turbine collision and the population consequences of mortalities, which in turn are important in wind energy project impact assessments. Numerous models (>50) and input parameters (75) have been used to assess wind energy collision impacts on birds. The required input parameters include data specific to the bird species, to the particular wind energy project and to the proposed types of turbine (Cook et al. 2025). Most commonly, the bird-specific morphometric and behavioural parameters used include body length, wing length, weight, flight speed, and avoidance rate (i.e. the probability that a bird avoids collision with a turbine). Additionally, time spent in the rotor-swept area and the number of individuals estimated to be exposed to turbine risk (e.g. within a given project area) are important inputs. Population viability analysis (PVA) can inform understanding of the population consequences, given the estimated collision risk and the predicted mortality, as determined by collision risk modelling. PVAs are also informative in assessing the population-level benefits of mitigation measures, for example, where mortality of individuals needs offsetting. PVAs require data inputs for demographic parameters and population dynamics. Where specific parameter information is missing, PVAs may use expert-elicited information.

5.1 Traits relevant to collision risk

The South-eastern Red-tailed Black-Cockatoo is a medium-sized bird with relatively low wing-loading, which enhances manoeuvrability for flying within forested landscapes. Low wing-loading is associated with lower collision risk (e.g. Janss 2000). Some data on body length, wing length, and weight data, all of which influence flight capability and are relevant to the calculation of collision risk, are known for the South-eastern Red-tailed Black-Cockatoo (Table 1; Table 2). These tables also summarise the gaps in knowledge for informing collision risk models.

Table 1. South-eastern Red-tailed Black-Cockatoo morphometric data relevant to collision risk modelling.

Data on morphometrics from Higgins (1999). Behavioural, population size, and group/flock size parameters are generally also required as collision risk model inputs, including site-specific details for a given project.

Morphometric trait	Value	Further information
Body length (cm)	55–60	This measurement (from bill tip to tail on a bird lying flat) is for the Red-tailed Black-Cockatoo (subspecies combined). It is not known if the available samples included any South-eastern Red-tailed Black-Cockatoos. Being the smallest subspecies, the total length *of C. b. graptogyne* is likely at the lower end of this range.
Wingspan	Unknown	No information
Wing length (mm)	378.8 (standard deviation: 9.52; range:363–389; *n*: 8)	Values from skins of the South-eastern Red-tailed Black-Cockatoo *C. b. graptogyne* Wing length for a single juvenile: 348 mm
Tail length (mm)	245.3 (standard deviation: 17.60; range: 220–271; *n*: 8)	Values from skins of the South-eastern Red-tailed Black-Cockatoo *C. b. graptogyne* Tail length for a single juvenile: 248 mm [included as it can be used in some flight agility models (e.g. Janns 2000), and because the data on total length and wingspan for this species is sparse]
Weight (g)	612.4 (range: 587–640)	Average value for *C. b. graptogyne*, based on weights of three adult males and two adult females

Table 2. South-eastern Red-tailed Black-Cockatoo behavioural data relevant to collision risk modelling.

Morphological and population dynamics parameters, and other behavioural parameters are generally also required as collision risk model inputs, including site-specific details for a given project. RERI = Renewables Environmental Research Initiative

Behavioural trait	Value	Further information
Flight speed	Unknown	No empirical information
Flight height and exposure to risk	Limited knowledge	A single study on flight heights at two locations near Edenhope (Victoria) (Biosis 2020) and a more recent flight study conducted as part of the RERI project (see Knowledge gaps and research recommendations section in this report)
Avoidance rate	Unknown	Commonly, collision risk models use avoidance rates of 90% to 99% for all species (Smales et al. 2013; Cook et al. 2018). No information exists on turbine or powerline avoidance behaviour or collision rates[1]. Museums Victoria has had specimens handed into the collection from road collisions.

[1]Organisations/experts contacted for information on powerline collisions: for South-eastern Red-tailed Black-Cockatoo—Museums Victoria, South Australian Museum, Wildlife Victoria, SA Power Networks, and a wildlife vet specialising in birds; for black-cockatoos—Murdoch University (Western Australia).

5.2 Population dynamics and demographic parameters

Knowledge on South-eastern Red-tailed Black-Cockatoo breeding ecology is limited due to challenges with locating and monitoring nests and individuals over time (Joseph et al. 1991; Koch 2022). Given their small population size, and low reproductive output and breeding success, even relatively small increases in mortality (such as those that may be associated with wind energy developments) could cause population decline (Saether and Bakke 2000). PVAs for the South-eastern Red-tailed Black-Cockatoo have been generated using primarily expert-elicited demographic parameters as well as breeding success data; however, these PVAs are unpublished and not publicly available. A PVA designed particularly for the subspecies has been developed more recently as part of another RERI project. While it is not publicly available at the time of preparation of this literature review, once published, it should be referred to when undertaking wind energy project assessments. This section outlines the information requirements for the PVA and the current published knowledge that is and is not available, which is summarised in Table 3.

The subspecies is long-lived, with a maximum life span of more than 30 years in the wild (Koch et al. 2022) and up to 50 years in captivity (Birdfact 2026). Their mating system is monogamous and adult males make up about 43% of the total population (SERTBC RT unpublished). The remaining proportion of the population consists of females and young birds less than 3 or 4 years of age. The information on age to maturity is from captive studies summarised by Higgins (1999), but it does not specify the subspecies. It includes one report on adult bill colour being attained in the third year and one report of a bird reaching maturity at 4 years of age.

Sex ratio is an important consideration for understanding population dynamics and growth but is unknown and difficult to establish for the South-eastern Red-tailed Black-Cockatoo due to two factors. First, it is not possible to visually distinguish females from immature birds, due to their plumage similarities. Second, obtaining sex ratios through monitoring nests is not feasible, because nesting attempts and tree use can vary between years.

South-eastern Red-tailed Black-Cockatoos can breed and successfully fledge chicks throughout the year (Commonwealth of Australia 2006), but most nesting occurs in spring and summer (Koch et al. 2022), from September to December (Attiwill 1972; Emison et al. 1995; Burnard and Hill 2002; Commonwealth of Australia 2006). Re-nesting after breeding failure may occur in January–February in summer or in autumn (Emison et al. 1995; Commonwealth of Australia 2006).

The subspecies has a low reproductive output, laying a single egg for each breeding attempt. The number of pairs nesting and nest tree use varies annually (Koch et al. 2022), and the annual or long-term average of nesting pairs and attempts is unknown. Estimates of breeding success (from multiple methods) have varied

from 10% to 50% (Hill unpublished). A high breeding failure rate relative to nesting attempts is likely (Koch et al. 2022). Predation is known to cause breeding failure, and low incubation and brooding rates may impact on egg and chick survival (Koch et al. 2022). Reduced nest attendance is thought to be linked to food availability and daily foraging requirements (Koch et al. 2022), as well as to annual breeding success and recruitment. However, detailed knowledge of the rates, role, dynamics and impact of potential nest predators and of reduced nest attendance on breeding success is lacking.

Table 3. South-eastern Red-tailed Black-Cockatoo population dynamics relevant to collision risk modelling.

Morphological and behavioural trait parameters, and other population size, and group/flock size parameters are generally also required as collision risk model inputs, including site-specific details for a given project. A population viability analysis (PVA) model currently being developed under another Renewables Environmental Research Initiative (RERI) project will include further documentation, including notes on estimation of other parameters required for analysis (Leihy et al. 2026).

Parameter	Currently known	Unknown and further information
Population size	About 1400 individuals (Hill et al. 2021) The South-eastern Red-tailed Black-Cockatoo occurs as a single population within its 18,000-km^2 range.	No further detail
Reproduction	1 egg laid (Koch et al. 2022) Females incubate and brood young chicks; males feed both until chicks are older (Koch et al. 2022)	Monogamous mating system Pairs are thought to breed each year, but they can nest in different locations from year to year. It is possible they do not all attempt breeding, especially in years with low-yield seed crops. It is unknown whether late nesting may influence breeding success in the following breeding season—for example, whether pairs with dependent young breed in the following breeding season. There is some unquantified loss of eggs and chicks to predation or usurpation of nesting hollows by other species. Breeding failure may also occur—for example, due to inadequate incubation or low nest attendance (Jarmyn 2000). These issues may be linked to food availability, which may affect the ability of the male's capacity to meet its daily food requirements and those of the chick and the female (Koch et al. 2022). Known nest predators are Brush-tailed Possums (*Trichosurus vulpecula*) and Little Ravens (*Corvus mellori*). Other possible predators include currawongs (*Strepera* spp.), Lace Monitors (*Varanus varius*) and Krefft's Gliders (*Petaurus notatus*) (Koch et al. 2022). Although South-eastern Red-tailed Black-Cockatoos have been reported to only lay one egg, there have been reports of two-egg clutches in other subspecies of Red-tailed Black-Cockatoos, but this happens rarely (e.g. only 2 of 118 clutches in Western Australia had two eggs, and the remainder only had one egg) (Higgins 1999).

Parameter	Currently known	Unknown and further information
Sex ratio	Unknown	The precise sex ratio is unknown, as females and young birds cannot be distinguished in the field. Adult males make up about 43% of the total population (SERTBC RT unpublished), with a range of 35% to 49% observed in data since 1999 (Koch et al. 2022).
Reproductive maturity	4 years	No further detail
Survival rates	No empirical measures of survival rates for either adults or immature 30% to 38% fledging success (Teixeira 2022; Koch et al. 2022) 13% 0–1-year-olds (poor year); 30% 0–1-year-olds (average year; Hill unpublished data)	Recruitment and age-specific survival of juveniles, immature, and adults are difficult to measure, due to plumage similarities of juveniles, immature, and females. There are no direct measures of survival and recruitment (Koch et al. 2022) because of the absence of long-term marking projects (which are technically difficult in large cockatoos). The maximum age is estimated at >30 years in the wild, and at 50 years in captivity. An indirect index of annual recruitment can be estimated from the relative proportions of adult males to barred birds (which include juveniles, immatures and females) in autumn flock counts. Flock counts that incorporated the proportion of barred birds indicate the population is declining, with a proportionate decrease in barred birds being observed since 2015 (Koch 2022). In 8 of 22 years, the proportion has been <55%. Higher proportions of males to barred birds are linked to recent poor seeding events (Koch et al. 2022). The mortality rates of adults are unknown (Koch et al. 2022).
Environmental stochasticity	Unknown	Environmental stochasticity is probably low, given that the subspecies has high annual survival, and clutch size is capped at one egg. The new PVA model currently under development under the RERI program will use values elicited from experts reflecting environmental stochasticity as model input parameters.
Proportion of adult females that lay eggs each year	Unknown	The new PVA model currently under development under the RERI program will use values elicited from experts for environmental stochasticity as model input parameters.
Population growth	Unknown	The new PVA model currently under development under the RERI program will use values elicited from experts for population growth rate as model input parameters.
Carrying capacity	Unknown	The new PVA model currently under development under the RERI program will use values elicited from experts for carrying capacity as model input parameters.
Density dependence	Unknown	The new PVA model currently under development under RERI program will use values elicited from experts for density dependence as model input parameters.

6 Habitat requirements

6.1 Diet and foraging behaviour

The South-eastern Red-tailed Black-Cockatoo is a highly specialised granivore, feeding primarily on the seeds of Desert Stringybark and Brown Stringybark, and seasonally on the seeds of Buloke. South-eastern Red-tailed Black-Cockatoos preferentially select feed trees with high-density seed crops, which typically are larger trees with high capsule density (Koch 2003). The diameter at breast height (DBH) of Buloke trees preferred by the subspecies is greater than 30 cm (Koch et al. 2022). Suitable feed trees can occur in continuous forest, in paddocks, along roadsides, and on the fringes of remnant vegetation. Isolated paddock trees can have much larger and denser seed crops, as they have less competition for light, water and nutrients (Maron et al. 2008). Both species of stringybark hold seed for up to 3 years. South-eastern Red-tailed Black-Cockatoos prefer to feed on the young seed crops of both species (Attiwill 1960; Joseph 1982; Koch 2003). South-eastern Red-tailed Black-Cockatoos also preference larger Buloke feed trees (>30 cm to 40 cm DBH). The presence of all three tree species is important for continuity of food supply over time. There are also incidental records of South-eastern Red-tailed Black-Cockatoos feeding in Soap Mallee (*Eucalyptus diversifolia*), River Red Gum (*E. camaldulensis*) and Dwarf Sheoak (*Allocasuarina pusilla*).

6.2 Nutrition and energetics

South-eastern Red-tailed Black-Cockatoos spend a considerable amount of each day feeding. Koch (2003) found that birds spent up to 88% of their day foraging in stringybark. Time spent foraging was likely linked to the age of the seed crop, with birds spending only 55% of the day feeding in a first-year stringybark seed crop. Cockatoos appear to optimise their foraging efficiency by preferencing large trees with large seed crops (Koch 2003; Maron and Lill 2004). The role of feeding on Buloke seed in summer and autumn in the nutrition and daily energetic requirements of fledglings and their parents in the post-nesting period is unknown. Similarly, the importance and contribution of Buloke as a food resource for population maintenance and recovery is unknown, noting the relative lack of Bulokes remaining in the landscape (<5%).

6.3 Roosting

South-eastern Black-Cockatoo nesting pairs roost overnight at the nest tree (Koch et al. 2022). During the non-breeding season, South-eastern Red-tailed Black-Cockatoos forage in flocks that can exceed 100 birds; in the evening, several flocks can join together to visit a watering point before moving to a communal roosting site for the night (Koch et al. 2022). Roosting birds of this subspecies utilise clumps of (usually tall) eucalypts, and sometimes use the same site each night for many months (SERTBC RT unpublished). Of 19 roost sites located, 15 (79%) were in copses of River Red Gum, 3 (16%) in copses of Yellow Gum (*Eucalyptus leucoxylon*) and 1 (5%) in copses of Manna Gum (*E. viminalis cygnatensis*). Thirteen of these sites (68%) were on private land. River Red Gum trees chosen for roosting had a DBH of 80 ± 13 cm and an average height of 26 ± 3 m (n = 9). The distance from a roosting tree to the nearest neighbouring tree was 6.2 ± 3.9 m (range 1–11 m; n = 9). Manna Gums chosen for roosting had a DBH of 64 ± 32 cm and an average height of 20 ± 2 m and were 3.9 ± 3.2 m from the nearest neighbouring tree (n = 4).

South-eastern Red-tailed Black-Cockatoos will fly substantial distances to use a traditional roost. For example, two groups were observed regularly flying up to 5 km from feeding sites to roosting sites (Hill unpublished).

6.4 Drinking

South-eastern Red-tailed Black-Cockatoos need to drink at least daily and more often in warmer weather, such as during the hotter months over summer. They use most sources of natural and artificial freshwater within their range. During drier times of the year, South-eastern Red-tailed Black-Cockatoos primarily use stock troughs and dams, which offer more permanent water sources and are generally located in cleared land. During wetter times of the year, they prefer drinking from puddles, from vehicle ruts and shallow pools on tracks and roads, and from unvegetated shallows around wetlands (Hill unpublished). During non-breeding periods, large flocks can gather at watering points in the evening, just before roosting (Koch et al. 2022).

6.5 Breeding and nesting

South-eastern Red-tailed Black-Cockatoos use large hollows (of 15–50 cm in diameter) for nesting. Such hollows occur naturally in larger eucalypts but may take centuries to develop (Gibbons and Lindenmayer 2002). South-eastern Red-tailed Black-Cockatoos use hollows in both living and dead trees, but they appear

to prefer nesting in dead trees if available. Although most of the known nests are in large River Red Gums on private land, they will use any eucalypt that has a suitable hollow (Koch et al. 2022). Nest trees recorded have ranged in height from 8 to 32 m (mean = 17.5 ± 5.0 m; *n* = 69) and in DBH from 48 to 198 cm (115.5 ± 30.0 cm; *n* = 74). Nests were much more likely to be found in dead trees (81% of nest trees, *n* = 97), to be an average of 11.4 ± 3.0 m (*n* = 80) above the ground, and were more likely to be found in 'spouts' rather than in hollows in trunks. Where hollow entrances were not vertical, hollow entrances tended to face north or south, rather than east or west. Nest trees tended to be in farmland rather than woodland. Tree density in farmland in a 1-hectare quadrat, around and including the nest tree, was 3.1 ± 1.7 trees/hectare (*n* = 32). Nest trees were 0.40 ± 0.24 km (*n* = 39) from the nearest potential drinking sites, which included dams, troughs and lakes.

South-eastern Red-tailed Black-Cockatoo nest trees can be highly clumped, with several pairs nesting within a 50-hectare area. Two active nests have been recorded in a single tree, but that was an exception. South-eastern Red-tailed Black-Cockatoos may share nest trees with Yellow-tailed Black-Cockatoos. South-eastern Red-tailed Black-Cockatoos are highly faithful to breeding sites and individual nest trees, returning to use the same area—and the same tree, if it remains suitable. However, the annual return rate is only about 25%, due to great interannual variation in foraging habitat patch quality. Nest density is therefore very dynamic. For example, in an area near Casterton, the number of active nest trees varied from 1 to 13 and the local population size of South-eastern Red-tailed Black-Cockatoos varied from 30 to 350.

South-eastern Red-tailed Black-Cockatoos typically nest close to their stringybark feeding habitat, within 4–5 km of stringybark patches (Hill and Burnard 2001; Koch et al. 2022; Wardle 2022). The extent of stringybark woodland within 4 km of nest sites is the most important determinant of the subspecies' nesting location (Koch et al. 2022; Duong and Maron unpublished). In addition, the extent of Desert Stringybark is strongly positively associated with nesting sites, and nesting is less likely to be recorded when the surrounding landscape is dominated by cropping—presumably this is because of the lower density of scattered paddock trees in areas where cropping is a major land use (SERTBC RT unpublished).

As reported for several other species of black-cockatoos, South-eastern Red-tailed Black-Cockatoos will nest in artificial supplementary hollows (Koch et al. 2022) as well as in natural hollows. The current recommended design for artificial supplementary hollows for three species of black-cockatoos (including the Red-tailed Black-Cockatoo) in south-western Australia has been described by the Department of Biodiversity, Conservation and Attractions (DBCA 2023). Koch (2019a) modelled large hollow availability across the range of the South-eastern Red-tailed Black-Cockatoo, using paddock tree density as a proxy and showed it was an influential variable. In response, priority areas were identified for supplementation with large artificial hollows and priority areas for revegetation, with the objectives of increasing potential nesting sites close to food sources and of increasing food sources close to potential nesting sites. A total of 100 new nest boxes were installed in 2019–2020 in locations with relatively low paddock tree density (Koch 2019a). Nest boxes may not always be successful and require maintenance and management. Although nest boxes can supplement nesting habitat, this management action is not considered a replacement for old or dead gum trees that provide natural hollows. Nest box uptake is relatively low for South-eastern Red-tailed Black-Cockatoos (SERTBC RT unpublished), for example, compared with Kangaroo Island Glossy Black-Cockatoos (*Calyptorhynchus lathami halmaturinus*), which readily attempt to nest in boxes installed as part of their recovery program (80% of nesting attempts in 2023) (Berris et al. 2023). Nest box uptake and success for the South-eastern Red-tailed Black-Cockatoo requires monitoring to understand the likelihood of use and fledging success (Koch et al. 2022). Predation of eggs by Krefft's Gliders in nest boxes can also occur and reduce breeding success, even with artificially supplemented nesting hollows (Koch et al. 2022).

6.6 Non-breeding habitat

Non-breeding South-eastern Red-tailed Black-Cockatoos use the same habitats as breeding birds for foraging and drinking. Outside of the breeding and nesting period, birds are no longer reliant on staying in proximity to the nest tree and are thus more mobile. During this time, they are more likely to fly over open agricultural land to access food tree patches across the subspecies' range and the intervening and surrounding landscape.

6.7 Important foraging habitat features

The two stringybark species used by the subspecies occur primarily as woodland to open woodland communities on low aeolian sand sheets. These communities often have a diverse understorey dominated by species such as: Desert Banksia (*Banksia ornata*), Heath Tea-tree (*Leptospermum myrsinoides*), Small Grass-tree (*Xanthorrhoea minor*), Austral Grass-tree (*Xanthorrhoea australis*) and Austral Bracken (*Pteridium esculentum*) (Koch 2003). Understorey composition and condition do not influence habitat use by South-eastern Red-tailed Black-Cockatoos. In Victoria, most records of the birds are from three Ecological Vegetation Classes: Heathy Woodland, Herb-rich Heathy Woodland and Damp Sands Herb-rich Woodland.

In South Australia, stringybark feeding habitat occurs primarily in two mapped vegetation groups, *E. arenacea/baxteri* open forest and *E. arenacea* open woodland with or without Pink Gum (*E. fasciculosa*).

The two stringybark species on which South-eastern Red-tailed Black-Cockatoos feed do not produce seed every year, with mass flowering years occurring approximately every 2–4 years for Brown Stringybark and approximately every 3 years for Desert Stringybark (Koch 2003). Seed is retained in capsules on the tree for multiple years, providing a year-round food resource. However, as the seed capsules age, they become harder and less favoured by the South-eastern Red-tailed Black-Cockatoos. Trees occurring on the edges of patches or as scattered paddock trees generally produce larger and denser seed crops than those occurring within remnant vegetation (Koch 2003; Maron et al. 2008).

South-eastern Red-tailed Black-Cockatoos will feed both in stringybark woodland blocks and in scattered paddock trees. There is no evidence that scattered trees are less likely to be used for feeding than trees in blocks of stringybark woodland. In a radio-tracking study undertaken in the Naracoorte area in 2000, where most South-eastern Red-tailed Black-Cockatoo habitat occurs as either privately owned blocks or degraded woodlands in grazed paddocks, the South-eastern Red-tailed Black-Cockatoos used paddock trees extensively (in 62% of feeding records). The areas chosen by these cockatoos tended to be 'degraded woodlands', where the distance between trees was generally considerably less than 50 m, but the subspecies were recorded selectively using stringybarks that were 60 m from the nearest other tree (Hill and Burnard 2001; SERTBC RT unpublished).

Koch (2019b) and Gandy (2021) found that stringybark sites with an understorey dominated by bracken or mixed heath had significantly higher seed production than sites dominated by Austral Grass-tree. The latter sites were also more susceptible to dieback caused by leaf-defoliating insects, which have become more widespread and severe since 2003 (Koch 2019b).

When fire scorches the crown of stringybark trees (causing seed drop and leaf death), trees divert resources from seed production to recovery and canopy replacement. The duration of this canopy recovery process depends on the percentage of canopy scorched and the terminal twig diameter (diameter of branches killed by fire), which in turn depends on the fire severity (Koch 2003). Studies of trees recovering from prescribed burns indicate that seed production is reduced by an average of 50% over a 10-year period post-fire (Koch 2003, SERTBC RT 2026). It is therefore critical that canopy scorch in Brown Stringybarks and Desert Stringybarks is minimised to maintain food supply.

The Buloke is dioecious, having separate male and female trees (Conomikes et al. 2011). Although birds only feed on the seeds on the female trees, it is unknown what distribution of male trees is required for successful fertilisation of female trees. Both male and female Buloke trees are therefore considered critical contributors to the food source for the South-eastern Red-tailed Black-Cockatoo. Buloke seed is produced in most years, but its productivity is highly variable (Maron and Lill 2004; Hill unpublished). The food value of Buloke seed is likely to be particularly high (Maron and Lill 2004), and the seed is only held on the tree between early summer and late autumn. South-eastern Red-tailed Black-Cockatoos preferentially feed in mature trees (of >30 cm DBH) and rarely feed in trees with a DBH of less than 19 cm (Maron and Lill 2004). The Buloke range within the South-eastern Red-tailed Black-Cockatoo range is primarily on private land, and the majority of the remaining mature Buloke trees survive as scattered paddock trees, on roadsides, or in patches of native vegetation on private land (Maron et al. 2008).

Tree isolation has no effect on the choice of Buloke feeding sites by the South-eastern Red-tailed Black-Cockatoo as the bird is highly mobile. There is no evidence that isolated paddock trees may provide poorer quality feeding habitat than intact woodland. In a study undertaken in 2000, 62.5% of feeding sites were on private land, and there was no difference between grazed/cropped and ungrazed sites with respect to the likelihood of a site being used as a feeding site (Maron 2000). The overall profitability of the resource for foraging South-eastern Red-tailed Black-Cockatoos appears to vary at the level of the individual tree between years, and a tree that does not provide a profitable resource in one year may do so in the following year (Maron and Lill 2004)

Scattered trees in paddocks, which are often on private land, make a disproportionately high contribution to food availability for the South-eastern Red-tailed Black-Cockatoo. Such trees have been recorded as having 12 (Brown Stringybark) to 27 (Desert Stringybark) times the median crop size of stringybark trees in woodland patches (Maron et al. 2008). This is likely to be due to paddock trees having less competition for light, nutrients and water. Trees on the *edges* of blocks of stringybark forest are also disproportionately important to the birds, likely for a similar reason (Koch 2003).

Based on the changes in stringybark distribution mapping over time, Koch (2020) reported that 40% of historical Brown Stringybark woodlands and 50% of historical Desert Stringybark woodlands have been cleared. The majority of the remaining stringybark woodlands are now protected in public parks and reserves, although significant areas occur as remnants on private land, particularly in South Australia.

Stringybark woodlands are much more depleted in South Australia (87% cleared) than in Victoria (42% cleared) (Koch 2003).

Less than 5% of the historical Buloke woodlands remain within the range of the South-eastern Red-tailed Black-Cockatoo (Maron et al. 2008), with around half of this clearance having occurred between 1963 and 2004 (Maron et al. 2008). Agricultural intensification, primarily the conversion of dryland cropping land to irrigated (centre-pivot) cropping, has been the leading cause of clearance of Buloke since 2004 (Maron et al. 2008). However, the vast majority of the land available for irrigated cropping has already been converted, so ongoing Buloke clearance due to agricultural intensification is now relatively rare (Maron 2005; Maron et al. 2008). There is no information on how this decline and the subsequent loss of the Buloke food resource relate to the South-eastern Red-tailed Black-Cockatoo's patterns of feeding, movement behaviour in summer and autumn, population size, post-fledging survival of pairs and their young, or breeding success.

6.8 Important and critical habitat

South-eastern Red-tailed Black-Cockatoos are nomadic within their range (see Section 7.5), so an absence of records of birds using an area does not indicate that the habitat is not important for the long-term survival of the subspecies. All habitats that meet the current habitat preferences within the subspecies range are habitat critical for the subspecies' survival, regardless of whether birds have been sighted at any time. As many of the preferred habitat trees are very old (Buloke feeding trees >200 years and nesting trees >220 years), areas currently supporting younger trees are important potential future habitat.

All three food tree species (Brown Stringybark, Desert Stringybark and Buloke) are required in order to ensure that there are adequate food resources in all seasons and all years, and where present together this is considered habitat critical to the survival for the subspecies. In light of this, all such locations require protection. Stringybark habitat includes trees of a range of sizes, but older trees, especially those isolated in paddocks, generally have higher seed crops than younger trees (Maron et al. 2008). However, South-eastern Red-tailed Black-Cockatoos will also use small stringybark trees with accessible seed crops. The current Buloke feeding habitat appears to be limited to trees with a DBH of greater than 19 cm (estimated age 100 years). The preferred Bulokes for feeding birds are estimated to be over 200 years old, with a DBH of greater than 30 cm. In 2004, there were estimated to be only 87,000 Bulokes of this size or greater remaining within the South-eastern Red-tailed Black-Cockatoo's range, approximately 45,000 occurring as scattered paddock trees (Maron et al. 2010). All Buloke trees of less than 19 cm DBH constitute potential future habitat.

The South-eastern Red-tailed Black-Cockatoo uses scattered eucalypts and eucalypt forests and woodlands for nesting and roosting, usually in areas close to feeding habitats. The current nesting habitat includes all eucalypts, alive or dead, bearing hollows of a sufficient size (15–50 cm diameter), within 5 km of feeding habitat of any size (Koch et al. 2022).

7 Movement behaviour

Due to their nomadic behaviour, South-eastern Red-tailed Black-Cockatoos move widely throughout their 18,000 km² range to feed on temporary, high-quality stringybark and Buloke resources, in response to highly variable availability and abundance of seed resources. Variability in annual movements reflects this dynamic resource availability, which in turn explains the subspecies' presence in any given location.

High-quality stringybark seed crops can persist for up to 2 years, and birds can be temporarily resident feeding on them for up to 2 years. While resident in an area, birds may re-use the same roosting site and drinking sites for several months. Breeding birds will return to known nesting areas within their temporary range to nest but may not use them every year, as nest site selection and nest initiation each year is influenced by the location of abundant food (SERTBC Recovery Team unpublished).

Although these general broad movement patterns for the South-eastern Red-tailed Black-Cockatoo are known, specific details of flight distances, flight heights, and movement corridors are unknown; more information exists on short-distance movements between feeding, nesting and roosting habitat than on long-distance movements. Annual and seasonal variation in occupancy and use of sites presents challenges for understanding movement and flight behaviour at larger scales and for assessing potential risk of collision (and risk mitigation strategies) associated with wind energy development. The subspecies is capable of moving long distances, and nomadic movement patterns across their range can give them exposure to multiple infrastructure sites across the landscape.

Once settled in an area with abundant seed crop, or when nesting, South-eastern Red-tailed Black-Cockatoos have predictable daily activity and movement behaviour patterns dictated by their need to feed, drink and roost. Understanding the timing, distance, and habitat type traversed during flights between the habitats, and the numbers of birds and at-risk flights, can assist in collision risk assessment and mitigation. However, the actual flight paths and distances moved can change over time as foraging and drinking resource availability changes. Large aggregations of birds occur throughout the year, with birds coming together to roost and drink and then splitting into smaller groups across nearby foraging habitat. Flocks of 100 or more birds are of great conservation relevance and present higher risk for collision impacts.

Movement behaviour that is relevant for understanding potential risks from renewable energy development, and particularly the potential impact from collisions, can be grouped into these categories:

- Daily activity patterns
- Nocturnal activity patterns
- Seasonal patterns
- Social behaviour patterns
- Home ranges
- Flight height.

Knowledge of timing of flights, distances flown between habitats and across the subspecies' range, and flight heights can inform collision risk assessment, avoidance of high-flight-activity areas and heavy-use habitats, and other mitigation measures. It is considered very unlikely that turbines or transmission lines for renewable energy projects would be located in native vegetation used by the South-eastern Red-tailed Black-Cockatoos. Thus, the greatest risk of flights intersecting with wind energy project infrastructure is in open, cleared agricultural land, because South-eastern Red-tailed Black-Cockatoos are known to use remnant vegetation, including scattered trees, in paddocks and may fly over cleared land when moving between woodland and forest blocks across the landscape.

Turbines and overhead powerlines located within plantations [pine (*Pinus* spp.) or Blue Gum (*E. globulus*)] could present a risk for South-eastern Red-tailed Black-Cockatoo if they are located between foraging and/or roosting habitat and if birds are likely to fly over plantations when accessing these habitats. The sociality and flocking behaviour of this subspecies may increase potential exposure to collision risk, as multiple individuals may fly through rotor-swept areas at one time (Croft et al. 2015). No evidence currently exists to understand whether this behaviour could lead to mass collision events for South-eastern Red-tailed Black-Cockatoos or other black-cockatoo species.

7.1 Daily activity patterns

South-eastern Red-tailed Black-Cockatoos move daily between feeding, roosting and drinking habitat. The birds are very vocal and depart roosts in the early morning, prior to sunrise, or at first light (Higgins 1999). Movement distances of the subspecies depend on the spatial configuration of these habitats in relation to each other and can be from several hundred metres up to 5 km. The birds spend most of their day feeding, drinking in the early morning or in the late afternoon or evening prior to returning to roost. Moving to access dams and troughs requires that the birds move further from the foraging and roosting habitat to access water. Where stock dams or wetlands occur within foraging habitat, flocks can congregate around them in the late afternoon. Birds may also fly over cleared land to feed in scattered paddock or roadside trees.

7.2 Nocturnal activity patterns

South-eastern Red-tailed Black-Cockatoos roost overnight. Red-tailed Black-Cockatoos in general are not known to be active at night, although they have been observed to move around in moonlit and low-light conditions (Higgins 1999). It is not clear whether the south-eastern subspecies exhibits this behaviour.

7.3 Social behaviour patterns

South-eastern Red-tailed Black-Cockatoos are highly social, with strong group bonds and flocking year-round. Flock sizes vary greatly throughout the year and are largest in autumn and winter, when foraging flocks can exceed 100 individuals (Koch et al. 2022); the average flock size is around 50 birds in July to August (Hill unpublished). The average flock size decreases over spring as the breeding season progresses, with an average flock size of 9 being recorded in October (Hill unpublished). Birds feed and roost together in flocks, pairs and small groups of 3 or more (Higgins 1999). Flocks roosting at the same location can split into multiple groups that fly to different locations within a stringybark woodland to forage. These separate groups may come together again in the evening to drink and roost (Koch et al. 2022).

When feeding flocks are disturbed or threatened by aerial predators, birds have been recorded to flush together, swirl above the tree canopy, and reach heights of 15–30 m (Biosis 2020). Anecdotal observations of interactions with Sulphur-crested Cockatoos indicate that South-eastern Red-tailed Black-Cockatoo flight behaviour can change in response to aggressive behaviour from other cockatoo species (Section 15.4).

7.4 Home ranges, ranging behaviour, and dispersal

Nesting trees are generally in proximity to stringybark (*E. arenacea* and *E. baxteri*) woodland blocks. All are within 5 km (Koch et al. 2022), the majority (67%) are within 1 km (Wardle 2022), and 95% are within 2 km (Commonwealth of Australia 2006, 2007). Breeding pairs also use the nest trees for roosting (Higgins 1999). The breeding season home range is considered likely to be up to 5 km, based on the known distances of nest trees from stringybark foraging habitat being greater than 5 hectare in size (Wardle 2022; Hill in prep.). The furthest recorded distance between foraging habitat and a nest is 4.6 km (Wardle 2022). Some information on adult and juvenile home ranges is known from Naracoorte (South Australia): a male of the subspecies was recorded as having a home range of 25 km^2 (minimum convex polygon—MCP) and a 95% home range of 4.8 km^2 (95% kernel density estimate—KDE) during a 2-month period in early summer (Hill in prep.). A juvenile home range was estimated at 110 km^2 (MCP) and 68 km^2 (KDE). Radio-tracking undertaken in the late 1980s to 1990s found no difference between the home ranges of individuals in Naracoorte (South Australia) and those in Casterton (Victoria). Birds tracked near Casterton mostly used public land, whereas individuals tracked near Naracoorte mostly used scattered trees on private land. This indicates the importance of considering the landscape context in understanding the subspecies' likely use of private land, which may support large scattered paddock trees that are attractive to the subspecies, and can thus include areas of higher collision risk to the subspecies, as outlined in Section 7.6.

Flocking (non-breeding) home ranges are unknown, though birds are known to range from several hundred metres up to 5 km (see Knowledge gaps and research recommendations section; Commonwealth of Australia 2006, 2007; Wardle 2022).

7.5 Long-distance movements and dispersal

Information on long-distance movements and dispersal for the South-eastern Red-tailed Black-Cockatoo is scant but suggests they are capable of long-distance movement and that birds may undertake such movements over short time frames. The main body of information comes from banding recoveries from 1956–1996, which included 10 recoveries from less than 10 km from the banding location, 1 recovery at 10–49 km from the banding location and 1 recovery at 50–99 km from the banding location (Higgins 1999). Additionally, a fledged chick moved 37 km from Naracoorte (South Australia) to the Little Desert National Park (Victoria), with the adult breeding pair in 2 weeks (Hill in prep.).

As birds complete nesting, they are more likely to range further within a flock and move across different parts of the subspecies' range in search of other food patches. Such movements may be triggered by depletion over time of food resources close to the nesting trees, requiring birds to move further in search of food. When birds are not breeding and form flocks, the flocks can be more mobile, and the location of abundant food resources is the main driver of movements. At such times, flocks could thus be moving greater distances, more frequently, and crossing more open areas more often, when moving between food tree patches.

7.6 Flight height

The flight behaviour of South-eastern Red-tailed Black-Cockatoos is poorly studied and known, but understanding is crucial for assessing potential exposure to collision risk from wind energy projects. Routinely, bird utilisation surveys undertaken to assess the collision risk of proposed wind energy projects fail to capture mobile species that mostly fly outside survey times or occupy different parts of the landscape from year to year or seasonally. No telemetry studies with flight height data collection have been undertaken on the South-eastern Red-tailed Black-Cockatoos in Victoria. This has resulted in the lack of an evidence base for understanding South-eastern Red-tailed Black-Cockatoo flight heights, making it challenging to survey and assess potential wind energy project impacts on the subspecies.

Proposed wind farm projects within the South-eastern Red-tailed Black-Cockatoo range have prompted one targeted study on flight height data collection in an attempt to understand this risk (Biosis 2020). Additionally, further recent work to complement the existing knowledge base was undertaken as part of the RERI project (Section 13). These two are the only studies that have collected flight height data on South-eastern Red-tailed Black-Cockatoos. More detailed research has been conducted on a related species of black-cockatoo in Western Australia by a research team at Murdoch University.

The Biosis (2020) study took place in July 2020. Fieldwork for the targeted research described in this report (Sections 13 – 16) was conducted in October 2025 in the Edenhope region. Although the studies are not directly comparable, due to methodological differences, they provide useful insights into flight heights of the subspecies. Biosis (2020) collected data 9:30–10:45 on 5 days, 14:30–15:30 on 4 days and 16:00–17:50 on all days, thus capturing flight behaviour within forest blocks in foraging habitat and flights between foraging habitat and roosts in the evenings. Of the 3639 observed flights, just over half (55%) were over cleared land, and the remainder (45%) were in forest blocks (Table 4). Flights over cleared land are at most risk of collision with proposed turbines, which are located in open country rather than forest and woodland habitat. Biosis (2020) grouped the flight heights into five categories for both habitats, showing that overall, in both habitats, the majority of flight heights were below 39 m, the highest flight was 54 m, and more flights at higher altitude occurred over cleared land (99%, at up to 39 m) than in or over woodland (99%, at up to 29 m).

Table 4. South-eastern Red-tailed Black-Cockatoo flight data relevant to collision risk modelling.
Source: Table 1 in Biosis (2020).

Height of flights over ground (metres)	Number of flights over open country (% within this environment)	Number of flights within or over woodland (% within this environment)
0–19	1110 (55%)	1341 (82%)
20–29	530 (26%)	278 (17%)
30–39	354 (18%)	6 (0.4%)
40–49	3 (0.2%)	0 (0.0%)
50–59	9 (0.4%)	8 (0.5%)

8 Threats

8.1 Historical

In a recent review of threats, Koch et al. (2022) found habitat loss to be the leading cause of historical decline—losses in the availability of breeding habitat, stringybark feeding habitat, and Buloke feeding habitat. Koch (2020; based on updated stringybark distribution mapping) reported that 40% of Brown Stringybark woodlands, and 50% of Desert Stringybark woodlands had been cleared. Most remaining stringybark woodlands are now protected in public parks and reserves, although significant areas occur as remnants on private land, particularly in South Australia. Stringybark woodlands are much more depleted in South Australia (87% cleared) than in Victoria (42% cleared; Koch 2003).

More than 95% of the Buloke woodlands within the range of the South-eastern Red-tailed Black-Cockatoo have been cleared (Maron et al. 2008). About half of this clearance occurred between 1963 and 2004 through agricultural intensification, primarily the conversion of dryland cropping land to irrigated (centre-pivot) cropping (Maron et al. 2008).

8.2 Current

The rate of habitat loss has now declined (Koch et al. 2022). The vast majority of land available for irrigated cropping has already been converted, so ongoing Buloke clearance due to agricultural intensification is now relatively rare (Maron 2005; Maron et al. 2008).

Nevertheless, ongoing entitled, permitted and illegal clearing of scattered trees is still an important threat, especially as mature paddock trees are of particular importance to South-eastern Red-tailed Black-Cockatoos, both as nesting habitat (many have large hollows) and for foraging (isolated stringybarks can have very high seed crops) (Koch et al. 2022). In addition to clearance, mature paddock trees also suffer dieback and senescence. In River Red Gums, increased dieback seems to have been driven by increased abundance of lerp-producing psyllid insects. These threats are amplified by climate change (Koch et al. 2022). Declines in groundwater-dependent ecosystems due to unsustainable drops in groundwater levels are a threat to the South-eastern Red-tailed Black-Cockatoo, as they have impacts on River Red Gum communities and paddock trees in affected areas. Further, there is little regeneration of paddock trees in farmlands due to agricultural practices (such as grazing, slashing, ripping, and stubble burning) and also through browsing of Buloke seedlings by kangaroos and rabbits.

Within disturbed woodland and forest patches, invasive woody weeds [including pines and Coastal Wattle (*Acacia longifolia sophorae*)] may compete with stringybarks, resulting in lower seed production; in places, infestations of pines and Coastal Wattle have been so severe that they have prevented stringybark regeneration and replaced the overstorey (Koch et al. 2022).

Reduced breeding success is another critical threat. Factors contributing to this are thought to include nest predation, inadequate food supply, reduced availability of nesting hollows, and climate extremes (Koch et al. 2022). Stringybark habitats are particularly vulnerable to fire, and extensive wildfire is a critical threat. Planned burns that result in crown scorch are also a threat to seed production and thus to stringybark feeding-habitat quality (Maron 2005; Maron et al. 2008).

Large and probably increasing populations of Sulphur-crested Cockatoos (*Cacatua galerita*), corellas (*Cacatua* spp.), Galahs (*Eolophus roseicapilla*) and other large, hollow-nesting bird species compete with South-eastern Red-tailed Black-Cockatoos for large hollows for nesting, which are a diminishing resource. Loss of nesting habitat trees due to decline and collapse of old trees has increased between 1997 and 2004 and is occurring at a rate of 2.4% per year (Koch 2019b).

8.3 Future and emerging

Climate change is expected to amplify many of the existing threats to South-eastern Red-tailed Black-Cockatoos:

- Increased frequency and severity of drought is likely to reduce food availability.
- Increased tree dieback and senescence is likely to result in disproportionate mortality of the mature paddock trees that are currently important as both nesting and foraging habitat.
- Temperature extremes, especially heatwaves, are likely to cause increased breeding failure and adult mortality.
- Increased likelihood of extensive high-intensity wildfires is likely to cause loss of nesting habitat, increased mortality of food trees, and landscape-scale diminution of the seed production potential of food trees for up to 10 years after a fire.
- Planned burns to control wildfire risk are likely to result in crown scorch and diminished seed crops in stringybarks.

Renewable energy projects could potentially pose threats in the future. These include threats from wind, solar, and critical minerals developments, and are discussed in Section 10.

9 Conservation actions

9.1 Habitat protection

A key conservation action is to avoid the clearing of habitat that is critical to the survival of the subspecies. Legal clearance of South-eastern Red-tailed Black-Cockatoo habitat, including scattered trees, is now exceptional and rare. Where habitat clearance is proposed, considerations increasingly extend beyond immediate habitat loss to include the implications of climate change for future habitat suitability and the subspecies' recovery requirements.

The South-eastern Red-tailed Black-Cockatoo has been the subject of successful community engagement and recovery team–led efforts to protect and restore habitat for the subspecies (Russell et al. 2017). A storyboard created by SERTBC RT (2026) enables mapping of habitat, including nest trees, nest boxes and revegetation projects and can be used to identify critical areas for minimising impact on the subspecies and its habitat more broadly, as well as for informing the planning and siting of renewable and critical minerals development.

9.2 Habitat supplementation

The national recovery plan has targets for restoration to meet long-term conservation and recovery objectives for the subspecies (Koch et al. 2022). Stringybark species are the fastest growing of the South-eastern Red-tailed Black-Cockatoo food plants, providing usable seed crops from about 10 years of age. Buloke is typically very slow growing in this part of its range, and the trees are first available for foraging at about 19 cm DBH, which takes about 100 years of growth (Hill and Burnard 2001). Since 2009, the recovery team has planted more than 600,000 stringybarks and 100,000 Buloke, and controlled woody weeds on almost 30,000 hectares of South-eastern Red-tailed Black-Cockatoo habitat (SERTBC RT unpublished).

Hollows large enough and suitable for supporting nesting can take from decades to over 100 years to develop. Nesting habitat can, however, be supplemented using artificial nest boxes, and there are currently about 220 nest boxes suitable for use by South-eastern Red-tailed Black-Cockatoos installed across their range. Nest boxes require regular maintenance, and all nest boxes installed for South-eastern Red-tailed Black-Cockatoos should be done through the South-eastern Red-tailed Black-Cockatoo (SERTBC) Recovery Team. Nest box maintenance requires time and funding, and there is a risk that such programs may be ceased in the future. Reliance on artificial nest programs is not sustainable and would lead to further decline in hollow availability with losses of large old trees and slow attrition of trees that support nest hollows. It is of critical importance to develop, investigate and research more sustainable artificially created hollow types for supporting the nesting of South-eastern Red-tailed Black-Cockatoos (SERTBC RT unpublished) and to protect the current known and potential nest trees and the trees that can become hollow-bearing in the future.

Attempts to create new nesting habitat over time in gum habitats have included planting of potential nesting habitat (scattered tree planting) at 10 trees/hectare in farmland. An estimated 95% of these plantings are on farmland used for grazing or cropping. As at 2022, approximately 500 hectares of scattered tree plantings have been installed.

All of these targeted investments in habitat recovery for the South-eastern Red-tailed Black-Cockatoo would benefit from appropriate protections.

10 Risks associated with renewable energy and critical minerals development

10.1 Wind

10.1.1 Collision

South-eastern Red-tailed Black-Cockatoos are likely to be primarily at risk from collision with operating turbines because:

- The subspecies is very mobile within its range, making regular flights from foraging sites to roosts or nests, and sometimes making longer-distance movements to find new food sources.
- These flights are usually made in flocks, and the birds often fly over cleared land as well as over woodlands and forest to move between habitats (for roosting, foraging, drinking and nesting), and throughout their daily and annual cycles.
- Flights are sometimes made at heights within the rotor-swept zone (Section 16.1; Biosis 2020).

Collision with static infrastructure, including operational turbines and transmission lines, is not considered likely to represent a significant risk, as flights are predominantly undertaken during daylight and the subspecies has low wing-loading and relatively slow, manoeuvrable flight. There are no reported turbine collision records for the subspecies in Victoria, noting that no wind farms currently operate within the Victorian range of the South-eastern Red-tailed Black-Cockatoo (Moloney et al. 2019; DEECA unpublished).

One wind farm (Lake Bonney Wind Farm) operates within the South Australian portion of the subspecies' range, but there is no publicly available information on mortality monitoring or confirmed occurrences of South-eastern Red-tailed Black-Cockatoos. The absence of records does not necessarily indicate that collisions have not occurred but may reflect limitations in detection.

10.1.2 Avoidance

Wind farms have the potential to restrict access of South-eastern Red-tailed Black-Cockatoos to suitable habitat. For example, the presence of people on foot and/or in vehicles (involved in construction and maintenance) may deter birds from using trees that might otherwise be suitable for foraging or nesting, because the birds can be sensitive to disturbance. Noise and lights associated with construction or maintenance may have similar effects. Whether or not such avoidance could pose significant risks to the birds is unknown. South-eastern Red-tailed Black-Cockatoos often nest in scattered trees on farms and appear to become habituated to presence of farm machinery.

10.1.3 Attraction

It is not known whether South-eastern Red-tailed Black-Cockatoos can be attracted to turbines. We consider it unlikely, given that current turbine models do not have suitable perches for the subspecies. There is, however, a risk that birds could be attracted to high-voltage transmission lines or power poles as potential perching sites, where there is a risk of electrocution. They may also fly to meteorological masts searching for a site to perch. Birds could conceivably use these structures to perch on, particularly in proximity to water sources. There have been records of Western Australian Forest Red-tailed Black-Cockatoos (subspecies *C. b. naso*) being electrocuted through contact with uninsulated cross-arms or the tops of poles. Power companies there have worked on methods (such as installation of bird covers) to prevent such incidents in future (Western Power 2026).

Structures associated with transmission lines and lighting at wind energy developments could potentially attract roosting South-eastern Red-tailed Black-Cockatoos. In northern Australia, Red-tailed Black-Cockatoos are commonly seen late in the day (at dusk) perching on high street light poles. For example, a flock of 100 individuals have been recorded perched on lights and light poles, with such behaviour reported to be common (eBird 2026).

The establishment of roads or tracks to construct or maintain wind farms could also attract South-eastern Red-tailed Black-Cockatoos, if puddles, drains or culverts associated with the roads provide places where the subspecies can drink. In such settings they are vulnerable to vehicle collision.

10.1.4 Habitat loss

Wind farms would only be likely to cause direct habitat loss to South-eastern Red-tailed Black-Cockatoo if their construction involved clearing of food trees or of potential nesting sites. Indirect loss of feeding, nesting

or drinking habitat could result if built infrastructure created a significant barrier to the birds' movements across the landscape.

10.2 Solar

10.2.1 Avoidance

Risks to cockatoos from solar farms are most likely to occur during construction, and during maintenance when operational. Effects on South-eastern Red-tailed Black-Cockatoo are likely to be minimal, given that the footprint of solar farms is relatively small and that they are likely to be placed in open settings, unshaded by trees where cockatoos might forage.

10.2.2 Attraction

South-eastern Red-tailed Black-Cockatoos could potentially be attracted to solar farms if they mistake solar panels for water bodies (Fleming 2025). This species flies slowly when landing beside water bodies, so the risk of injury from solar panel collisions may be low. South-eastern Red-tailed Black-Cockatoos may also be attracted to puddles associated with solar farms and the roads used to construct or maintain them, potentially putting them at some risk from collisions with vehicles.

10.2.3 Habitat loss

Solar farms would only be likely to cause direct habitat loss to South-eastern Red-tailed Black-Cockatoos if their construction involved clearing of food trees or potential nesting sites.

10.3 Critical minerals

10.3.1 Avoidance

Operational noise and movement, and a lack of treed habitat during the operational phase of mining, may all create a virtual barrier to South-eastern Red-tailed Black-Cockatoo flight paths and result in flocks avoiding important feeding areas or nest trees. Such risks should be considered on a case-by-case basis. In most situations, such risks are likely to be negligible or low.

10.3.2 Attraction

South-eastern Red-tailed Black-Cockatoos could be attracted to tailings dams associated with mineral sand-mining operations. The mining and processing of titanium- and zirconium-bearing mineral sands commonly requires tailings dams, because the extraction process generates large volumes of wet tailings that must be stored safely. Tailings dams, especially those storing wet tailings, can create multiple, well-documented hazards for birds. Tailings dams from the mining of mineral sands often contain mixtures of heavy minerals, heavy metals, and radioactive components (Shun Waste 2025), creating hazardous potential drinking sites for South-eastern Red-tailed Black-Cockatoos. Because South-eastern Red-tailed Black-Cockatoos re-use the same drinking site repeatedly during and between years, individual birds may incur repeated exposure to these hazards. South-eastern Red-tailed Black-Cockatoos may be attracted to road table drains and culverts associated with mining projects, resulting in impacts similar to those from solar and wind energy development.

10.3.3 Habitat loss

Mineral sand mining is typically open-cut strip mining, requiring the removal of all vegetation within the footprint. Feeding and nesting habitat loss associated with mining developments is considered to be the main threat of impact for the South-eastern Red-tailed Black-Cockatoo. Eggs or nestlings in trees with occupied nest hollows (especially during spring and early summer, but potentially any time of the year) might also be killed during clearing/construction operations.

10.4 Current, proposed and likely projects within the South-eastern Red-tailed Black-Cockatoo range

10.4.1 Wind

To summarise the potential exposure to risk from wind energy development:

- In Victoria, Renewable Energy Zones (REZs) have been identified as priority areas for new wind farms. As of 2026, none of the current REZs fall within the South-eastern Red-tailed Black-Cockatoo range.
- South Australia has not identified priority areas for wind energy developments.

- One operating wind farm (built in three stages) is located on the edge of the South-eastern Red-tailed Black-Cockatoo range at Lake Bonney near Millicent in South Australia. In Victoria, two operating wind farms have been approved within the South-eastern Red-tailed Black-Cockatoo range (VicGrid).
- The current capacity is limited by existing transmission line constraints, with the main constraint being the distance from transmission lines to connect wind energy projects to the grid.

10.4.2 Solar

The potential for solar farms within the South-eastern Red-tailed Black-Cockatoo range currently appears low, based on mapping for photovoltaic power potential in Australia (Global Solar Atlas). No solar farms currently operate within the South-eastern Red-tailed Black-Cockatoo range.

10.4.3 Critical minerals

To summarise the potential exposure to risk from critical minerals development:

- Extensive areas prospective for the critical minerals titanium and zirconium exist within the South-eastern Red-tailed Black-Cockatoo range (see: Victoria's critical minerals opportunities: titanium, zirconium and REEsLarge areas in both states within the South-eastern Red-tailed Black-Cockatoo range have mineral exploration licences (see DEM 2025 for critical mineral exploration areas and participating companies within the South-eastern Red-tailed Black-Cockatoo range).
- The one mineral sand mine that has operated within the South-eastern Red-tailed Black-Cockatoo range (Iluka Douglas) removed native vegetation from an area of 905 ha before it ceased in 2012. The original proposal was for more than 4000 ha of mined area, including significant areas of stringybark woodland on public land; however, Iluka split the project, with a plan to extend once the first stage was completed. Iluka is now developing a large mineral sands project on the far north-eastern edge of the South-eastern Red-tailed Black-Cockatoo range (Iluka 2025).

10.5 Renewable energy development impacts on the South-eastern Red-tailed Black-Cockatoo

Habitat loss through native vegetation removal from the South-eastern Red-tailed Black-Cockatoo's preferred habitat is the greatest likely impact from critical mineral resources development. Habitat loss may also occur if wind and solar development removes native vegetation for infrastructure. Turbine collisions are considered to constitute the greatest concern and risk of impact by wind farm development.

South-eastern Red-tailed Black-Cockatoo behaviour and mortality around wind energy developments is unknown. Only one project is operating within the subspecies' range, on the south-western edge of the range in South Australia. No information on mortality monitoring was found through the literature search.

10.5.1 Population-level impacts

Currently no known mortalities have been identified at the single operating wind energy project within the South-eastern Red-tailed Black-Cockatoo range. Population-level impacts are possible if recruitment and mortality are impacted, for example, if nest trees or other important and critical foraging habitat are removed or if mortality increases due to turbine collisions.

10.5.2 Cumulative impacts

The cumulative impacts on the South-eastern Red-tailed Black-Cockatoo are unknown, given the low level of renewable energy and critical mineral resources development within the subspecies' range so far. However, the decline of the subspecies and its listing status are a result of ongoing cumulative decline in habitat. Further habitat loss and any impact that reduces habitat availability is likely to contribute to further decline. Cumulative impacts could occur if habitat is removed for multiple projects and if multiple wind energy projects result in collisions. The cumulative impacts of strip mining are considered to be a potentially larger risk than those from renewable developments, particularly for critical minerals, while collisions are the main concern from wind farm developments.

11 Managing renewable energy impacts—measures for avoiding, mitigating and offsetting

The EPBC Act requires proposed actions to follow the mitigation hierarchy steps of 'avoid, mitigate, offset' to reduce impacts on listed threatened species (DCCEEW 2026). Impacts need to be avoided completely, or to the greatest extent possible, before implementing measures to minimise and mitigate residual risk. This hierarchy and measures for avoiding, mitigating and offsetting the identified impact risks for renewable projects on the South-eastern Red-tailed Black-Cockatoo are now summarised. More detail is provided in Sections 11.1, 11.2 and 11.3.

Avoid

Strategic landscape-scale siting

1. Site projects outside the subspecies' range, wherever possible.

Site-based infrastructure siting

2. Site projects away from the subspecies' habitat and habitat elements, including native vegetation (Brown Stringybark, Desert Stringybark and Buloke). Additionally, for wind farm developments, avoid project and infrastructure siting in proximity to non-native habitat with high activity, where flocks move over cleared agricultural land (between foraging, roosting, nesting and drinking habitats). Use wind farm infrastructure–free habitat buffers based on known subspecies' movement distances to avoid, minimise and mitigate collision risk.
3. Avoid removal of any suitable habitat.

Mitigate

Potential mitigation measures, which require further studies to determine their efficacy, include:

- Increase turbine ground clearance to heights with lower frequency of the subspecies' flights.
- Shut down turbines on demand using camera and acoustic technology.
- Shut down turbines during high-activity periods—morning and evening.
- Provide artificial water sources close to foraging habitat, to reduce likely movements over cleared land with turbines and other infrastructure.

Offset

Offsets should follow the currently recommended measures outlined in the South-eastern Red-tailed Black-Cockatoo Recovery Plan (Koch et al. 2022). It states that offsets should be avoided, where possible, due to the long time frames involved in establishing suitable foraging and nesting trees—well beyond development project operational timelines. The challenges inherent in protecting habitat and in the limitations associated with artificial nesting hollows (uncertainties regarding uptake and the benefits to breeding success, and maintenance requirements) should be considered.

Offsets should also adhere to State and Federal offset policy and guidelines and other relevant information, including, for example, where existing habitat is protected as an offset under native vegetation removal regulation (e.g. Commonwealth of Australia 2006, 2007; Maron et al. 2008, 2018; Koch et al. 2022)

11.1 Avoiding impacts

The first and most important step in managing renewable energy impacts for the South-eastern Red-tailed Black-Cockatoo is to site developments outside the range of the South-eastern Red-tailed Black-Cockatoo. Avoiding collisions for wind farm developments through siting is the most effective impact avoidance measure. If projects are located within the subspecies' range, impacts on the subspecies are to be avoided by protecting all of their suitable habitats and habitat elements from development and habitat loss. These measures to avoid impacts apply to all renewable energy developments—wind, solar and critical mineral projects. Additionally, for wind farm developments, it is important to avoid areas of high activity that may occur in non-native habitats, such as cleared agricultural land over which birds move between foraging, roosting, nesting and drinking habitats, including scattered trees and water sources in paddocks. Avoiding removal of Brown Stringybark, Desert Stringybark and Buloke, and avoiding development in suitable habitat,

are important for the long-term persistence of the subspecies and to avoid declines in population size and viability.

For wind farm developments, Regan et al. (2025) used expert elicitation (regarding pre-selected potential mitigation measures to reduce turbine collision impacts) to evaluate the possible effectiveness of each measure for birds and bats, including the South-eastern Red-tailed Black-Cockatoo. For this species, habitat buffers were found to have the greatest potential for avoiding collision impacts (Regan et al. 2025). Infrastructure exclusion zones and buffers can be very effective. Studies have shown that South-eastern Red-tailed Black-Cockatoos move up to 5 km from foraging habitat to access other habitats (Section 7.4), and this information can be used to inform the design of habitat buffers around foraging habitat to avoid and minimise potential collision impacts around high-activity areas of daily commuting flights between these habitats. Information regarding avoiding and minimising impacts of collision risk for long-distance flights is more difficult, because no information on the locations and frequency of these flights exists.

It is important to consider siting developments away from restored habitat and known South-eastern Red-tailed Black-Cockatoo habitats, to avoid potential impacts in general and under the EPBC Act Significant Impact Guidelines. This is to avoid impacts that developments in close proximity to restored habitat may have, which may be incompatible with the subspecies' recovery actions.

11.2 Mitigating impacts

11.2.1 Turbine collision

Shutdown on demand (SDOD) using artificial intelligence (AI)–driven species recognition is likely to be the most effective method for mitigating turbine collision risk for the South-eastern Red-tailed Black-Cockatoo, once a wind energy facility becomes operational (Regan et al. 2025). However, as with other impact mitigation measures, this technique remains untested and unstudied for the subspecies. The South-eastern Red-tailed Black-Cockatoo is a medium-sized bird, and modern AI camera systems can identify this size category of birds to species level with medium to high confidence. The South-eastern Red-tailed Black-Cockatoo characteristics are within the detection envelope and physical parameters validated by such technology (IdentiFlight 2025). However, there appears to be no independent verification of the identification accuracy for medium-sized birds (e.g. 500–900-g birds such as the South-eastern Red-tailed Black-Cockatoo). AI camera–based SDOD should be recommended for new wind farm projects within the South-eastern Red-tailed Black-Cockatoo range whenever the qualitative risk assessment is greater than 'Low'.

Where the South-eastern Red-tailed Black-Cockatoos reside (or take up residence) for weeks and months, complete turbine shutdowns (in which turbines are not spinning) in the mornings and evenings could be effective, though have not been tested. This mitigation measure could potentially be easy and feasible to implement, given the subspecies' predictable daily activity patterns when moving to and from roosts around twilight, sunrise and sunset.

A high ground clearance for wind turbines (i.e. an increased minimum height between the ground and lower blade-tip) could reduce the potential for and the number of collisions, given what is currently known about South-eastern Red-tailed Black-Cockatoo flight heights. Raising the minimum blade-tip height above the ground to 65 m was found (through expert elicitation) to be likely to reduce collision mortalities (Regan et al. 2025). However, uncertainty remains about the long-distance flight heights and the frequency of flights of the subspecies in response to disturbance. Even with a raised turbine ground clearance, some collision risk remains.

Restricting access to water has also been assessed, through expert elicitation, as a potential mitigation measure for the species (Regan et al. 2025; DEECA 2026 unpublished). The need to access water in dams and troughs is a key driver for drawing South-eastern Red-tailed Black-Cockatoos out into cleared farmland where new wind farms may be sited. Limiting access to potentially problematic dams and troughs, and replacing them with strategically located alternative water sources (e.g. closer to feeding and roosting habitat) may reduce South-eastern Red-tailed Black-Cockatoo flights into areas where they may be at risk of encountering turbines and colliding with them. Steep dam banks around the margins of potentially problematic water sources, and setting water levels low (>20 cm below the rim) to prevent birds reaching the water, could potentially work to reduce attraction to these water features (Hill pers. obs.). It is unknown how effective limiting access to water is in reducing its attraction and the associated flight activity over open cleared land. If the presence of foraging habitat is the main determinant of where flocks are within a landscape, uncertainty remains about whether South-eastern Red-tailed Black-Cockatoos would find an area with fewer watering points less attractive, or whether they would use the foraging habitat and regularly fly further to access water, which could still place the birds at risk of collision with turbines in open cleared agricultural land. An alternative strategy would be to assess where additional water supplies (troughs) might be placed to encourage birds away from riskier drinking sites.

None of these measures have been implemented, tested or studied, and there is high uncertainty about the actual effectiveness of all of these mitigation measures, reflected in the need to evaluate these mitigations through an expert elicitation process (Regan et al. 2025; DEECA unpublished).

11.2.2 Roads, tracks and structures

Roads and tracks should be designed to avoid the pooling of water that can attract South-eastern Red-tailed Black-Cockatoos, to avoid and reduce potential collisions with vehicles. Infrastructure that provides potential roosting habitat, such as horizontal pole arms, should be avoided near wind turbines, to avoid and reduce potential collisions with turbines.

11.2.3 Tailings dams

Tailings dams within the South-eastern Red-tailed Black-Cockatoo range may be very hazardous to South-eastern Red-tailed Black-Cockatoos, because they routinely use dams for drinking. To minimise this risk, tailings dams should be designed to exclude drinking by South-eastern Red-tailed Black-Cockatoos. Though recommendations exist regarding design considerations for avoiding and minimising impacts on the South-eastern Red-tailed Black-Cockatoo, the recovery team should be consulted on design. The risks of impact for other species also need to be considered.

11.3 Offsetting impacts

Offsetting requirements are pertinent in two situations, in the event that impacts cannot be avoided: (i) loss of habitat and (ii) loss of individuals. Offsetting, as a last resort, should follow recommendations for native vegetation loss and habitat removal, as outlined in existing recovery plans and other related documents, including Koch et al. (2022) and Maron et al. (2008), taking into consideration the need to offset an equivalent type and amount of habitat, and the duration of the gain in habitat.

Restoration of foraging habitat is essential for recovery, but there are long delays before restored habitat can produce the food quality of mature habitat, and longer delays for the provision of natural nesting hollows. Such delays would be associated with increased pressures on the South-eastern Red-tailed Black-Cockatoo and have an impact on feeding, roosting, nesting, breeding success, and population maintenance and recovery. Importantly, losses of mature Buloke habitat cannot be replaced for over 100 years, so any losses are unlikely to be able to be appropriately offset. Protection of Buloke and stringybark habitat is important, and where paddock trees are cleared, the like-for-like principle of protecting other paddock trees is recommended (Maron et al. 2008; Koch et al. 2022)

Offsets that protect existing habitat only may result in habitat loss over time (Maron et al. 2008), and introduce more risks (Maron et al. 2018). Careful design and management of such offsets to ensure habitat value is maintained or increased are required. Protection of paddock trees used as offsets can reduce tree mortality rates; however, the extent to which this approach can substantially offset losses should be carefully considered, when protection is relied upon as a compensatory measure (Maron et al. 2008).

Scenario modelling by Maron et al. (2008) indicated that Buloke tree patches used as offsets for paddock-tree clearing suffered a decline in habitat resources over time. Nevertheless, habitat outputs under protection were more favourable than those predicted without protection, largely due to reduced rates of tree death. Achieving gains in stringybark feeding habitat on private land is likely to require additional improvements beyond protection alone (Maron et al. 2008).

Where nesting habitat is lost, offsets may involve a combination of (i) protecting existing at-risk hollow-bearing trees suitable for breeding and (ii) restoring habitat that may, over long time frames (centuries), develop suitable hollows. Offsets may also include the installation and long-term maintenance of artificial nest boxes or potentially artificial hollows in appropriate locations. Ongoing maintenance, typically on an annual basis and for the duration of the impact, would be necessary to avoid offset failure or unintended negative outcomes (Lindenmayer et al. 2017).

Offsetting for mortalities (e.g. from turbine collisions) is more complicated and will require further work including quantification of the population-level benefits of combinations of feeding and breeding habitat restoration, and the time lags involved in those. To determine the population-level impacts from wind turbine collisions and the associated compensatory actions required, collision risk models are used to estimate the likely numbers of mortalities. Using this data, a PVA is then undertaken to determine population-level impacts and the potential benefits of proposed compensatory measures. Any mortalities of a long-lived, endangered and declining species with such a low reproductive output as that of the South-eastern Red-tailed Black-Cockatoo are likely to be important. Because of these factors, cumulative ‘avoidable’ mortalities over periods of decades must be included in such calculations.

12 Survey and assessment methods

12.1 Current assessment standards and guidelines—presence surveys

Survey guidelines for the South-eastern Red-tailed Black-Cockatoo are incorporated into the Australian Government's 'Survey guidelines for Australia's threatened birds', designed to assist impact assessment and likely significant impacts on EPBC Act–listed species. They are not mandatory for EPBC Act referral or for assessing or determining whether a significant impact is likely to occur. These guidelines focus on detecting and determining the likelihood of presence. The guidelines don't provide guidance on estimating abundance, movement behaviour, or flight distances and heights (all crucial for assessing wind energy project collision risk), and they are therefore not suitable for this purpose.

12.2 Annual counts—flock presence and abundance surveys

The South-eastern Red-tailed Black-Cockatoo Recovery Team (with volunteers) conduct annual counts, across the subspecies' Victorian and South Australian range (SERTBC RT 2026). These counts are used to identify the locations and habitat use patterns of flocks within the subspecies' range, to derive an estimate of the minimum annual population size, and to obtain an index of the relative rate of recruitment. The team's survey methodology has been developed to locate flocks using two methods—'scientific' (stopping every 500 m to listen); and 'drive in the park' (driving slowly, looking for feeding signs, and stopping regularly to find birds). Both methods rely on listening to calls to locate flocks. A combination of these methods can be used to locate birds: driving tracks, starting from the location of the most recent sighting, while looking for fresh feeding signs and stopping regularly—every 500 m in calm conditions and every 250 m in windy conditions—to listen to calls.

12.3 Survey and risk assessment approaches for renewable energy projects

No guidelines exist for renewable energy–specific impact survey and assessment for the South-eastern Red-tailed Black-Cockatoo. General guidance for threatened species within the renewable energy context has recently been released in Victoria: '*Handbook for the Development of Renewable Energy in Victoria. Guidance to Avoid, Minimise, Mitigate and Compensate for Impacts on Threatened Bird and Bat Species*' (DEECA 2025), with a priority for species of concern, which include the South-eastern Red-tailed Black-Cockatoo. The handbook recommends a risk-based approach for assessing potential impacts of wind energy development consistent with the Victorian Ministerial Guidelines For Assessment of Environmental Effects. The criteria for consideration include whether a proposed development is in an area of high biodiversity value, has characteristics that do, or can, support threatened birds and bats, and whether the surrounding landscape supports threatened species or features they rely on and may move between (DEECA 2025). Various possible assessment methods are outlined, including the use of mapping tools, desktop analyses, and surveys to determine the occurrence, likelihood of occurrence, density and abundance of threatened species and habitat features (e.g. roosting, breeding, flocking, feeding habitat); bird utilisation surveys; behavioural and flight height studies; collision risk modelling; and PVAs. Additionally, the guidelines outline the utility of identifying protected areas and habitat features in the surrounding landscape in order to understand how movement, flight and migration patterns could mean infrastructure has an impact on birds and bats.

Impact assessments for renewable energy projects generally assess the occupancy of threatened birds within 5–10 km of a project boundary, using database searches and elicitation of data and information from experts and the community. Collision risk is assessed through bird utilisation surveys. Such surveys are undertaken to obtain flight heights for modelling likely mortality impacts and to gain an understanding of a project area's bird fauna assemblage. In rare cases, where a PVA exists, the population-level impact and proposed compensatory measures are assessed (DSE 2011); where bird utilisation surveys cannot capture sufficient data for collision risk modelling, scenario modelling of estimated heights may be used. Bird utilisation survey methods are not suitable for assessing South-eastern Red-tailed Black-Cockatoo at-risk flight behaviour and potential impacts from collisions, due to their nomadic behaviour and the substantial variability in locations occupied and flock sizes from year to year and during any given year. One targeted flight height study was undertaken for two wind energy projects in south-western Victoria (Biosis 2020). Flocks were not present at or near the proposed projects, and the study focused on collecting flight height data at locations where large flocks were present in that season—in the Edenhope area, within 10–15 km of the Wombelano Wind Farm, which was in pre-approval stages at the time and not yet constructed. That study provided some general information on South-eastern Red-tailed Black-Cockatoo flight heights. However, limitations of the study included the short data collection period (8 days) in one year (2020), and one season, and there is uncertainty about generalising the findings more broadly. Additionally, flight height

studies using on-ground observations can have limitations and some uncertainty in flight height estimation accuracy, though the Biosis study (2020) attempted to overcome this through calibrating flight heights prior to the study, and between observers. The Biosis (2020) study, and the literature review and targeted research sections of this report highlight the challenges in surveying, understanding flight paths and flight heights, and assessing risk of impact for any given project for the South-eastern Red-tailed Black-Cockatoo.

12.4 Information needs for renewable energy surveys and risk assessment

12.4.1 Detection and occupancy

Current survey and detection methods can successfully detect flocks and nests. The factors influencing occupancy are, however, incompletely known and difficult to study. Emerging information on stringybark food resources indicate that the food abundance of seed crops follows a 2–3-year cycle, with South-eastern Red-tailed Black-Cockatoo site occupancy being linked to this cycle.

South-eastern Red-tailed Black-Cockatoos may occur in any suitable habitat across their distributional range and they may fly over cleared land between suitable habitat patches of stringybark and scattered paddock trees that may be used for feeding, roosting or nesting. Where the birds find an abundant food source, they may be present for several months and undertake local movements within that period. Dispersal and longer-distance movements can occur as the seed crops in one area become depleted and the birds move to other areas and forest blocks in search of food.

Although South-eastern Red-tailed Black-Cockatoos are vocal and can be easily detected using currently known search methods, occupancy at a given location can vary from year to year in response to the food availability. Flocks can be located using the South-eastern Red-tailed Black-Cockatoo Recovery Team methods (SERTBC RT 2026). The social and vocal nature of the subspecies, their predictable daily activity and movement patterns, and their propensity to remain in the same stringybark forest block or patch for weeks or months, make it relatively easy to detect flocks near recent observations or fresh signs of feeding. Where no recent record exists, fresh signs of feeding can help in locating a flock. Birds are most vocal at the start and at the end of the day, prior to sunrise when at roost and when flying to feeding areas, and in the few hours leading up to sunset as the birds move to drink and to roost (Hill pers. obs.). They are most detectable when leaving the roost and for their first hour of feeding. Birds depart the roost at dawn, fly to and feed in stringybark, where they remain all day, and then depart for a drinking site up to an hour before sunset. They may also drink a second time during the day on warmer and longer days (Hill pers. obs.). South-eastern Red-tailed Black-Cockatoos are very social, keep within earshot of each other, and call quite regularly during the day while feeding and moving within stringybark habitat (Hill pers. obs.). Breeding individuals feed with flocks and return to their nest tree to feed the young and to roost. Following lone adult males can aid in the locating of nests (Joseph et al. 1991).

12.4.2 Population and abundance

The overall population size is well known, through long-term annual monitoring and flock counts. Parts of the population can occur in multiple different locations each year, and the flock size at any given location can vary. This makes it challenging to assess and interpret numbers at a particular location, and thus the impact of any given project. Large flocks of hundreds (up to 500 birds) may occur anywhere within their range where suitable and abundant stringybark is present. Impact assessments for renewable energy projects generally assess the occupancy of threatened birds within 5–10 km of a proposed site; the short duration of surveys typical of renewable energy development are inadequate for assessing the numbers at risk at any given time or over the lifetime of a project.

TARGETED RESEARCH

13 Background and context

The literature review indicated that the key concern recognised for the South-eastern Red-tailed Black-Cockatoo in relation to renewable energy developments is potential wind turbine collision. However, strip mining for critical minerals is emerging as a significant impact risk, primarily through clearance of critical feeding and nesting habitat. The siting of strip mines has less flexibility than the siting of wind and solar farms.

Crucial information on the subspecies' flight heights has been lacking for collision risk and impact assessment, with only one study having been undertaken, in the northern part of the subspecies' range (Biosis 2020). Biosis (2020) reported South-eastern Red-tailed Black-Cockatoos flying at heights that overlap with the turbine rotor–swept area of existing wind farms. The subspecies' flocking and flight behaviour patterns increase the risk of multiple mortalities from wind turbine collision. Such an event would constitute a major threat to the population viability of this species, given its known demographic and population parameters.

Despite this, our understanding of collision risk for the South-eastern Red-tailed Black-Cockatoo is very limited. Key knowledge gaps remain regarding the duration, frequency and altitude of flights that might occur in the collision risk zone. In contrast, there is relatively good understanding of the scale of local movements, although much of this information is unpublished. No information exists on effective mitigation measures for impacts on this species (or on other black-cockatoos) from wind farms. While raising the minimum blade-tip height above the ground to the subspecies' maximum flight height may be a feasible mitigation option, the absence of robust flight height data prevents assessment of its effectiveness. Accurate flight height data (including maximum flight heights, and the frequency or probability of at-risk flights) have not been available to support the assessment of mitigation measures. Targeted research to address the critical knowledge gap of the subspecies' flight heights was undertaken, as part of the RERI project for the South-eastern Red-tailed Black-Cockatoo, to address this critical knowledge gap.

The study focused on documenting flights over cleared land where flocks of South-eastern Red-tailed Black-Cockatoos, as well as single birds or smaller groups, are known to fly to access foraging, roosting, nesting and drinking habitat. These areas of flight activity are considered to present the greatest risk for collision for the subspecies, because cleared land is the most likely location for wind farm and turbine siting. Native vegetation clearance for tracks and turbine pads, and turbine siting in native woodland and forest habitat is unlikely, given the importance of this habitat to the South-eastern Red-tailed Black-Cockatoo, native vegetation regulations, and the challenges in obtaining approval and in the offsetting of large-scale native vegetation habitat loss. Some wind farm developments may be sited in pine and Blue Gum plantations, in which case South-eastern Red-tailed Black-Cockatoos could be at risk of collision with turbine rotors if the birds use the plantations for roosting, or if the landscape settings are such that birds move across the plantations when accessing roosting, foraging, nesting or drinking habitat.

13.1 Aims

The aim of this targeted research was to improve understanding of collision risk by undertaking a flight height study of South-eastern Red-tailed Black-Cockatoos, to support the evaluation of potentially suitable collision avoidance and mitigation measures.

14 Methods

14.1 Study area and site selection

The study was located in the broader Edenhope area, in south-western Victoria, and undertaken in spring (19–24 and 26–30 October 2025, with data being collected on 10 of these days). Three individual observers were involved overall, with a team of two observers collecting data in each of the 2 weeks. One of the observers was present for both weeks and collected the majority of the data.

Recent sightings of South-eastern Red-tailed Black-Cockatoos were obtained from BirdLife Australia and used to identify stringybark forest blocks for reconnaissance to assess their suitability for data collection. An additional site where the subspecies regularly occurs was visited, based on separate discussions with a landholder. This site had been included in the previous flight height study on the South-eastern Red-tailed Black-Cockatoo (Biosis 2020). Sites with the most recent records of large flocks (≥50 birds) and with stringybark foraging blocks and gum roosts adjacent to open cleared land were visited to search for flocks. While locations with large flocks were prioritised, sites where smaller flocks (≥10 birds but <50 birds) had been observed flying over cleared land (or were likely to fly over cleared land) were also visited to assess their suitability for the study. One of the sites in the present study—Yallakar State Forest—was also included in the study by Biosis (2020).

Site reconnaissance was carried out in the mornings 1–2 hours after sunrise and in the afternoons in order to find a flock and set up a data collection observation point. To search for flocks, forest tracks were driven, starting from the location of the most recent sighting. When fresh signs of feeding were found, the vehicle was stopped and the engine turned off to listen for calls. Listening periods lasted for a minimum of 30 seconds every 500 m in calm weather and every 250 m in windy conditions. The car was also stopped when a Wedge-tailed Eagle (*Aquila audax*) was sighted, as flocks are likely to be vocal when flushed by a bird of prey. These methods were recommended by one of the authors (Hill) and broadly follow the South-eastern Red-tailed Black-Cockatoo annual count methodology.

Of 11 identified locations (9 through BirdLife Australia and 2 through local landholders), 6 sites were visited, and 3 selected for repeat data collection and inclusion in the study—Yallakar State Forest ('Yallakar'), Jilpanger Nature Conservation Reserve ('Jilpanger') and Kadnook State Forest ('Kadnook') (Appendix 2, Table A2.1). Very low numbers of individuals flew over cleared land at Kadnook State Forest. The majority of repeat data collection was therefore conducted at Yallakar and Jilpanger, where birds were regularly and reliably flying over cleared land. Once a flock was found, an observation point for data collection was selected for collecting flight height data when birds were moving to and from the roost in the morning and evening. The periods between late morning and late afternoon were used to visit and assess other sites to search for flocks and to assess their suitability for inclusion in the study.

14.2 Selection of observation points

Once a flock was located, aerial imagery and on-ground visual inspections of the landscape surrounding the feeding flock were studied to determine the most likely nearest roost site. Once the likely roost site was identified, a suitable observation point for flight height data collection was chosen that provided the clearest view of the stringybark feeding area, the likely roost, and open cleared land. South-eastern Red-tailed Black-Cockatoos drink near or at dusk (Higgins 1999; Koch et al. 2022) prior to flying to the roost, so the most likely drinking site in proximity to the feeding and roosting habitat was also identified. Where possible, the observation point was situated so as to also allow a clear view of the likely drinking habitat.

14.3 Tree height data and flight height calibration

Within- and between-observer errors were not explicitly captured for observers or for individual flights. On the first day of data collection, it became clear that the flights occurred within a short time frame, and a small number of flights recorded by both observers either matched or differed by 1–2 m, which may have been due to differences between observers or to differences in the exact location of the bird when the flight was recorded. The data collection method used in the field was found to be the most efficient way to observe and record all visible flights—generally, one observer estimated and called out flight heights to the second observer, who recorded the data. A small number of flights not visible to the main observer were recorded by the second observer. The main methods of accounting for measurement error were (i) having the same observer estimate the majority of the flight heights, and (ii) calibrating the estimated flight heights against the height of known objects, as determined using a laser rangefinder. Some error may still be expected in the estimated flight heights, particularly with flights recorded from greater distances and at greater heights.

Due to the speed and flight heights of South-eastern Red-tailed Black-Cockatoos, it was not possible to use a laser rangefinder directly to obtain flight heights—early attempts showed that it was not possible to fix the rangefinder on a flying bird before it flew out of view, and attempting to do this would have resulted in missing data for many flights.

Instead, the heights of scattered trees in open cleared land, a sampling of stringybarks and gum trees, and a fence post were measured by two observers using a laser rangefinder (Nikon Forestry Pro) for comparison. Where measurements of tree heights differed, due to slight variation between the two laser rangefinders, the average of the readings was recorded. The height of the measuring person from the ground to eye-level was added to the tree canopy height, as per the laser rangefinder instructions. The fence post measurement of 1 m and the tree height measurements were then used to calibrate the estimations of the South-eastern Red-tailed Black-Cockatoo flight heights to the nearest metre and to minimise observer error.

The birds flew singly, in pairs and in groups. The flight height of each bird was recorded. When multiple birds flew at the same height, the number of birds flying at that height was recorded.

To further minimise observer error, the majority of the flight height estimates were undertaken by one person, with a small number of additional flights being estimated by a second observer (in cases where birds were flying simultaneously in opposite directions, and a visual on both sides was not possible). On the morning of 24 October 2026, the two observers were stationed separately on either side of a roost at Yallakar State Forest to maximise the visibility of flights from the roost to foraging habitat.

14.4 Data collection

14.4.1 Timing of flight height data collection

Data were collected in spring over 10 days (19–24 and 26–30 October 2025) (Appendix 3), in the evening and morning, when South-eastern Red-tailed Black-Cockatoos fly to and from the roost. No data were collected on the morning of 22 October due to severe weather conditions. The data included in the analyses were collected on three evenings and two mornings at Yallakar, and on three evenings and three mornings at Jilpanger. Kadnook was visited three times. On the first visit on 26 October, the flock was not found at the location of the most recent sighting. Small groups of birds were found on either side of Olive Grove Road and Cactuses Track. A likely roost of a patch of gums in the paddock surrounded by several dams was located at the corner of these tracks, and the observation point for that evening was located at this corner. Only a single pair was observed flying in stringybark near sunset. No birds were seen to fly to the gums over the cleared land, and no data were collected on roost fly-ins that evening. Another potentially likely gum roost was identified using aerial imagery, and the roost site was found around twilight (20:24) by stopping, listening and hearing calls from the roost. Data collection at Kadnook was ceased after two sessions, due to the very small number of birds flying over cleared land–eight in total—and to maximise data collection at the other two sites, where greater numbers of flights occurred over cleared land.

14.4.2 Flights over cleared land and treed habitat

All flights visible to the observers were recorded during the morning and evening roost fly-out and fly-in. These included flights over cleared land and treed habitat. Only the flight height data for flights over cleared land were included in the analyses, but the numbers of flights over treed habitat are also provided to indicate the numbers and proportions of flights observed over each habitat as birds were flying in and out of the roost.

14.4.3 Habitat use and general movement behaviour

During the evening and morning flights between the roost and the foraging area, the timing of flight, drinking and calling behaviour was noted, to develop an understanding of the timing of these behaviours relative to sunrise, sunset, and civil twilight times.

After the morning roost fly-out, tracks within the forest block were driven to identify the locations where the birds landed in the stringybark feeding habitat, and to estimate the distances flown between the night roost and foraging areas. The distance between these habitats was taken as the distance from the approximate centre of the roost to that of a foraging flock. In the evenings, the team set up at the observation point approximately 1.5 hours prior to sunset, seeking to confirm the likely drinking site identified earlier in the day and to estimate the distance between the drinking habitat and the feeding habitat, and between the drinking habitat and the roosting habitat.

14.4.4 Tree heights

South-eastern Red-tailed Black-Cockatoos will fly over as well as through woodland habitat, and over and between scattered paddock trees. Trees in habitats used by South-eastern Red-tailed Black-Cockatoos were measured to determine whether flight heights were related to the canopy height of the habitats birds flew through or over. This included measuring the heights of all the scattered paddock trees in open cleared land that were visible and within 100 m of the observation points at each site, of 10 gum trees at roost sites (either

within the roost, or on the edge of the roost, depending on access) and of 10 stringybark trees (on the edge of and adjacent to cleared land and/or the gum roost). Trees along the woodland edges, rather than within the forest block, were chosen for measuring the heights of stringybark trees, as these were the locations that the birds were flying into or over between the feeding and roosting habitats.

14.5 Data analysis methods

14.5.1 South-eastern Red-tailed Black-Cockatoo flight heights

Flight height data from Jilpanger and Yallakar (where sufficient data were available) were used to model South-eastern Red-tailed Black-Cockatoo flight heights. The flight height of South-eastern Red-tailed Black-Cockatoo ($x_i > 0$) was modelled using a Gamma likelihood, which is appropriate for continuous, strictly positive, right-skewed data (McCullagh and Nelder 1989; Gelman et al. 2013). The Gamma density was parameterised in terms of a mean μ_i and a shape parameter $\kappa > 0$ (the larger the shape parameter the smaller the variance). To evaluate flight height, we modelled the mean μ_i with fixed effects of location (l_i) and time of day (t_i) and their interaction, and random effects of date (date_i). A log link ensured positivity of predicted flight heights. The shape parameter was allowed to vary with time of day (morning or evening). Under this parameterisation,

$$\begin{aligned} x_i &\sim \mathrm{Gamma}\left(\kappa, \frac{\kappa}{\mu_i}\right) \\ \log(\mu_i) &= \beta_0 + \beta_1 l_i + \beta_2 t_i + \beta_3 l_i t_i + \gamma_{\mathrm{date}_i} \\ \gamma_{\mathrm{date}_i} &\sim \mathcal{N}(0, \sigma^2_{\mathrm{date}}) \\ \log\kappa_i &= \delta_0 + \delta_2 t_i \end{aligned}$$

The location and time-of-day variables are both categorical and were coded using treatment (dummy) contrasts from the default combination of a location (Jilpanger) and time of day (morning).

Weakly informative priors were used to regularise estimates and avoid implausible predictions, while allowing the data to dominate inference (Gelman 2006; Gelman et al. 2013). Priors were placed on parameters on the log-mean scale. The intercept was given a broader Normal prior centred on the empirical mean of the response (after log transformation). The priors were specifically:

- Fixed effects: $\beta_1, \beta_2, \beta_3, \delta_1 \sim \mathcal{N}(0, 2.5^2)$
- The intercept: $\beta_0, \delta_0 \sim \mathcal{N}(m_0, s_0^2)$
- Random effect: $\sigma^2_{\mathrm{date}} \sim \mathrm{half-t}(3,0,2.5)$.

All models were fitted using the *brms* package (Bürkner 2017) in R (R Core Team 2025), which provides a high-level interface to stan (Carpenter et al. 2017) and uses Hamiltonian Monte Carlo with the No-U-Turn Sampler (NUTS) for efficient Bayesian inference (Hoffman and Gelman 2014). Estimation was performed using four parallel Markov chains with 4000 iterations per chain, including 2000 warm-up iterations. Convergence was assessed using the Gelman–Rubin statistic ($\hat{R}$ < 1.01 for all parameters) (Gelman et al. 2013), effective sample sizes for bulk and tail parameters (>400 per parameter), and inspection of Markov chain trace plots. Model adequacy was examined using posterior predictive checks (Gelman et al. 2013; Gabry et al. 2019).

14.5.2 Probability of flights within the rotor-swept height zone

The probability of flights above and below various heights and within various height bands was obtained from the estimated posterior distribution of the South-eastern Red-tailed Black-Cockatoo flight data.

14.5.3 Tree heights

Tree heights were modelled to understand the differences between tree height in the main habitats used by the South-eastern Red-tailed Black-Cockatoo, and to compare the tree heights with flight heights to identify any patterns in relation to flight height.

Tree height ($\mathrm{y_i} > 0$) was modelled using a Gamma likelihood, which is appropriate for continuous, strictly positive, right-skewed data (McCullagh and Nelder 1989; Gelman et al. 2013). The Gamma density was parameterised in terms of a mean (η_i) and a shape parameter (ν_i) (the larger the shape parameter the smaller the variance). To evaluate how mean tree height varied with environmental conditions, we modelled the mean η_i as a function of location (ℓ_i), habitat (h_i), and their interaction. A log link ensured positivity of predicted heights. The shape parameter was assumed constant.

Under this parameterisation:

$$\begin{aligned} y_i &\sim \text{Gamma}\left(\nu, \frac{\nu}{\eta_i}\right) \\ \log(\eta_i) &= \alpha_0 + \alpha_1 l_i + \alpha_2 h_i + \alpha_3 l_i h_i \end{aligned}$$

The location and habitat variables are both categorical and were coded using treatment (dummy) contrasts from the default combination of a location of Jilpanger and stringybark habitat of forest block edge.

Weakly informative priors were used to regularise estimates and avoid implausible predictions, while allowing the data to dominate inference (Gelman 2006; Gelman et al. 2013). Priors were placed on parameters on the log-mean scale. The intercept was given a broader Normal prior centred on the empirical mean of the response (after log transformation). The priors were specifically:

- Fixed effects: $\alpha_1, \alpha_2, \alpha_3 \sim \mathcal{N}(0, 2.5^2)$
- The intercept: $\alpha_0 \sim \mathcal{N}(m_0, s_0^2)$
- The shape parameter ν: $\text{Gamma}(0.01,0.01)$.

All models were fitted using the *brms* package (Bürkner 2017) in R (R Core Team 2025), which provides a high-level interface to stan (Carpenter et al. 2017) and uses Hamiltonian Monte Carlo with the No-U-Turn Sampler (NUTS) for efficient Bayesian inference (Hoffman and Gelman 2014). Estimation was performed using four parallel Markov chains with 4000 iterations per chain, including 2000 warm-up iterations. Convergence was assessed using the Gelman–Rubin statistic ($\hat{R}$ < 1.01 for all parameters) (Gelman et al. 2013), effective sample sizes for bulk and tail parameters (>400 per parameter), and inspection of Markov chain trace plots. Model adequacy was examined using posterior predictive checks (Gelman et al. 2013; Gabry et al. 2019).

15 Results

15.1 Proportion of flights over cleared land

Of 692 flights of South-eastern Red-tailed Black-Cockatoos, when birds were flying between the roost and the foraging habitat in the mornings and evenings, 46% were over cleared land and 54% in or over woodland habitat. At Kadnook, most flights occurred over treed habitat (91%), whereas more than 50% of flights were over cleared land, 58% of flights at Jilpanger and 51% of flights at Yallakar (Table 5).

Table 5. Number of flights over cleared land and treed habitat.

Only the data on flights over cleared land at Jilpanger and Yallakar were used for modelling flight height.

Habitat	Time of day	Jilpanger	Yallakar	Kadnook	Morea	Total
Cleared	Morning	42	116	4	0	162
	Evening	72	83	4	1	160
	Subtotal	*114*	*199*	*8*	*1*	*322*
Treed habitat (stringybark/gum)	Morning	43	60	7	0	110
	Evening	38	131	76	11	256
	Subtotal	*81*	*191*	*83*	*11*	*366*
Overall	**Total**	**195**	**394**	**91**	**12**	**692**

15.2 South-eastern Red-tailed Black-Cockatoo flight height

The flight height model showed a difference in flight height between some locations (mean height), and variability between times of the day and between days (Figure 2 and Figure 3). The flight heights were substantially more variable in the evenings [the shape parameter was 40% smaller [95% credible interval (CI): 18% to 57%] (see Appendix 4, Table A4.1). At Yallakar, the flight heights were substantially higher than at Jilpanger [by a factor of 1.5 (95% CI: 1.1–2.2)] (Table A5.1 and Figure 3). The inclusion of date as a random effect gave a better model than the same model without the random effect. The inclusion of this random effect is a way of accounting for some of the variability in flight heights being due to environmental and weather conditions, which may affect the flight heights of the South-eastern Red-tailed Black-Cockatoo.

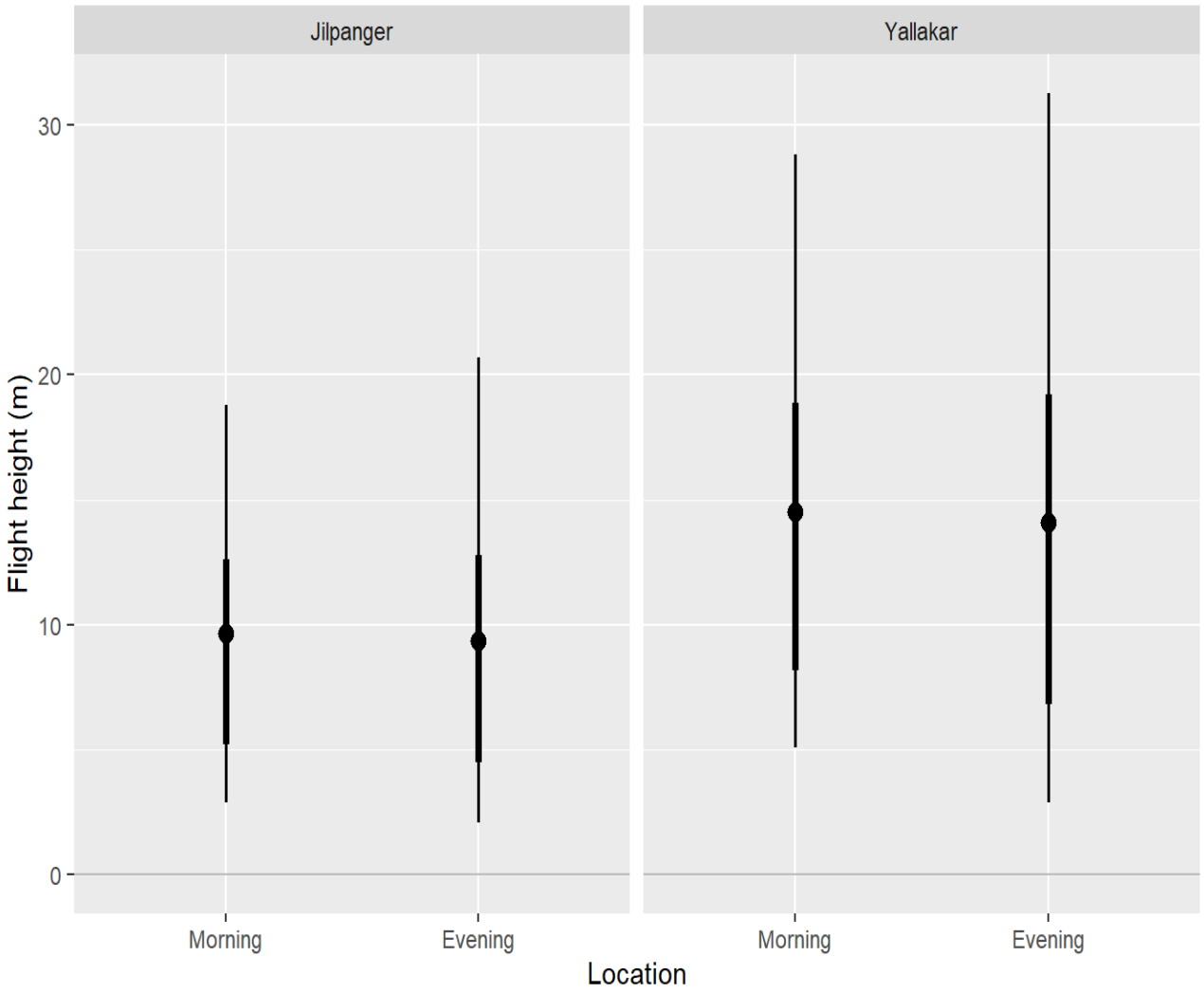


Figure 2. Estimated South-eastern Red-tailed Black-Cockatoo flight height across locations and time of day from the posterior distributions.

The circles represent the medians. The thick lines represent the 95% credible intervals, while the thin lines represent the 95% prediction intervals.

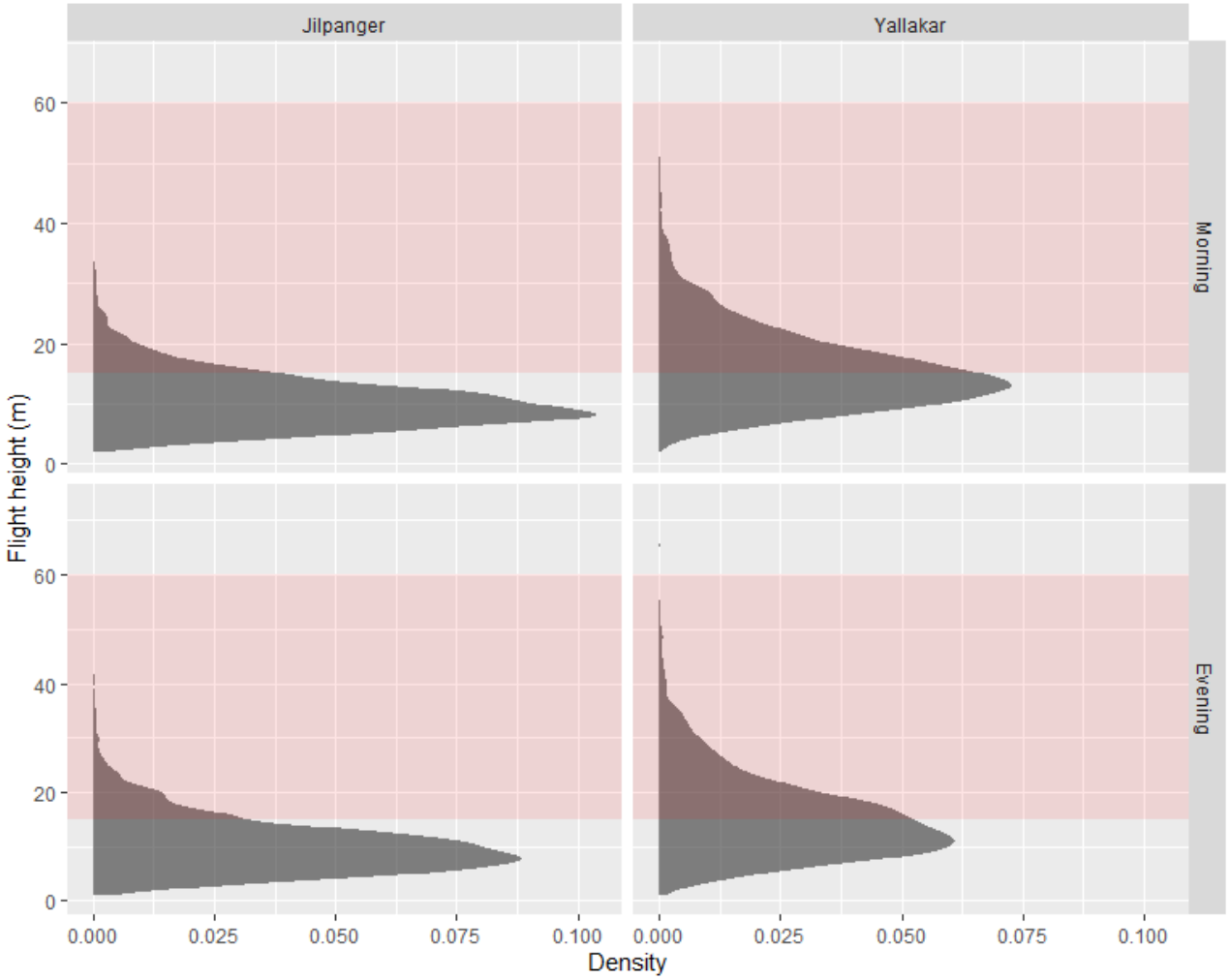


Figure 3. Estimated posterior distribution for South-eastern Red-tailed Black-Cockatoo flight height across locations and time of day.

The red-shaded area represents distance above the ground from the known minimum (15 m) to the proposed (>60 m) minimum height of the lower blade-tip at operating wind farms in Victoria. See also Appendix 4 (Table A4.2) for the probability of flights occurring under, within and over the height categories and bands).

Only eight flights over cleared land were recorded at Kadnook, which did not provide sufficient data for formal statistical analyses. Among these eight flight observations, one pair of birds flew at 34 m and one pair flew at 36 m during the morning observations, and one pair flew at 16 m and one pair flew at 21 m during the evening observations, indicating that South-eastern Red-tailed Black-Cockatoos may fly higher over the cleared land at Kadnook than they do at Jilpanger and Yallakar, but more data would be required to confirm a difference in the flight height means. Additionally, while the analyses here do not include flights over woodland, an observation of a single bird at Jilpanger calling and circling at up to 40–50 m above stringybark woodland indicates the birds will at times fly at higher altitudes.

15.3 Tree heights

The tree height modelling showed a difference in tree height between habitat types and between some locations. The tree heights in the forest block edge were substantially lower than in the other habitat types. The height of the stringybarks in the forest block edge was around 13 m (Figure 4). In comparison, the gums were larger by a factor of 1.6 (95% CI: 1.3–2) and 1.4 (95% CI: 1.2–1.7) in clear open land and roosts, respectively (Appendix 4, Table A4.3).

There is evidence that the gums at Yallakar in open cleared land were taller than those at the roosts in this study (among clumps of gums) by a factor of 1.3 (95% CI: 1.1–1.5). There is some evidence that the tree heights at the roosts at Kadnook were larger than elsewhere, with the posterior distribution being larger 97% and 98% of the time compared with roosts at Jilpanger and Yallakar, respectively. For the remaining comparisons, there was insufficient evidence to conclude that the tree heights in the three different habitats varied between locations.

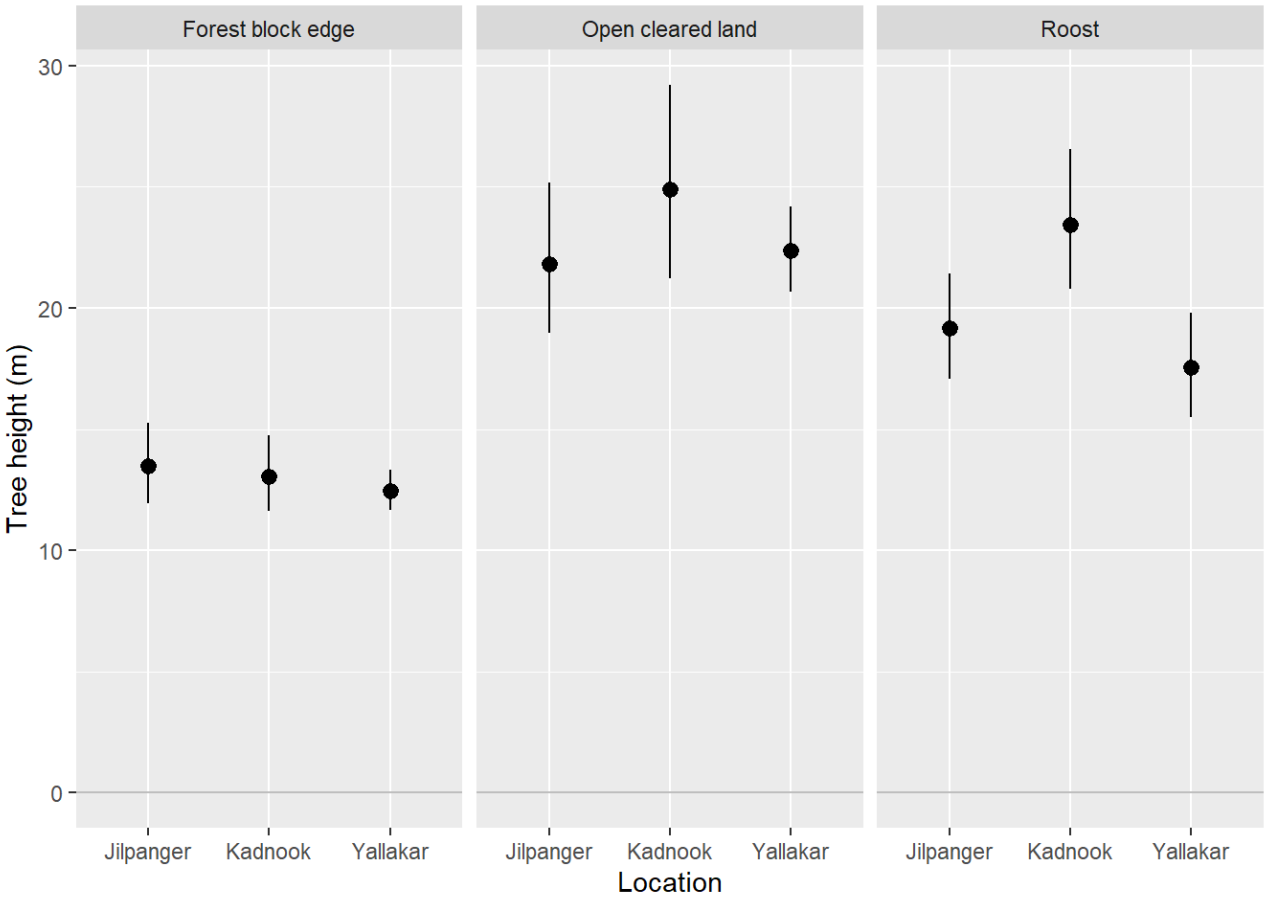


Figure 4. Estimated tree height across locations and habitats.

15.4 Habitat use and general movement behaviour

South-eastern Red-tailed Black-Cockatoos were vocal before sunrise and after sunset when at roost and when moving to and from foraging habitat. In the evenings, birds were flying, drinking and calling in the 2-hour period from the onset of civil twilight till settling in at the roost (Appendix 1 and 2). The timing of birds flying in the evenings and into the roost was more consistent between days and sites than the timing of the morning roost fly-outs. However, the duration of the period when birds were flying was generally longer in the evenings than in the mornings (about 2–2.5 hours versus 15–30 minutes), with flights to foraging areas from the roost occurring over shorter time periods.

Flights also occurred after sunset and before civil twilight, and between civil twilight and sunrise, with birds flying in low-light conditions. These flights occurred at Yallakar (i) when a group of 11 birds flew almost in the dark, 5 minutes after last light (after civil twilight) and after settling to roost with the flock; and (ii) when birds started leaving the roost 10 minutes prior to sunrise. On other mornings, birds departed the roost within about the first 15–30 minutes after sunrise, except at Kadnook, where some birds flew out about 1.5 hours after sunrise, indicating some variability in the timing and duration of morning roost fly-outs between days and sites.

Birds flew direct from the night roost to foraging habitat in the morning, but returned via a water source in the evenings. At all sites, the birds drank from puddles along the forest tracks in proximity to the roost sites and foraging habitat. At Yallakar, the birds drank from puddles at two locations, one either side of the roost. At Jilpanger, the location of a second likely water source in between stringybark habitat and a canola crop was not confirmed due to lack of access to private land.

The average distance between the night roost and morning foraging areas was 696 m (range: 260–1620 m; n = 11) (Appendix 5). The distances moved were similar each day at a given site, but varied between the sites. Birds moved furthest from the roost at Kadnook (1620 m). At Yallakar and Jilpanger, the birds split into separate foraging groups at various distances from the roost.

Other general behavioural observations included differences in the roost location compared with 2020, and a landholder reporting aggressive behaviour of Sulphur-crested Cockatoos chasing South-eastern Red-tailed Black-Cockatoos. The birds at Yallakar used a roost consisting of a patch of gums, which differed from the scattered trees they roosted in at this location in 2020 (Biosis 2020).

16 Discussion

16.1 South-eastern Red-tailed Black-Cockatoo flight heights and collision risk

The proportion of flights over cleared land in this study was similar to that recorded by Biosis (2020), though the current study only focused on collecting data for flights to and from roosts. South-eastern Red-tailed Black-Cockatoos were on average predicted to fly at or below 15 m over cleared land at the two sites, below the lowest known minimum blade-tip height of the oldest turbines in Victorian wind energy projects (DEECA unpublished). However, there was found to be considerable variability in flight heights, and the South-eastern Red-tailed Black-Cockatoos at Jilpanger and Yallakar were predicted to fly at heights of up to 31 m, which would place them inside the rotor-swept height zone (15–250 m), with potential collision risk. Additionally, although flight heights were similar at the two sites, the variability between them and the substantially higher flight altitudes of the small number of flights observed at Kadnook (16–36 m, and an observation of a single bird flying at 40–50 m above the woodland canopy) provide evidence that the subspecies is likely to fly above 30 m at times. Similarly, Biosis (2020) found that most flights over cleared land were below 39 m, but there were some flights at up to 54 m, and flights of up to 30 m above woodland canopy were observed. Circling flight behaviour, as was observed in both studies, could expose birds to greater risk than a single, direct commuting flight, as the number of passes or time spent flying in a rotor-swept area would be greater. Thus, the exposure to collision risk is likely to vary depending on the location, the turbine-blade-tip ground clearance for a given wind energy project, and on the types of flight behaviour the birds are engaging in.

Our findings suggest that flight height was broadly similar in the mornings (when South-eastern Red-tailed Black-Cockatoos depart from the night roost) to that of the evenings (when they return to roost), and thus the collision risk may be similar at these times of the day. However, the greater variation observed in the flight altitudes in the mornings and at Yallakar indicate that the risk could be somewhat higher in the mornings, and that exposure to risk may differ between sites. The level of risk could be different at other times of the year, on other days and at other sites, none of which were sampled in the current study. In particular, flight heights have not been described for South-eastern Red-tailed Black-Cockatoos when making long-distance flights or nomadic flights during the non-breeding season. Knowledge on long-distance flights of other species suggests that these flights are generally at higher altitudes than local movements between roosting, feeding and nesting habitats. Anecdotal reports from community members in the broader study area included occasional observations of groups of South-eastern Red-tailed Black-Cockatoos flying over cleared land in the mornings and afternoons. The frequency and height of these flights remains a gap in knowledge. Additionally, environmental and weather conditions (such as wind speed and direction) on any given day could influence the altitude of flying birds. Although we did not sample these variables, the model captured daily variation in flight heights, which could have been due to differences in weather conditions between days. Investigating the potential effect of weather (e.g. wind speed, wind direction, rain) and flock size on flight heights would have required a larger sample size than was possible within the current study.

Similarities in the flight heights observed during this study and during a previous study suggest some general patterns and consistencies in South-eastern Red-tailed Black-Cockatoo flight heights—similar results were obtained in winter and autumn at some of the sites in the Edenhope area (Biosis 2020). It is unclear whether the greater number of flights above 39 m observed by Biosis (2020) could have been due to differences in behaviour, time of year, sampling methods, or other factors. The size of the flocks in the Biosis (2020) study were slightly greater, and it is unknown whether flock size itself affects flight heights, or whether flying in larger groups simply results in birds flying at different altitudes to avoid colliding with one another. In the current study, most birds were observed flying in pairs or in small groups of less than 10 individuals at a time.

Biosis (2020) also recorded flights at up to 30 m above the woodland canopy, when flocks were flushed by a Wedge-tailed Eagle. With the addition of the canopy height of the woodland habitat (average 13 m), these flights would place the birds within the rotor-swept height zone. The frequency, timing and context of such flights is not known, though Wedge-tailed Eagles are common across the landscape, present year-round, and likely to be most active from late morning to afternoon. The risk of collision resulting from birds being flushed from within woodlands is likely to be negligible, given the status and protection of South-eastern Red-tailed Black-Cockatoo habitat and the native vegetation regulations. However, given that the birds feed in scattered large old Buloke trees and stringybark trees in paddocks (Commonwealth of Australia 2007), collision risk could be higher at certain times, for example, during January to March, when Buloke seed is available and if turbines are located in close proximity to food trees.

The findings from the current study and that of Biosis (2020) on the proportions and probability of flights occurring at different heights suggest that South-eastern Red-tailed Black-Cockatoos mostly fly below 35 m,

and the probability of collision with turbines is therefore low but not impossible. Although at Jilpanger all flights were predicted to be below 45 m, the results from Yallakar show that there is a small probability of birds flying at 45–65 m, with an even smaller probability of flights occurring above 65 m at that site. Biosis (2020) also reported a small proportion (0.6%) of flights at 40–54 m, meaning that exposure to collision risk above 35 m still exists. Understanding variability between sites would require further investigation and replication at a greater number of sites across the subspecies' range.

Currently, one wind energy project is operating within the South-eastern Red-tailed Black-Cockatoo range at Lake Bonney, South Australia. The project includes 112 turbines with minimum blade-tip heights of 22 m or 28 m above the ground, indicating collision risk for the subspecies at this site exists if birds fly through it. Two other recently approved wind energy projects in Victoria within the subspecies' range have minimum blade-tip heights of 60–65 m (DEECA 2025), and the collision risk at these sites could be lower if the flight heights from this study and that of Biosis (2020) are indicative of the general flight behaviour and flight heights of the South-eastern Red-tailed Black-Cockatoo. However, the proportion of flights likely to occur within the rotor-swept height zone is an additional important consideration for understanding potential risk, even when the turbine ground clearance height is raised. While the birds may mostly fly below the rotor-swept zone, even a small proportion of flights being at risk of collision could potentially result in mortalities that impact the population, given the subspecies' demographics and low breeding output. The current study recorded roosting in Blue Gum, and there are landscape settings within the South-eastern Red-tailed Black-Cockatoo range where suitable foraging habitat occurs adjacent to pine plantations. Turbines sited within pine or Blue Gum plantations, where the birds might roost or fly over, could pose a higher risk, despite the raised minimum blade-tip height. In these cases, the effective clearance for flights below the blades without risk of collision would be between the canopy and the minimum blade-tip height, rather than between the ground and the minimum blade-tip height. While the majority of flights observed over cleared land were below 35 m, it is conceivable and likely that South-eastern Red-tailed Black-Cockatoo fly at similar heights *above the tree canopy* when commuting between habitats. Thus, even in situations where the turbine ground clearance has been raised to 60–65 m, the safe flying zone (between the canopy height and the minimum blade-tip height) will be much narrower over woodland, and the risk of collision would be similar to that for lower-ground-clearance turbines sited in cleared land. For example, a canopy height of 40–50 m would have most flights occurring within the rotor-swept height zone, which would substantially increase the exposure of flights to turbine collision risk if birds are flying over plantations or if disturbed and flushed from roosts in the plantations.

16.2 Tree height and relationship to flight heights

South-eastern Red-tailed Black-Cockatoos do fly over woodland habitat and above scattered tree canopies, and flights of 10–50 m above the canopy have been recorded (Biosis 2020; Section 15.2). The height of the tree canopy could thus be important when considering how high the birds may fly when using or flying over woodland blocks and scattered trees, and whether this represents a significant collision risk for the subspecies.

The stringybark trees within the public land state forests and nature conservation reserves were consistently shorter than the gum trees at roosts and in open cleared land across all three sites. This pattern likely reflects similar soils, geomorphology, and disturbance history between the study sites. Brown Stringybark can be small when growing on poor dry soils but grow taller in open forests and foothills, in more fertile and wetter soils, and in areas with less frequent burning and clearing (Costermans 1981). Across the South-eastern Red-tailed Black-Cockatoo range, stringybarks are taller in the Nelson area and smaller in the Little Desert, indicating that variation in the tree height of the main feeding resource exists throughout the range; collision risk may differ throughout the subspecies' range if tree canopy height influences flight heights at any given location.

The height of gum trees was similar roosts and on open cleared land between the sites, though variation between the sites was evident. The roost at Kadnook included a tall Blue Gum plantation and a large patch of River Red Gums containing numerous older and taller trees than at Jilpanger and Yallakar, which could explain some of the differences. Tall clumps of eucalypts (not plantations) are typical South-eastern Red-tailed Black-Cockatoo roosting habitat, generally located within private land, with variable tree heights, similar to this study's findings. The roost trees at the three sites (19 ± 3 m average height) were within the known South-eastern Red-tailed Black-Cockatoo roost tree height range of 26 ± 3 m for River Red Gums and 20 ± 2 m for Manna Gums across 13 sites on private land (Commonwealth of Australia 2006). Much of the gum eucalypt habitat used by South-eastern Red-tailed Black-Cockatoos for roosting now occurs mainly as remnant patches of varying extent and as scattered paddock trees, which are often larger and older trees. The subspecies' nest tree heights can be up to 32 m, with a mean of 17.5 m.

The flight height analyses did not model the effect of tree height on flights, and the data collected in this study were not suited to such analyses. Additionally, we made no comparisons between the stringybark

(over woodland) and gum (over open cleared land to and from the roost) flights. Further work on this in the future may be warranted to understand whether and how canopy height in different habitats, sites and parts of the South-eastern Red-tailed Black-Cockatoo range influences exposure to collision risk. The gum tree heights and flight heights were similar between Jilpanger and Yallakar, where most of the flight data were collected. Kadnook had taller gum trees and the birds flew higher there, but very few flights over cleared land were recorded at that location. Knowledge of flight heights for understanding and assessing collision risk impacts is important if turbines are sited within plantations (such as Blue Gum plantations, which birds could roost in, or pine plantations, which birds may fly over when commuting between night roosts and foraging habitats). Yellow-tailed Black-Cockatoos are known to feed, roost and fly over pine, though this behaviour and habitat use has not been recorded for the South-eastern Red-tailed Black-Cockatoo.

16.3 Habitat use and general movement behaviour

The habitat use and general movement behaviour of South-eastern Red-tailed Black-Cockatoos recorded in the current study were consistent with current knowledge. Movement distances between the roost and foraging areas were comparable with distances the subspecies is known to move between foraging and nesting trees (Section 7.4). Calling and night roost fly-ins and fly-outs were observed either side of sunrise and sunset, as reported by Higgins (1999). The current study recorded some individuals flying in conditions with very low light levels. The current study did not record any circling behaviour in response to Wedge-tailed Eagle presence as was noted by Biosis (2020), though a lone South-eastern Red-tailed Black-Cockatoo was observed circling at rotor-swept-zone heights above the stringybark canopy. The frequency and timing of raptor-induced flights is unclear and unpredictable, as is the behaviour reported by a landholder of altered flight patterns of South-eastern Red-tailed Black-Cockatoos being aggressively pursued by Sulphur-crested Cockatoos. Situational awareness of South-eastern Red-tailed Cockatoos being aggressively pursued is likely to be greatly reduced compared with during normal behaviours of foraging, roosting, drinking and commuting between habitats, and birds may be more at risk when engaged in this type of behaviour. The potential exposure to collision risk during such flights requires further consideration on a site-by-site basis.

16.4 Study limitations

This study focused on understanding daily flight behaviour in which frequent flights between roost and feeding areas occur only in the morning and evening. The main limitations of the study are the short duration of the data collection period, the limited number of survey sites, the limited coverage of the diurnal and annual cycles, and the small spatial extent of the data collection coverage within the South-eastern Red-tailed Black-Cockatoo range. The study, however, has increased the understanding of the subspecies' daily flight behaviour for non-breeding flocks, with the ability to compare findings with those of a similar previous study in the same part of the subspecies' distribution (Biosis 2020). Due to the limitations, any generalisations beyond the sites, to other times of the day, other seasons, or to other times of the year are not possible.

Visual estimates of flight heights are subject to within- and between-observer errors. These errors were not recorded explicitly (Section 14.3) and thus were not included in the analyses. Calibrating heights against known objects reduces error, but some inaccuracies would be expected in the flight height estimates. The findings should therefore be interpreted within this context, though the data errors in this study are not considered to have major implications for the findings and their interpretations. The study did not capture longer-distance flights that can occur throughout the year as the subspecies moves to access changing food resources and nesting trees. Movement behaviour in response to, and after, bushfires is also unknown. Due to the nomadic behaviour of the subspecies, such information is very difficult to collect using observational field studies. Similarly, other flights throughout the day, including flights between habitats, circling, or being flushed by birds of prey, may be more difficult to predict and study using such methods.

Based on the current knowledge from the literature and anecdotal observations, flight behaviour is likely to be different when water sources in and around the forest tracks dry up. Our study provides no insights into flight distances or flight heights at other times of the year, including during summer and autumn, when the birds are known to drink from stock dams and troughs and fly over cleared land to access water.

16.5 Conclusions and summary of implications

South-eastern Red-tailed Black-Cockatoos flight heights observed in this study were mostly below 35 m, which is below the rotor-swept height zone of two approved wind energy projects in Victoria and within the rotor-swept height zone of one operating wind farm in South Australia. The flight heights observed were comparable with the findings of a previous study in the area (Biosis 2020). While collision risk could be mitigated by avoiding the habitats the subspecies use and fly over, there is incomplete knowledge on the location and frequency of flights across open cleared habitats and other habitats. These flight times and

locations can vary between years as birds move to access food resources, though their daily movements and flight behaviour may be more predictable once they locate an abundant food supply and a nearby roost.

In the present targeted research, the birds observed flew over cleared land within relatively confined times around sunrise and sunset. The birds may be exposed to collision risk at these times of the day. This knowledge about the subspecies' behaviour at particular times of the day could inform potential mitigation measures, such as timed turbine shutdowns (curtailments). Flight activity and flight heights throughout the day and the annual life cycle of the South-eastern Red-tailed Black-Cockatoo remain a knowledge gap in understanding the effectiveness of such mitigation measures more broadly—overall, these measures are untested and require further investigation.

Turbines located within the subspecies' range could cause collisions if and where habitats and flight paths are not avoided. This is particularly the case where flocks fly over cleared land between foraging woodland patches, and between roosting and foraging habitat, which can occur as smaller isolated patches and scattered trees within a cleared agricultural land matrix.

Increasing the turbine minimum blade-tip height from the ground could reduce exposure to collision risk for this subspecies, based on the findings from this study and that of Biosis (2020). However, the wider applicability of these findings is uncertain, as the level of risk is likely to be site-specific. The risk may vary depending on the location, time of year, and habitat setting (e.g. whether the wind farm is located in open cleared land or in a plantation). South-eastern Red-tailed Black-Cockatoos are likely to fly at rotor-swept heights and be exposed to collision risk at times, but the frequency and timing of such flights remains unknown. Further, the likelihood that the subspecies may avoid (or be attracted to) the wind farm or individual turbines is unknown. The variability in flight heights observed, and the limited spatial and temporal coverage sampled, means the findings from the current study cannot be taken as indicative of behaviour at other sites or times of the year, and they should not be extrapolated or generalised. Further research would provide a more comprehensive understanding of the subspecies' flight behaviour and collision risk; of the potential efficacy of mitigation measures to reduce collision risk; and of possible population impacts for the South-eastern Red-tailed Black-Cockatoo.

Turbines placed between foraging habitat and habitats used for roosting, nesting and drinking present a high risk, as South-eastern Red-tailed Black-Cockatoos move between these habitats daily, for weeks or months at a time. The existing information on these daily movement distances is corroborated between many studies and indicates that excluding turbines from sites within 5 km of foraging habitat is likely to reduce collision risk greatly, as these areas are high-activity zones for the subspecies. Longer daytime movements, and the dispersal and nomadic flights of flocks across broader open landscapes to access feeding woodland blocks are considered to be associated with a potentially high risk for wind farm turbine collisions, but no information on the flight paths and heights exists. This risk is dependent upon landscape contexts, wind farm siting and layout, and turbine sizes and specifications. Such flights are almost impossible to predict and their study was not part of the current study. These long-distance South-eastern Red-tailed Black-Cockatoo flight heights and behaviours represent a significant knowledge gap.

KNOWLEDGE GAPS AND RESEARCH RECOMMENDATIONS

17 Knowledge gap summary

17.1 Renewable energy and critical minerals

The identified knowledge gaps relevant to conservation of the South-eastern Red-tailed Black-Cockatoo are summarised in Table 6, although a lot of knowledge exists for informing most management decisions, as detailed in the Draft South-eastern Red-tailed Black-Cockatoo National Recovery Plan 2022–2027 (Koch et al. 2022). This information is relevant within the renewable energy development and impact assessment context, for avoiding, mitigating and offsetting impacts, particularly impacts on the subspecies' habitat. The main additional information requirements related to renewable energy project assessment are related to movement behaviour, such as the timing, frequency, location and height of flights that may result in collision mortality.

Table 6. Knowledge gaps relevant to conservation of South-eastern Red-tailed Black-Cockatoos.
Outlining those that are relevant within the renewable energy and critical minerals development context, relevant to impact assessment under the *Environment Protection and Biodiversity Conservation Act 1999*

Information need	Existing information	Knowledge gaps
Distribution and population size	The subspecies' distribution has been modelled, and there are estimates of population size based on annual counts.	There has been too much variation in annual counts to make direct assessment of population trends; more field work or potentially tracking studies are needed to find where 'missing' birds are in some years.
Population dynamics	Declines in proportion of 'barred birds' in flocks strongly suggest declines in recruitment.	Causes of demographic change in the structure of flocks is unknown, but is likely to be due to ongoing loss and limitation of food habitat. Age at maturity is poorly known; it is not known if it can change over time. The cause of apparent temporal variation in breeding success is poorly known; association with droughts has not yet been modelled.
Habitat requirements	There is good understanding of diet, attributes of nest hollows, and the required proximity of food trees and nests. Communal roosts can hold large aggregations of birds.	There is limited understanding of uptake of artificial nest hollows, and of ways in which uptake can be improved. There are changes in roost site locations over time, and the timing of shifts in roost location are difficult to predict.
Movement behaviour	There is good understanding of diurnal schedules, including movements between feeding areas, roosts, and nests. There is much qualitative and some quantitative data on flight height when moving between feeding sites and roosts/drinking sites: flights are at low-to-moderate height, sometimes as high as rotor-swept zones.	Observational data suggest the subspecies can exploit suitable foraging sites throughout their range, but the scale, frequency and timing of exploratory long-distance movements to 'new' foraging sites are unknown. This is a key unknown/uncertainty. There is limited flight height data, both spatial and temporal, for collision risk modelling; in particular, there is no information on flight heights when making long-distance nomadic flights during the non-breeding season. This is a key unknown/uncertainty, in general, and for offset considerations/decisions.

Information need	Existing information	Knowledge gaps
Conservation actions	Installation of artificial nest boxes at strategic sites across the range has had low uptake and uncertain breeding success. Revegetation projects, planting Bulokes and stringybarks Incentive programs for improved habitat management on private land Land purchase programs and conservation covenants to protect habitat on important privately owned sites Community-based outreach and weed-management programs	The success of revegetation programs (in terms of producing mature trees, and in terms of attracting the subspecies) is poorly known (and difficult to assess in early stages).
Threats	Habitat loss/loss of feeding habitat/senescence: clearance, dieback and senescence of feeding trees, especially of scattered mature trees in paddocks (which are of disproportionate importance due to their high seed crops) Habitat loss: restricted recruitment of paddock trees, due to grazing or agricultural management Habitat loss/unsuitable agricultural practices: limited hollow availability, which is likely to get worse due to senescence of and damage to old trees and to increasing competition with other hollow-using species Habitat loss: due to both permitted and illegal clearance of habitat Woody weed invasion in key habitat Reduced habitat or damage to habitat: due to pathogens and pests of food trees, and browsing by introduced species Reduced breeding success Nest predation Planned burns: impact on canopy due to crown scorch Bushfires: impact on foraging habitat and food availability Climate change amplifies the listed threats; increased frequency of climate extremes are likely to cause more mortality through heat stress and more habitat loss as a result of extensive wildfires.	Causes of reduced breeding success are poorly understood but related to food availability. There is limited ability to predict demographic changes in response to climate change. In the context of the very high rate of loss of the Buloke tree food resource within the subspecies' range (>95%; Maron, et al. 2008), key knowledge gaps include: how the loss of this important food resource for the post-fledging period may have impacted the population of this species; immediate post-fledging food requirements of the South-eastern Red-tailed Black-Cockatoo in late summer and autumn; where in the landscape Buloke is important; what key recovery actions for revegetation of Buloke are needed, including where in the landscape such actions may be needed; where in the landscape Brown Stringybark and Desert Stringybark are important; what key recovery actions for revegetation of Brown Stringybark and Desert Stringybark are needed, including where in the landscape such actions may be needed

Information need	Existing information	Knowledge gaps
Renewable energy impact avoidance and mitigation measures	Not researched	The effectiveness of mitigation measures is unknown and uncertain.
Offsets	Offsetting recommendations for habitat loss contained in recovery plan and action documents	It is unknown how best to offset potential mortality.
Other	Drinking habits reasonably well known—the subspecies apparently needs to drink daily and uses a variety of settings, including wetlands, farm dams, puddles, and troughs	There is limited knowledge on how to deter this species from drinking at potentially dangerous drinking sites, such as tailings dams.

17.2 Relevant information on other congeneric black-cockatoos for filling knowledge gaps

The South-eastern Red-tailed Black-Cockatoo is one of five subspecies of Red-tailed Black-Cockatoo. There are four other species of Black-Cockatoo that are considered to be closely related: Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Baudin's Black-Cockatoo (*Zanda baudinii*), Carnaby's Black-Cockatoo (*Z. latirostris*) and Yellow-tailed Black-Cockatoos (*Z. funereus*). These black-cockatoo species have many ecological and behavioural traits in common with the Red-tailed Black-Cockatoo, including dependence on large tree hollows when nesting, similar social behaviour that includes flocking during the non-breeding season, similar drinking and roosting behaviour, and (in some species or subspecies) dependence on the seeds of a small number of tree species. There may therefore be information on these species that may provide guidance on knowledge gaps for the South-eastern Red-tailed Black-Cockatoo. However, the information on movement behaviour that is most important in determining the threats posed by renewable energy projects is very dependent on context, for example, the distribution of hollows, food sources, and drinking sources in the landscape. It is therefore not possible to be sure whether information on movement distances, flight heights, or size of home range will be equivalent in all species.

17.3 Recommendations and further research

Gaps in the knowledge remain about the flight behaviour of the South-eastern Red-tailed Black-Cockatoo. This includes lack of knowledge about flight heights throughout the annual cycle of the subspecies, in different seasons and at different times of the day. It is challenging to address such knowledge gaps from on-ground observational studies alone and at a scale that is meaningful and generalisable across the subspecies' range. This is particularly the case due to the subspecies' wide-ranging and nomadic behaviour, and its use of habitats sited at different locations from year to year, which are generally not easy to predict. Local movement patterns and activity are better known, and some information exists on local movement behaviour around feeding, roosting, drinking and nesting habitat, including two flight studies of short duration. However, given the short duration of the flight height studies it is not possible to generalise beyond the survey locations and 'commuting' flights between feeding areas and roosts. This limits the ability to understand the risk of collision with turbine rotor blades across the subspecies' range and in locations where wind energy projects will or may operate.

GPS-tracking of South-eastern Red-tailed Black-Cockatoos could provide a much better understanding of flight heights, distances and paths. Satellite telemetry has been used to study movements of a related species, Carnaby's Cockatoo (Groom et al. 2107). For South-eastern Red-tailed Black-Cockatoo, a study would ideally include tracking at multiple sites in different landscape contexts throughout the subspecies' South Australian and Victorian range. A multiyear study of a sufficient number of individuals to capture likely variation is recommended, provided that pilot studies demonstrate that the subspecies can be GPS-tracked without adverse effects. Such a study should include collecting data on potentially relevant variables, including habitat and weather. Variables such as habitat and weather may influence flight behaviour and could be informative in understanding collision risk and potential mitigation measures, enabling a more comprehensive understanding of flight behaviour and environmental factors that may influence flight height and collision risk exposure. While detailed tracking information is currently unavailable, and understanding of long-distance and nomadic flights remains a critical knowledge gap, public records and observations of encounters with such flights could be elicited. This could take the form of collecting such observations and

including a methodology for recording and reporting flights via the existing South-eastern Red-tailed Black-Cockatoo networks.

Research incorporating the marking of individuals would assist in identifying and following individual birds to address knowledge gaps on population dynamics, breeding output, survival, and mortality and help refine population estimates, and age and sex ratios through annual mark–resighting data. To date, these data have been difficult or virtually impossible to collect. As a result, South-eastern Red-tailed Black-Cockatoo individuals have been difficult to find and to follow, relatively few nests have been found, their recruitment is difficult to measure, and their breeding biology is poorly understood.

References

Attiwill, A.R. (1960). Red-tailed Black-Cockatoo in South-east of South Australia. *South Australian Ornithologist* **23,** 37–38.

Attiwill, A.R. (1972). Birds breeding in Naracoorte district, 1941–1971. *South Australian Ornithologist* **26**, 58–64.

AviList Core Team. (2025). AviList: The Global Avian Checklist, v2025. doi:10.2173/avilist.v2025

Baird, R.F. (1986). Historical records of the Glossy Black-Cockatoo *Calyptorhynchus lathami* and Red-Tailed Black-Cockatoo *C. magnificus* in south-eastern Australia. *South Australian Ornithologist* **30**, 38–45.

Berris, K.K., Welz, T. and Leigh, S. (2023). Kangaroo Island Glossy Black-Cockatoo 2023 breeding season report. Kangaroo Island Landscape Board (KILB), Kingscote, South Australia. KILB Publication Number KILB-2023-11-R2.

Biosis. (2020). *Summary of Red-tailed Black-Cockatoo flight behaviour investigation for Wombelano Wind Farm*. Biosis Unpublished Report to Wind Projects Australia.

Birdfact. (2026). *How Long Do Cockatoos Live? (All You Need to Know)*. https://birdfact.com/articles/how-long-do-cockatoos-live (accessed 18 December 2025).

Brooker, M. I. H., & Kleinig, D. A. (1990). *Field guide to eucalypts: South-western and southern Australia (Vol. 2)*. Inkata Press, Melbourne, Victoria

Bürkner, P.-C. (2017). Brms: An *R* Package for Bayesian Multilevel Models Using *Stan*. *Journal of Statistical Software* **80**, 1–28. doi:10.18637/jss.v080.i01

Burnard, T. and Hill, R. (2002). *Draft South-eastern Red-tailed Black-Cockatoo Recovery Plan*. Birds Australia report to the Department of the Environment and Water Resources, Canberra, ACT.

Carpenter, B., Gelman, A., Hoffman, M.D., Lee, D., Goodrich, B., Betancourt, M, Brubaker, M., Guo, J., Li, P. and Riddell, A. (2017). *Stan*: A Probabilistic Programming Language. *Journal of Statistical Software* **76**: 1–32. doi:10.18637/jss.v076.i01

Commonwealth of Australia. (2006). *Background and implementation information for the South-eastern Red-tailed Black-Cockatoo, Calyptorhynchus banksii graptogyne Recovery Plan*. Department of the Environment and Water Resources, Canberra, ACT.

Commonwealth of Australia. (2007). National Recovery Plan for the South-eastern Red-tailed Black-Cockatoo *Calyptorhynchus banksii graptogyne*. Department of the Environment and Water Resources, Canberra, ACT.

Conomikes, M., Wright, M. and Delpratt, J. (2011). Sex discrimination of Buloke (*Allocasuarina luehmannii*) for selective revegetation. *Muelleria* **29**, 104–109. doi:10.5962/p.292517

Cook, A.S.C.P., Humphreys, E.M., Bennet, F., Masden, E.A. and Burton, N.H.K. (2018). Quantifying avian avoidance of offshore wind turbines: current evidence and key knowledge gaps. *Marine Environmental Research* **140**, 278–288. doi:10.1016/j.marenvres.2018.06.017

Cook, A.S.C.P., Salkanovic, E., Mosden, E., Lee, H.E. and Kiilerich, A.H. (2025). A critical appraisal of 40 years of avian collision risk modelling: How have we got here and where do we go next? *Environmental Impact Assessment Review* **110**, 107717. doi:10.1016/j.eiar.2024.107717

Costermans, L.F. (1981). *Native Trees and Shrubs of South-eastern Australia*. *Covering areas of New South Wales, Victoria and South Australia.* Reed New Holland, Sydney, NSW.

Costermans, L.F. (2009). *Native Trees and Shrubs of South-eastern Australia*. Reed New Holland, Sydney, NSW.

Croft S., Budgey R., Pitchford J.W. and Wood, A.J. (2015). Obstacle avoidance in social groups: new insights from asynchronous models. *Journal of The Royal Society Interface* **12**, 20150178. doi:10.1098/rsif.2015.0178

DBCA (Department of Biodiversity, Conservation and Attractions, Western Australian Government). (2023). *Fauna Notes – Artificial Hollows for Black-Cockatoos*. https://library.dbca.wa.gov.au/Journals/082168/082168-2023.02.pdf (accessed 29 June 2026).

DCCEEW (Department of Climate Change, Energy, the Environment and Water, Australian Government). (2026). *Offsets Mitigation Hierarchy*. https://www.dcceew.gov.au/environment/epbc/approvals/offsets/guidance/mitigation-hierarchy (accessed 20 April 2026).

DEECA (Department of Energy, Environment and Climate Action, Victorian Government). (2025). *Handbook for the Development of Renewable Energy in Victoria*. The State of Victoria Department of Energy, Environment and Climate Action, Victoria, Australia.

DEM (Department for Energy and Mining, South Australian Government). (2025). *Critical Minerals South Australia*. https://www.energymining.sa.gov.au/industry/geological-survey/gssa-projects/critical-minerals-south-australia (accessed 18 December 2025).

DSE (Department of Sustainability and Environment, Victorian Government). (2011). *Interim guidelines for the assessment, avoidance and offsetting of potential wind farm impacts on the Victorian brolga population*. The State of Victoria Department of Sustainability and Environment, Melbourne, Australia.

eBird. (2026). eBird Checklist – 23 January 2026 – Innisfail. http://ebird.org/checklist/S296620780 (accessed 10 March 2026).

Emison, W.B., White, C.M. and Caldow, W.D. (1995). Presumptive renesting of Red-tailed Black-Cockatoos in south-eastern Australia. *Emu – Austral Ornithology* **95(2)**, 141–144. doi:10.1071/MU9950141

Ewart, K.M., Lo, N., Ogden, R., Joseph, L., Ho, S.Y.W., Frankham, G.J., Eldridge, M.D.B., Schodde, R. and Johnson, R.N. (2020). Phylogeography of the iconic Australian Red-tailed Black-Cockatoo (*Calyptorhynchus banksii*) and implications for its conservation. *Heredity (Edinb.)* **125**, 85–100. doi:10.1038/s41437-020-0315-y and Erratum in: *Heredity (Edinb.)* 2020; **125(3)**, 167. doi:10.1038/s41437-020-0343-7

Fleming, PA. (2025). All that glitters – Review of solar facility impacts on fauna. *Renewable and Sustainable Energy Reviews* **224**, 115995

Gabry, J., Simpson. D., Vehtari, A., Betancourt, M. and Andrew Gelman, A. (2019). Visualization in Bayesian Workflow. *Journal of the Royal Statistical Society Series A: Statistics in Society* **182**, 389–402. doi:10.1111/rssa.12378.

Gandy, B.P. (2021). *Drivers and indicators of seed crop productivity of two critical food source species: Eucalyptus baxteri and Eucalyptus arenacea*. Honours thesis. School of Ecosystem and Forest Sciences, The University of Melbourne, Melbourne, Victoria.

Gelman, A. (2006). Prior distributions for variance parameters in hierarchical models (comment on article by Browne and Draper). *Bayesian Analysis* **1**, 515–554. doi:10.1214/06-ba117a

Gelman, A., Carlin, J.B., Stern, H.S., Dunson, D.B., Vehtari, A. and Rubin, D.B. (2013). *Bayesian Data Analysis*, 3rd edn. CRC Press, New York, USA. doi:10.1201/b16018

Gibbons, P. and Lindenmayer, D. (2002). *Tree Hollows and Wildlife Conservation in Australia,* 1st edn. CSIRO Publishing, Clayton, Victoria

Groom, C., White, N.E., Mitchell, N., Roberts, J.D. and Mawson, P. (2017). Assessing the spatial ecology and resource use of a mobile and endangered species in an urbanized landscape using satellite telemetry and DNA faecal metabarcoding. *Ibis* **159**, 390–405. doi:10.1111/ibi.12442

Higgins, P.J. (Ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds, Volume 4. Parrots to Dollarbird.* Oxford University Press, Melbourne, Victoria.

Hill, R. and Burnard, T. (2001). *A Habitat Management Plan for the South-eastern Red-tailed Black-Cockatoo*. Unpublished report to the Red-tailed Black-Cockatoo Recovery Team by Birds Australia. https://www.redtail.com.au/uploads/Management%20Plan%20Final%20Version%202001.pdf (accessed 29 June 2026).

Hill, R., Maron, M., Teixera, D. and Garnett, S.T. (2021). South-eastern Red-tailed Black-Cockatoo *Calyptorhynchus banksii graptogyne*. In: Garnett, S.T. and Baker, G.B. (Eds) *The Action Plan for Australian Birds 2020*, pp. 384–387. CSIRO Publishing, Clayton, Victoria.

Hill, R. and McPherson, S. (2022). What is a flock count and the 2022 report. *Red-tail News* Issue **55**. DELWP, Victoria, and BirdLife Australia. https://www.redtail.com.au/uploads/Red-Tail%20News%20Issue%2055.pdf (accessed 29 June 2026).

Hoffman, M.D. and Gelman, A. (2014). The No-U-Turn Sampler: adaptively setting path lengths in Hamiltonian Monte Carlo. *Journal of Machine Learning Research* **15**, 1593–623. doi:10.48550/arXiv.1111.4246

IdentiFlight. (2025). *IdentiFlight species list. A comprehensive list of all species that IdentiFlight can currently identify for scientific monitoring and tracking purposes*. https://static1.squarespace.com/static/5e710b62f0a8ee01b4352bf5/t/695ed0f21a464b5fedb4ed9f/1767821554816/IDI+Species+List_12-Nov-2025+%28SALEMARK%29.pdf (accessed 18 December 2025).

Iluka. (2025). *Wimmera Critical Minerals Project.* https://www.iluka.com/media/2j0c1kuu/iluka-wimmera-factsheet.pdf#:~:text=HORSHAM,at%20Eneabba%20in%20Western%20Australia (accessed 18 December 2025).

Janss, G.F.E. (2000). Avian mortality from power lines: a morphologic approach of a species-specific mortality. *Biological Conservation* **95**, 353–359. doi:10.1016/S0006-3207(00)00021-5

Jarmyn, B. (2000). Nest predation of cockatoos in south-west Victoria: with special reference to the endangered subspecies of Red-tailed Black-Cockatoo, *Calyptorhynchus banksii graptogyne*. BSc (Hons) Thesis, University of Adelaide, Adelaide, SA.

Joseph, L. (1982). The Red-tailed Black-Cockatoo in south-eastern Australia. *Emu* **82**, 42–45.

Joseph, L., Emison, W.B. and Bren, W.M. (1991). Critical assessment of the conservation status of the Red-tailed Black-Cockatoo in south-eastern Australia with special reference to nesting requirements. *Emu* **91**, 46–50. doi:10.1071/MU9910046

Koch, P. (2003). Factors influencing food availability for the endangered south-eastern Red-tailed Black-Cockatoo *Calyptorhynchus banksii graptogyne* in remnant stringybark woodland, and implications for management. PhD thesis, University of Adelaide, Adelaide, SA.

Koch, P.J. (2019a). *Spatial Targeting of Artificial Nest Boxes for the South-eastern Red-tailed Black-Cockatoo*. Report prepared for the South-eastern Red-tailed Black-Cockatoo Recovery Team.

Koch, P.J. (2019b). Habitat extent mapping and rates of habitat change for the 2003 to 2017 period across feeding and nesting resources for the South-eastern Red-tailed Black-Cockatoo. Report prepared for the South-eastern Red-tailed Black-Cockatoo Recovery Team by Future Ecosystems, Chapel Hill, SA.

Koch, P.J. (2020). *Revegetation strategy to increase feeding and nesting habitat for the Southeastern Red-tailed Black-Cockatoo: adapting to a changing climate*. Report prepared for the South-eastern Red-tailed Black-Cockatoo Recovery Team by Future Ecosystems, Chapel Hill, SA.

Koch, P. (2022). *South-eastern Red-tailed Black-Cockatoo Recovery Program*. Story Map prepared for the South-eastern Red-tailed Black-Cockatoo Recovery Team, funded by the Limestone Coast Landscape Board in partnership with project partners and the Australian Government. https://storymaps.arcgis.com/stories/107f025a54af4bcf972bf3d467177c89 (accessed 5 March 2026).

Koch, P., Burnard, T. and Pritchard, R. (2022). *National Recovery Plan for the South-eastern Red-tailed Black-Cockatoo Calyptorhynchus banksii graptogyne*. BirdLife Australia, Victoria.

Leihy, R.I., Bruce, M.J., Stevenson, S.L., Stamation, K.A., Hauser, C.E., Moore, J.L, Pacioni, C., Scroggie, M.P., Hollings, T., Thomson, J.R., Yen, J.D.L., Khwaja, N.S., Lentini, P.E., Lumsden, L.F., Rogers, D.I., van Harten, E.M., Mazor, T.K., Santosa, R.T., Sutton, F.M., and Regan, T.J. (2026). Decision Support Tool for estimating wind turbine collision impacts on threatened birds and bats. Arthur Rylah Institute for Environmental Research. Published Report for the Australian Government Department of Climate Change, Energy, the Environment and Water. Department of Energy, Environment and Climate Action, Heidelberg, Victoria.

Lindenmayer, D.B., Crane, M., Evans, M.C., Maron, M., Gibbons, P., Bekessy, S. and Blanchard, W. (2017). The anatomy of a failed offset. *Biological Conservation* **210**, 286–292. doi:10.1016/j.biocon.2017.04.022

Maron M. (2000) *Characteristics of feeding sites of the endangered southeastern Red-tailed Black Cockatoo Calyptorhynchus banksii graptogyne in remnant Buloke Allocasuarina luehmannii woodland.* Honours Thesis. School of Biological Sciences, Monash University, Clayton, Victoria.

Maron, M. (2005). Agricultural change and paddock tree loss: implications for an endangered subspecies of Red-tailed Black-Cockatoo. *Ecological Management and Restoration* **6**, 206–211. doi:10.1111/j.1442-8903.2005.00238.x

Maron, M., Dunn, P.K., McAlpine, C.A., and Apan, A. (2010). Can offsets really compensate for habitat removal? The case of the endangered red-tailed black-cockatoo. *Journal of Applied Ecology* **47,** 348-355. https://doi.org/10.1111/j.1365-2664.2010.01787.x

Maron, M., Brownlie, S., Bull, J.W., Evans, M.C., von Hase, A., Quétier, F., Watson, J.E.M. and Gordin, A. (2018). The many meanings of no net loss in environmental policy. *Nature Sustainability* **1**, 19–27. doi:10.1038/s41893-017-0007-7

Maron, M., Koch, P., Freeman, J., Schultz, S., Dunn, P. and Apan, A. (2008). *Modelling and planning to increase future habitat of the Red-tailed Black-Cockatoo*. Unpublished report. Wimmera Catchment Management Authority, Horsham, Victoria.

Maron, M. and Lill, A. (2004). Discrimination among potential buloke (*Allocasuarina luehmannii*) feeding trees by the endangered South-eastern Red-tailed Black-Cockatoo (*Calyptorhynchus banksii graptogyne*). *Wildlife Research* **31**, 311–317. doi:10.1071/WR03079

McCullagh, P. and Nelder, J.A. 1989. *Generalized Linear Models*, 2nd edn. Chapman and Hall, London, UK. doi:10.1007/978-1-4899-3242-6

Moloney, P.D., Lumsden, L.F. and Smales, I. (2019). *Investigation of existing post-construction mortality monitoring at Victorian wind farms to assess its utility in estimating mortality rates*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 302. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Newell, G., Millen, C. and White, M. (2016). *Refining the spatial distribution of food resources for the South-eastern Red-tailed Black-Cockatoo*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 269. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

R Core Team. 2025. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Regan, T.J., Bruce, M.J., van Harten, E.M. and Lumsden, L.F. (2025). *Estimating the potential effectiveness of wind farm mitigations using structured expert elicitation*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 394. Department of Energy, Environment and Climate Action, Heidelberg, Victoria.

Russell, V., Hill, R., Burnard, T., Perryman, B., Copley, P., Gilkes, K., Maron, M., Baker-Gabb, D., Pritchard, R. and Koch, P. (2017). Science, community and commitment underpin recovery for the Red-tailed Black-Cockatoo. In: Garnett, S., Latch, P., Lindenmayer, D. and Woinarski, J. (Eds) *Recovering Australian Threatened Species: A Book of Hope*. CSIRO Publishing, Clayton, Victoria.

Sæther, B. and Bakke, Ø. (2000). Avian life history variation and contribution of demographic traits to the population growth rate. *Ecology* **81**, 642–653. doi:10.1890/0012-9658(2000)081

Saunders, D.A. and Pickup, G. (2023). A review of the taxonomy and distribution of Australia's endemic Calyptorhynchinae Black-Cockatoos. *Australian Zoologist* **43**, 145–191. doi:10.7882/AZ.2023.022

SERTBC RT (South-eastern Red-Tailed Black-Cockatoo Recovery Team). (2026a). *Red-tailed Black-Cockatoo South-eastern Subspecies. Annual Counts*. https://www.redtail.com.au/annual-counts.html (accessed 10 February 2026).

SERTBC RT (South-eastern Red-Tailed Black-Cockatoo Recovery Team). (2026b). *Documenting the journey: South-eastern Red-tailed Black Cockatoo Recovery Program storymap*. https://www.redtail.com.au/news/156/72/Documenting-the-journey-South-eastern-Red-tailed-Black-Cockatoo-Recovery-Program-storymap.html (accessed 29 June 2026).

Shun Waste. (2025). *Environmental Impact of Tailings: Pollution, Risks, and Ecosystem Disruption Explained*. https://shunwaste.com/article/how-do-tailings-affect-the-environment (accessed 18 December 2025).

Smales, I., Muir, S., Meredith, C. and Baird, R. (2013). A description of the biosis model to assess risk of bird collisions with wind turbines. *Wildlife Society Bulletin* **37**, 59–65. doi:10.1002/wsb.257

Teixeira, D., Linke, S., Hill, R., Maron, M. and van Rensburg, B. J. (2022) Fledge or fail: Nest monitoring of the endangered black-cockatoos, *Calyptorhynchus banksii graptogyne* and *C. lathami halmaturinus*, using bioacoustics and open-source call recognition. *Ecological Informatics*, **69**, 101656. https://doi.org/https://doi.org/10.1016/j.ecoinf.2022.101656.

Wardle, O.C. (2022). *The spatial and temporal intersections between nesting and foraging resources affect breeding occurrences of the South-eastern Red-tailed Black-Cockatoo*. Master of Science Thesis, University of Melbourne, Victoria.

Western Power. (2026). *Western Power Keeping Iconic Threatened Species Safer*. https://www.westernpower.com.au/news/western-power-keeping-iconic-threatened-species-safer/#:~:text=%E2%80%9CIn%20a%20recent%20incident%2C%20two,and%20Biodiversity%20Conservation%20Act%201999 (accessed 26 February 2026).

Appendices

Appendix 1: Field sites visited

Table A1.1. Sites visited to assess suitability for inclusion in the study to collect South-eastern Red-tailed Black-Cockatoo flight data.

Sites selected for data collection are in bold font.

Date of first visit	Site	Selected for data collection	Justification and further information	Observation point location
19/10/2025	Arnolds State Forest	No	No birds seen or heard during an evening watch Landholder indicated regular sightings Site used in 2020, with data collected by Biosis (2020)	-36.944694, 141.444719
20/10/2025	**Yallakar State Forest**	Yes	Flock located approximately 1 km from most recent record Birds flying over cleared land	-37.114242, 141.414609 The two locations below were used on 24/10/2025 -37.109766, 141.420304 -37.109563, 141.417995
22/10/2025	Edenhope Golf Course	No	Pair of birds sighted—insufficient numbers for data collection	No observation point location; site visited to assess suitability for data collection
22/10/2025	Morea State Forest	No	Small flock located in stringybark with birds flying over the forest block in opposite direction to open cleared land; a single bird made a short flight over cleared land while moving between stringybark habitat Landholder indicated that flocks have	-36.752815, 141.299144 Approximate location on public land to maintain privacy of private landholder

Date of first visit	Site	Selected for data collection	Justification and further information	Observation point location
			previously roosted in gums adjacent to the stringybark with flights over cleared land	
23/10/2025	**Jilpanger Nature Conservation Reserve**	Yes	Group of 8 located approximately 1 km from most recent record Birds flying over cleared land	Location next to most recent sighting used on 23/10/2025 -37.014622, 141.734680 Location below used on all other days, once roost was located -37.014685, 141.722845
26/10/2025	**Kadnook State Forest**	Yes	No further information available	-37.154565, 141.331110 (26/10/2025 Evening) -37.173714, 141.336232 (27/10/2025 Morning) -37.1679439, 141.3471164 (27/10/2025 Evening)

Appendix 2: Flight height data collection

Table A2.1. Flight height data collection.

Sunrise, sunset, and civil twilight times from Edenhope.

Date	Location	Time of day	Sunrise/sunset or civil twilight	Survey start and end times	Observation point location
20/10/2025	Yallakar	Evening	19:55 sunset 20:22 twilight	18:15 20:27	-37.114242, 141.414609
21/10/2025	Yallakar	Morning	6:15 twilight 6:42 sunrise	6:10 7:44	-37.114242, 141.414609
21/10/2025	Yallakar	Evening	19:56 sunset 20:23 twilight	18:15 20:27	-37.114242, 141.414609
23/10/2025	Yallakar	Morning	6:12 twilight 6:40 sunrise	6:15 7:01	-37.109766, 141.420304
23/10/2025	Jilpanger	Evening	19:58 sunset 20:26 twilight	18:30 20:30	-37.014622, 141.734680
24/10/2025	Yallakar	Morning	6:11 twilight 6:38 sunrise	6:20 7:00	-37.109563, 141.417995
27/10/2025	Kadnook	Morning	6:07 twilight 6:35 sunrise	6:15 8:04	-37.168113, 141.346784
27/10/2025	Kadnook	Evening	20:02 sunset 20:30 twilight	18:15 20:30	-37.167944 141.347116
28/10/2025	Jilpanger	Morning	6:04 twilight 6:31 sunrise	6:15 8:10	-37.014685, 141.722845
28/10/2025	Jilpanger	Evening	20:03 sunset 20:34 twilight	18:15 20:30	-37.014685, 141.722845
29/10/2025	Jilpanger	Morning	6:05 twilight 6:32 sunrise	6:15 7:30	-37.014685, 141.722845
29/10/2025	Jilpanger	Evening	20:04 sunset 20:34 twilight	18:30 20:30	-37.014685, 141.722845
30/10/.2025	Jilpanger	Morning	6:04 twilight 6:31 sunrise	6:22 8:40	-37.014685, 141.722845

Appendix 3: Model parameter estimates

Table A3.1. Parameter estimates from the South-eastern Red-tailed Black-Cockatoo model.
All estimates are on the log scale except for the random effect. . CI = credible interval.

Component	Parameter	Estimate	S.E.	Lower 95% CI	Upper 95% CI
Mean	Intercept	2.312	0.242	1.757	2.741
Mean	Location: Yallakar	0.429	0.188	0.050	0.780
Mean	Random effect	0.578	0.215	0.295	1.125
Shape	Intercept	2.159	0.113	1.933	2.376
Shape	Time of day: Evening	-0.508	0.163	-0.844	-0.194

Table A3.2. Estimated probability of flights at different heights (under, over, between given height categories and bands).

Location	Time of day	Class	Value (m)	Probability
Jilpanger	Evening	Under	15	0.844
Jilpanger	Evening	Under	25	0.98425
Jilpanger	Evening	Under	35	0.997
Jilpanger	Evening	Under	45	1
Jilpanger	Evening	Under	55	1
Jilpanger	Evening	Under	65	1
Jilpanger	Evening	Between	15–25	0.14025
Jilpanger	Evening	Between	25–35	0.01275
Jilpanger	Evening	Between	35–45	0.003
Jilpanger	Evening	Between	45–55	0
Jilpanger	Evening	Between	55–65	0
Jilpanger	Evening	Over	65	0
Jilpanger	Evening	Over	55	0
Jilpanger	Evening	Over	45	0
Jilpanger	Evening	Over	35	0.003
Jilpanger	Evening	Over	25	0.01575
Jilpanger	Evening	Over	15	0.156
Jilpanger	Morning	Under	15	0.865
Jilpanger	Morning	Under	25	0.99175
Jilpanger	Morning	Under	35	0.9995
Jilpanger	Morning	Under	45	1
Jilpanger	Morning	Under	55	1
Jilpanger	Morning	Under	65	1
Jilpanger	Morning	Between	15–25	0.12675
Jilpanger	Morning	Between	25–35	0.00775
Jilpanger	Morning	Between	35–45	0.0005
Jilpanger	Morning	Between	45–55	0
Jilpanger	Morning	Between	55–65	0
Jilpanger	Morning	Over	65	0

Location	Time of day	Class	Value (m)	Probability
Jilpanger	Morning	Over	55	0
Jilpanger	Morning	Over	45	0
Jilpanger	Morning	Over	35	0.0005
Jilpanger	Morning	Over	25	0.00825
Jilpanger	Morning	Over	15	0.135
Yallakar	Evening	Under	15	0.54925
Yallakar	Evening	Under	25	0.886
Yallakar	Evening	Under	35	0.97625
Yallakar	Evening	Under	45	0.9935
Yallakar	Evening	Under	55	0.99825
Yallakar	Evening	Under	65	0.999
Yallakar	Evening	Between	15–25	0.33675
Yallakar	Evening	Between	25–35	0.09025
Yallakar	Evening	Between	35–45	0.01725
Yallakar	Evening	Between	45–55	0.00475
Yallakar	Evening	Between	55–65	0.00075
Yallakar	Evening	Over	65	0.001
Yallakar	Evening	Over	55	0.00175
Yallakar	Evening	Over	45	0.0065
Yallakar	Evening	Over	35	0.02375
Yallakar	Evening	Over	25	0.114
Yallakar	Evening	Over	15	0.45075
Yallakar	Morning	Under	15	0.53
Yallakar	Morning	Under	25	0.91225
Yallakar	Morning	Under	35	0.9875
Yallakar	Morning	Under	45	0.998
Yallakar	Morning	Under	55	0.99975
Yallakar	Morning	Under	65	0.99975
Yallakar	Morning	Between	15–25	0.38225
Yallakar	Morning	Between	25–35	0.07525
Yallakar	Morning	Between	35–45	0.0105
Yallakar	Morning	Between	45–55	0.00175
Yallakar	Morning	Between	55–65	0
Yallakar	Morning	Over	65	0.00025
Yallakar	Morning	Over	55	0.00025
Yallakar	Morning	Over	45	0.002
Yallakar	Morning	Over	35	0.0125
Yallakar	Morning	Over	25	0.08775
Yallakar	Morning	Over	15	0.47

Table A3.3. Parameter estimates from the tree height model.
All estimates are on the log scale except for the shape component. CI = credible interval.

Component	Parameter	Estimate	S.E.	Lower CI	Upper CI
Mean	Intercept	2.599	0.063	2.482	2.725
Mean	Location: Kadnook	-0.033	0.090	-0.202	0.138
Mean	Location: Yallakar	-0.078	0.074	-0.218	0.063
Mean	Habitat: open cleared land	0.481	0.095	0.300	0.670
Mean	Habitat: roost	0.353	0.087	0.178	0.519
Mean	Location: Kadnook and habitat: open cleared land	0.163	0.140	-0.109	0.432
Mean	Location: Yallakar and habitat: open cleared land	0.106	0.109	-0.109	0.315
Mean	Location: Kadnook and habitat: roost	0.234	0.125	-0.004	0.473
Mean	Location: Yallakar and habitat: roost	-0.013	0.110	-0.235	0.216
Shape	Intercept	26.218	3.401	20.043	33.247

Appendix 4: Movement distances recorded

Table A4.1. Movement distances between roost and foraging areas.

These represent minimum distances for birds moving from roost into foraging habitat in the morning, calculated as the straight-line distance between point locations. Not all birds were always found subsequent to morning roost fly-outs. Roost locations were at: Yallakar -37.112277, 141.418606; Kadnook -37.179403, 141.344904; Jilpanger -37.014321, 141.722606. At Jilpanger, some birds also roosted in gums at approximately -37.014896, 141.720782 and flew direct to feed in the stringybark. The actual total distance flown in some instances was longer, when the birds did not fly in a direct line from roost to foraging area, and when they may have moved after landing and before the birds were observed in the foraging habitat.

Date and roost location	Movement distance	Foraging flock location and notes
21/10/2025 at Yallakar	576	One flock only located: -37.109120, 141.413449
23/10/2025 at Yallakar	450; 846	Two separate flocks: -37.109201, 141.415276; -37.107259, 141.425869
24/10/2025 at Yallakar	487; 931	Two separate flocks: -37.109157, 141.414740; -37.105292, 141.424458
27/10/2025 at Kadnook	1620	One flock only located: -37.165054, 141.348051
28/10/2025 at Jilpanger	742	One flock only located: -37.0098305, 141.7287801
29/10/2025 at Jilpanger	742; 260	Two separate flocks: -37.012483, 141.721231; -37.0098305, 141.7287801
30/10/2025 at Jilpanger	742; 260 392+	Two separate flocks: -37.012483, 141.721231; -37.0098305, 141.7287801 Group of four—out of view before landing: -37.0168474, 141.7256811—not included in the average calculation as birds continued flying for >392 m

www.deeca.vic.gov.au

www.ari.vic.gov.au