

**Targeted Fauna Assessment**  
**The Sathya Olive Company**  
**Binningup**



**Ecology Matters Australia Pty Ltd**

**October 2023**

## **Targeted fauna assessment for The Sathya Olive Company, Binningup**

Prepared for:

Tanuja Sanders

The Sathya Olive Company

7553 Forrest Highway, Binningup, WA 6233

Prepared by:

Natalia Huang and Jamie Wadey

Ecology Matters Australia Pty Ltd

41 Japonica View, Wellington Mill, WA 6236

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Images on front cover: Dead tree with multiple hollows in western area; suitable black-cockatoo breeding hollow in western area; forest red-tailed black-cockatoo foraging evidence on Blackbutt nuts in eastern area (photos: J. Wadey).

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## 1 Introduction

### 1.1 Background

The Sathya Olive Company is proposing to clear approximately 3 ha of remnant vegetation on its property at 7553 Forrest Highway, Binningup, to plant additional olive trees. The Company submitted an application for a native vegetation clearing permit to the Department of Water and Environmental Regulation (DWER) and received a request for additional information. This information included a fauna survey, including a habitat tree assessment, for black-cockatoos, western ringtail possum and brushtail phascogale. Ecology Matters Australia Pty Ltd was commissioned to conduct this fauna survey and habitat tree assessment. This report presents the findings said assessments.

### 1.2 Target species

The species of interest are:

**1) Carnaby's black-cockatoo (*Zanda latirostris*)**

Listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and under Schedule 2 Division 2 (Endangered) of the *Western Australian Biodiversity Conservation Act 2016* (BC Act).

**2) Forest red-tailed black-cockatoo (*Calyptorhynchus banksia naso*)**

Listed as: Vulnerable under the EPBC Act and Vulnerable under Schedule 2 Division 3 (Vulnerable) of the WA BC Act.

**3) Baudin's black-cockatoo (*Zanda baudinii*)**

Listed as: Endangered under the EPBC Act and Endangered under Schedule 2 Division 2 (Endangered) of the WA BC Act.

**4) Western ringtail possum (*Pseudocheirus occidentalis*)**

Listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and under Schedule 2 Division 1 (Critically Endangered) of the *Western Australian Biodiversity Conservation Act 2016* (BC Act).

**5) Western brush-tailed phascogale (*Phascogale tapoatafa wambenger*)**

Listed under Schedule 1 Division 1 (species of special conservation interest) of the *Western Australian Biodiversity Conservation Act 2016* (BC Act).

### 1.3 Survey area

The survey area consists of two separate areas, as indicated in **Figure 1-1**. From here-on, the triangle-shaped area is referred to as the 'western area' and the rectangle-shaped area the 'eastern area'.

The vegetation within the survey area consists of scattered remnant native trees over absent to degraded middle and under storeys, as is typical of rural agricultural land. There are large Tuart and Peppermint trees present across both areas, with the addition of Jarrah and Banksia trees in the western area, and Marri trees in the eastern area.



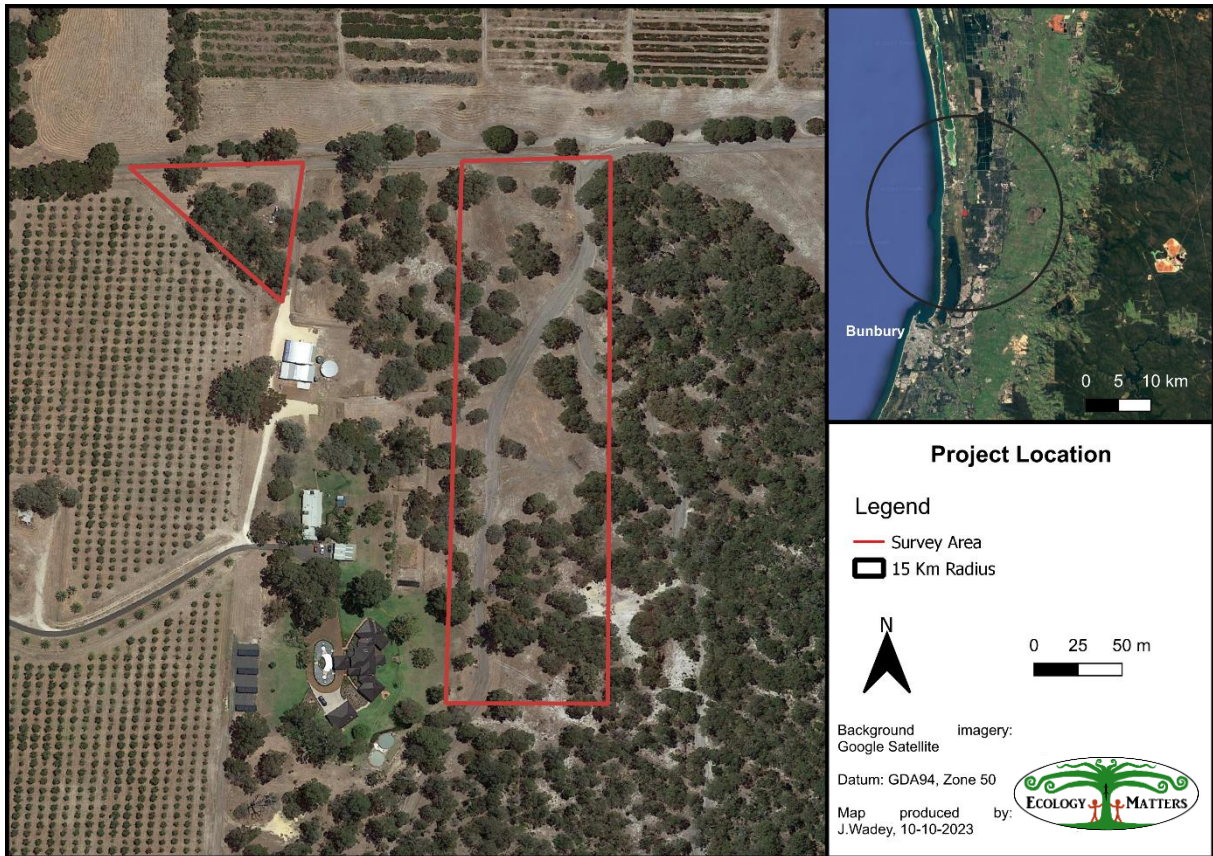


Figure 1-1 Location and boundaries of survey area

## 2 Methods

### 2.1 Field survey and personnel

The survey area was visited on 28<sup>th</sup> September 2023 by Ms Natalia Huang (BSc., Hons., MBA; 17 years experience) and Dr Jamie Wadey (BSc., Hons., Ph.D.; 8 years experience). The entire survey area was traversed on foot by both zoologists (see **Figure 2-1**).



**Figure 2-1 Tracks taken by one zoologist; note the second zoologist walked separately from the first such that the entire survey area was traversed.**

### 2.2 Black-cockatoos

#### 2.2.1 Guidelines

Survey methodology followed the recommendations on the Department of Climate Change, Environment, Energy and Water (DCCEE) website and the guidelines from the (previous) Department of Agriculture, Water and the Environment (DAWE; DAWE 2022). The methodology used to score breeding and foraging value was developed by Bamford Consulting Ecologists (BCE) and has been widely accepted as an effective approach to assessing value for black-cockatoos; this method is available on the BCE website (<https://ecologists.bamford.id.au>).

### 2.2.2 *Breeding*

The purpose of the breeding assessment was to record all potential breeding trees which may contain hollows suitable for black-cockatoo breeding. A potential breeding tree was identified based on EPBC guidance for any tree with a diameter at breast height (DBH) of at least 500 mm (or 300 mm for Wandoo/Yate). Note that this is guidance only and there may be trees which contain suitable breeding hollows but which have smaller DBH; in this case the trees of smaller DBH but with suitable hollows are also recorded. When a potential breeding tree was identified, the following information was recorded: GPS location, tree species, whether it was alive or dead and DBH (mm). The tree was also assessed from the ground for the potential presence and quality of hollows and allocated a nesting rank based on the following method (see **Table 2-1**).

Potential suitable hollows for black-cockatoos are characterised by being vertical or near-vertical with a suitable-sized nest chamber at the base of the hollow, and a suitable-sized hollow entrance. The angle of the hollow and size of nest chamber is a key characteristic of a suitable black-cockatoo breeding hollow. While black-cockatoos favour vertical hollows for the nest chamber, the hollow entrance may be vertical, have a side entrance or have a horizontal spout entrance.

The nesting rank ranges from 1 to 5, with 1 being of most immediate value to black-cockatoos as the hollow is likely being used for nesting at the time of the survey, and 5 being of least immediate value to black-cockatoos. However, it is noted that although trees may be ranked 5 at the time of survey, they may become rank 4 or 3 within the short to medium term and may eventually be used for nesting; the premise is that all rank 1 trees would have started as rank 5 trees. A limitation of this ranking system is that it assesses the nesting value of trees in the immediate term.

**Table 2-1. Ranking system for the assessment of potential nest-trees for black-cockatoos (developed by BCE).**

| Rank | Description of tree and hollows/activity   |
|------|--|
| 1    | Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.   |
| 2    | Visible hollow of suitable size, shape, vertical or near-vertical direction with chew marks around entrance indicating current/recent use.   |
| 3    | Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows <5m so in a Wheatbelt breeding site a lower criterion may be more appropriate. The nest chamber is usually vertical or near-vertical, but the entrance may be horizontal. |
| 4    | Tree with large hollows or broken branches that might contain large hollows, but hollows or potential nest chamber are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by black-cockatoos.   |
| 5    | Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown. Tree may have small hollows.  |

### 2.2.3 Foraging

The foraging assessment involved assigning a foraging score to the survey area, based on three components – vegetation composition, condition and structure (a score out of six), context of the site (a score out of three), and species density (a score out of one). Details of this method are provided in Appendix 1. The foraging score provides a numerical value that is designed to provide the sort of information needed by DAWE, DWER and the Environmental Protection Authority (EPA) to assess impact significance and offset requirements. A higher score represents better foraging value. The survey area was also searched for foraging evidence.

### 2.2.4 Roosting

During the site visit, areas with the potential to be used as roosting sites (e.g. sites adjacent to watercourses with large trees) were noted. Note that if a targeted roosting assessment is required, the survey area needs to be revisited in the late afternoon.

## 2.3 Western ringtail possum

A habitat assessment was conducted for the western ringtail possum. This involved searching for presence of suitable habitat, such as peppermint and sheoak trees and acacia shrubs, searching for dreys (nests), noting suitable hollows, searching for scats at the base of trees and noting arboreal connectivity. Note that no nocturnal surveys were conducted.

## 2.4 Western brush-tailed phascogale

A habitat assessment was conducted for the western brush-tailed phascogale. This involved searching for presence of suitable habitat such as trees with suitable hollows, log piles, and noting arboreal connectivity. Note that no camera trap or nocturnal surveys were conducted.

## 2.5 Survey limitation

A key survey limitation is the inherent limitation of sighting hollows from the ground; hollows may not be obvious from the ground so may be missed, and recorded hollows may be solid. In addition, the current ranking system for breeding trees assesses immediate value, not future nesting value.



### 3 Results

#### 3.1 Fauna habitat

##### 3.1.1 Survey area

The survey area is typical of previously-grazed land with absent or sparse middle and under storeys and remnant or regrowth mature native trees as overstorey.

The western and eastern areas are slightly different – the western area contains mature native trees of Banksia (*B. attenuata*), Peppermint (*Agonis flexuosa*), Jarrah (*Eucalyptus marginata*) and Tuart (*E. gomphocephala*) over a weedy understorey (**Figure 3-1**).



**Figure 3-1 Vegetation in western area showing Peppermint and Banksia trees over weedy understorey.**

The eastern area contains mature trees of Peppermint and Tuart, but also includes mature trees of Marri (*Corymbia calophylla*), regrowth Blackbutt (*E. todtiana*, **Figure 3-2**), scattered Acacia shrubs and isolated grass trees and zamia palms, with most of the area being open and cleared (**Figure 3-3**). Habitat assessment in relation to each targeted species is presented separately below.





**Figure 3-2 Regrowth Blackbutt in the southern part of the eastern area.**

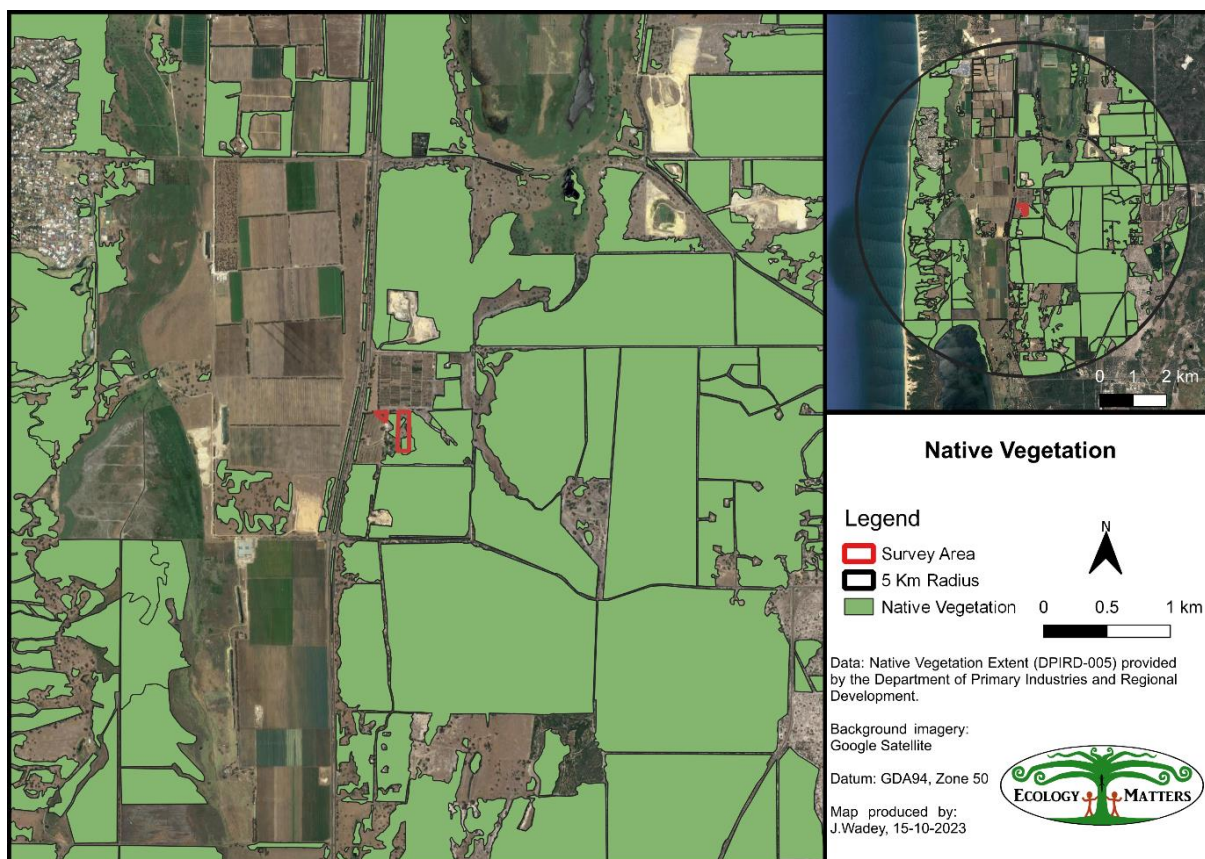


**Figure 3-3 Vegetation in the eastern area showing open bare areas with scattered mature Peppermint.**



### 3.1.2 Extent of remnant vegetation

The extent of native vegetation within 5 km of the survey area is shown in **Figure 3-4**. This shows agricultural or rural land to the west and partly to the north of the survey area. To the east and south there is immediate connectivity to remnant native vegetation, which connects further to native vegetation to the north, south and east. To the east at least, remnant vegetation appears to be more intact fauna habitat than what is present in the survey area with a Marri/Jarrah woodland of denser canopy cover and presence of middle and under storeys.



**Figure 3-4. Remnant native vegetation within 5 km of the survey area.**

## 3.2 Black-cockatoos

### 3.2.1 Presence

Carnaby's and forest red-tailed black-cockatoos are expected to be regular visitors to the survey area based on their known ranges while Baudin's black-cockatoo is expected to be an irregular visitor to the survey area. None of the species were recorded during the time of survey, but this does not mean they will not utilize the area. Foraging evidence of different ages was recorded (see Section 3.2.3) which suggested the survey area has been visited by black-cockatoos at least several times. Suitable habitat exists within and adjacent to the survey area so it is likely to be visited by black-cockatoos.

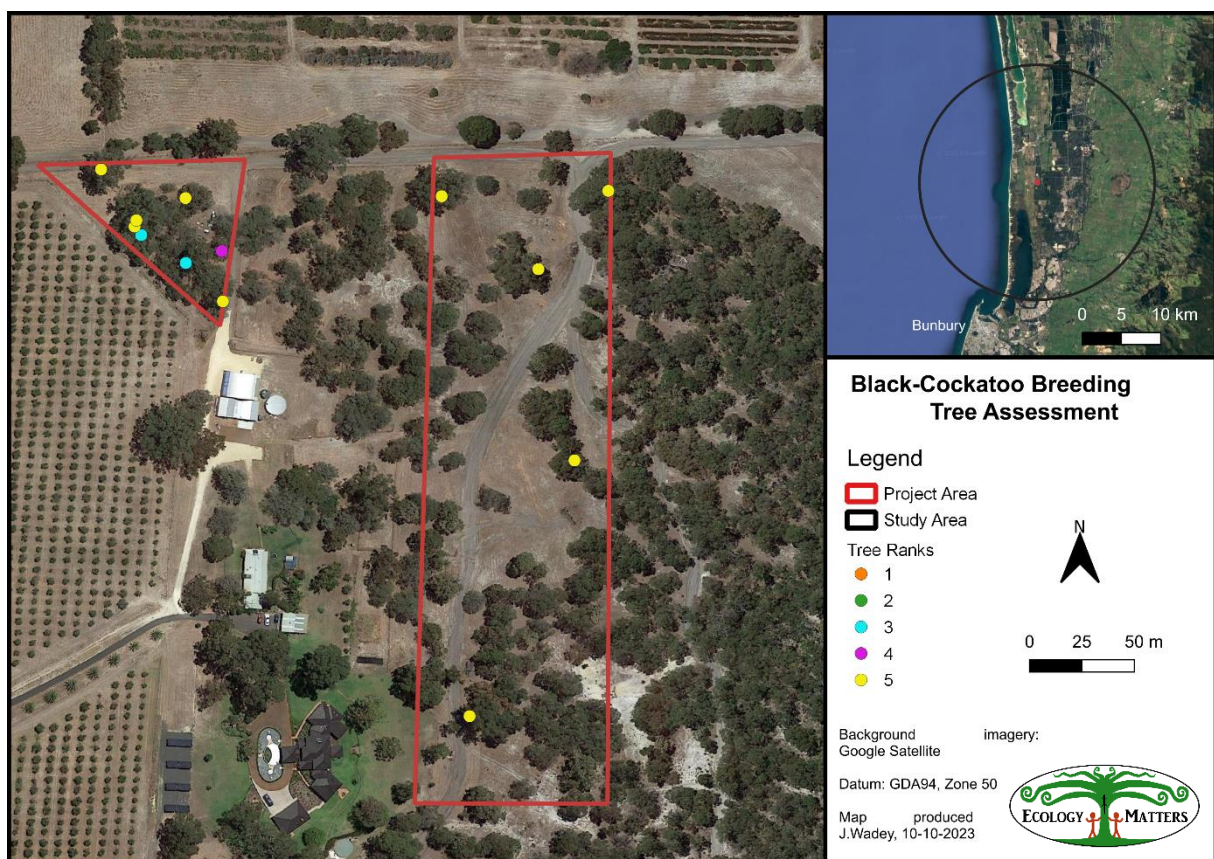
### 3.2.2 Breeding assessment

There is suitable black-cockatoo breeding habitat present in the survey area, with a total of 13 trees meeting the minimum DBH requirement; two of these were given a nesting rank of 3 (containing

suitable black-cockatoo hollow/s) and one of rank 4 (containing potentially suitable black-cockatoo hollow/s). The locations of these trees are shown in **Figure 3-5**. An example of a hollow from a tree ranked 3 is shown in **Figure 3-6**; note the vertical hollow entrance and nest chamber. Note that some of the rank 5 trees in the western area are considered likely to contain suitable hollows in the future. For example, there are dead trees which contained many hollows but none were large or vertical enough to be allocated as rank 3 at the time of survey, but they are considered likely to become rank 3 with time or following disturbance such as a storm event. Details of each recorded tree are presented in Appendix 2.

Note: all recorded hollows were assessed with confidence that they were not being used at the time of survey nor were used recently by black-cockatoos. This is evidenced by the lack of chew marks or chipped off bark at the entrance to the hollow which is typical of hollow use by black-cockatoos.

Although there are suitable breeding trees present in the survey area, particularly in the western area, there is forest of higher quality in the immediate vicinity of the survey area (see **Figure 3-4**). The adjacent forest is likely to be dominated by Marri, a tree species known for developing suitable black-cockatoo hollows. This forest contains denser canopy cover, middle and under storeys, and experiences less human disturbance compared to the western area which is surrounded on most sides by agriculture.



**Figure 3-5** Locations of potential black-cockatoo breeding trees





**Figure 3-6 Example of a hollow considered suitable for black-cockatoos and given a rank of 3; this tree was located in the western area**

### 3.2.3 Foraging assessment

There are foraging opportunities for all three black-cockatoo species in the survey area, with varied foraging values for the western and eastern areas for each species.

The western area is more important for Carnaby’s black-cockatoo than the other species due to the presence of their mainstay food plant (*Banksia* sp.), and so the western area was given a total foraging score of 6 out of 10 for Carnaby’s black-cockatoo and 4 out of 10 for the Baudin’s and forest red-tailed black-cockatoos. Sites context was 2 out of 3 for all species due to the overall loss of foraging habitat in the area and region, and species stocking rate was given a 0 as evidence of the species was not recorded. Details of foraging scores for the western area are given in **Table 3-1** (see Section 2.2.3 for details of methodology).

**Table 3-1 Foraging values for each black-cockatoo species for western area**

| Species                          | Site Condition (out of 6) | Site Context (out of 3) | Species Stocking Rate (0 or 1) | Total (out of 10) |
|----------------------------------|---------------------------|-------------------------|--------------------------------|-------------------|
| Carnaby’s Black-Cockatoo         | 4                         | 2                       | 0                              | 6                 |
| Baudin’s Black-Cockatoo          | 2                         | 2                       | 0                              | 4                 |
| Forest Red-tailed Black-Cockatoo | 2                         | 2                       | 0                              | 4                 |

The eastern area is more important for forest red-tailed black-cockatoo than the other species due to the higher abundance of their mainstay food plant (Marri), and so the eastern area was given a total foraging score of 7 out of 10 for forest red-tailed black-cockatoo, 6 out of 10 for Baudin’s black-cockatoo and 5 out of 10 for Carnaby’s black-cockatoo. Sites context was 2 out of 3 for all species due to the loss of foraging habitat in the area and region, and species stocking rate was given a 1 only for forest red-tailed black-cockatoo as foraging evidence for this species was recorded. Details of foraging scores for the eastern area are given in **Table 3-2** (see Section 2.2.3 for details of methodology).

**Table 3-2 Foraging values for each black-cockatoo species for eastern area**

| Species                          | Site Condition (out of 6) | Site Context (out of 3) | Species Stocking Rate (0 or 1) | Total (out of 10) |
|----------------------------------|---------------------------|-------------------------|--------------------------------|-------------------|
| Carnaby’s Black-Cockatoo         | 3                         | 2                       | 0                              | 5                 |
| Baudin’s Black-Cockatoo          | 4                         | 2                       | 0                              | 6                 |
| Forest Red-tailed Black-Cockatoo | 4                         | 2                       | 1                              | 7                 |

There was foraging evidence by forest red-tailed black-cockatoos on Marri nuts and Blackbutt nuts scattered throughout the eastern area; these were of Intermediate to Old age, suggesting the species has visited the site over several occasions (**Figure 3-7**). The locations of foraging evidence are shown in **Figure 3-8**.





Figure 3-7 Foraging evidence on Marri nuts (left) and Blackbutt nuts (right) by forest red-tailed black-cockatoo.

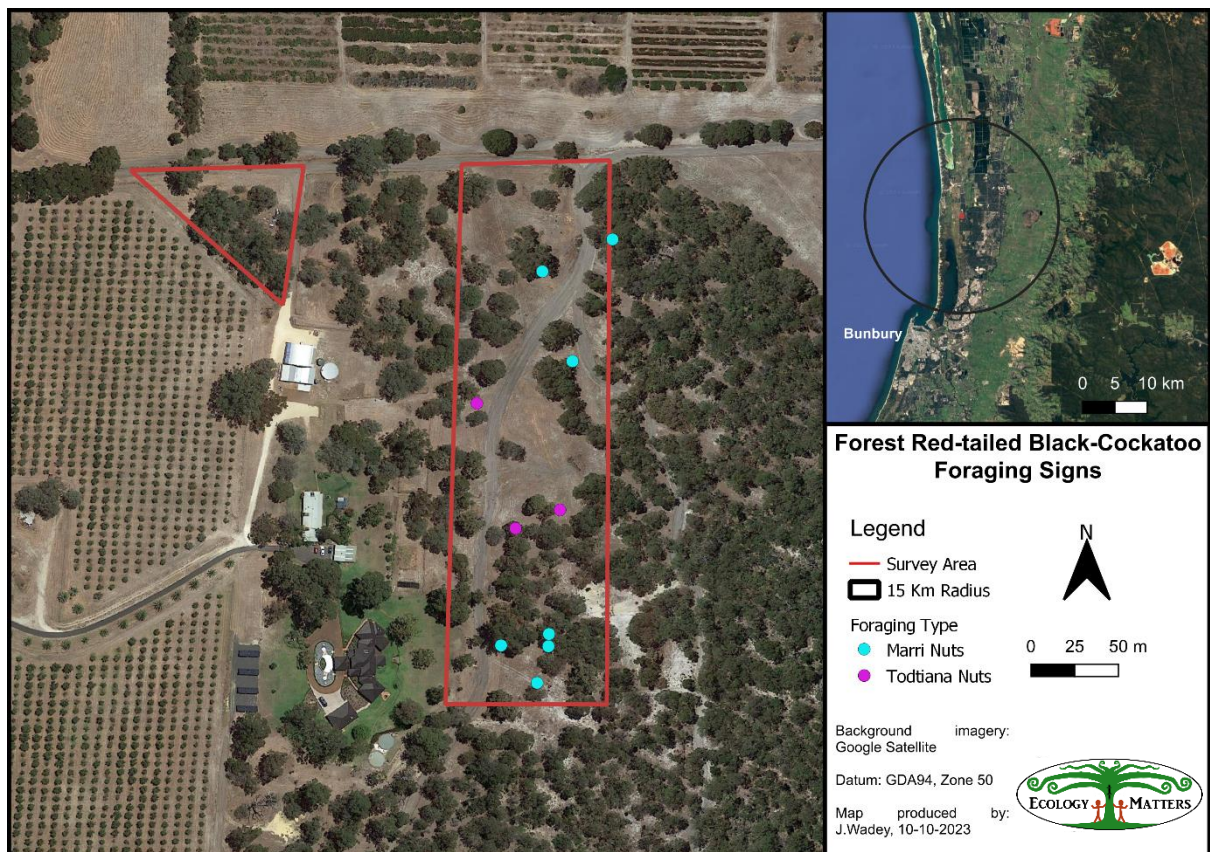


Figure 3-8 Locations of black-cockatoo foraging evidence.

### 3.2.4 *Roosting assessment*

The survey area provides potential roosting opportunities for black-cockatoos as there are tall trees scattered throughout both areas and nearby water sources. A nearby water source is known as an important feature of a black-cockatoo roost as they like to drink just before roosting. There is suitable roosting habitat in the immediate vicinity with an extensive forested area located adjacent to the survey area (see **Figure 3-4**).

### 3.3 Western ringtail possum

There was suitable habitat for the western ringtail possum in the survey area, with peppermint trees present in both western and eastern areas and acacia shrubs present on the eastern border of the eastern area. There were some hollows of suitable size present in the western area, though none appeared to be in current use by possums (i.e., none showed wear on bark at hollow entrances which is often the case in possum hollows). Arboreal connectivity was relatively low in the eastern area with large areas of bare ground or low weeds between scattered trees. Although arboreal connectivity was better within the western area, connectivity between the western area and adjacent forest is relatively low, with trees scattered and canopies not well-connected. No dreys nor scats were recorded. The species is considered likely to occur as a regular visitor to the survey area.

Note that a nocturnal survey was not conducted in this assessment. As the possum is mobile and its activity varies through the night, a nocturnal survey provides a snapshot of activity at the time of survey. If the species is not recorded during the survey this does not mean the species is not present (as it may have been undetected or in a hollow) and it does not mean the species does not use the survey area at other times. For this reason, it was considered appropriate to conduct a qualitative habitat assessment. This determined that suitable possum habitat is present given the presence of suitable foraging plants (peppermint) and the presence of trees with hollows (though none of the observed hollows showed signs of current use). The possum is considered unlikely to be a resident in the survey area due to hollows not showing signs of current use, the lack of dreys, the low canopy connectivity to nearby habitat, and the presence of more intact forest in the immediate vicinity which may be preferred by the species.

### 3.4 Western brush-tailed phascogale

There was suitable habitat for the western brush-tailed phascogale in the survey area, with four trees with multiple hollows of suitable size present in the western area (see **Figure 3-9** and Appendix 2). There were two log piles present in the eastern area as a result of previous clearing and these may provide habitat for the phascogale (**Figure 3-10**). Arboreal connectivity was relatively low in the eastern area with large areas of bare ground or low weeds between scattered trees. Although arboreal connectivity was better within the western area, connectivity between the western area and adjacent forest is relatively low, with trees scattered and canopies not well-connected. No evidence of the species was recorded. The species is considered likely to occur as a regular visitor though higher quality habitat is available to the east of the survey area and beyond.





**Figure 3-9** Dead tree which contained multiple hollows of suitable size for the western brush-tailed phascogale (located in western area).



**Figure 3-10** One of two log piles recorded in eastern area which may provide habitat for phascogales.

### 3.5 Opportunistic fauna records

There were 16 birds and two mammal species recorded opportunistically during the fauna assessment (Appendix 3). Species were typical of disturbed agricultural or rural landscapes.

## 4 Summary

The survey area provides suitable nesting, roosting and foraging habitat for all of the target species but the habitat is degraded with weedy understorey and the survey area is located on the edge of agricultural disturbance. The highest fauna value is in the remnant trees, which are large and mature; these provide foraging, roosting and nesting habitat for all species, with several containing suitable breeding hollows for black-cockatoos, western ringtail possum and western brush-tailed phascogale, particularly in the western area. None of these hollows show evidence of being currently or recently used by black-cockatoos or western ringtail possum.

While there is arboreal connectivity within the western area, there is relatively low connectivity in the eastern area where trees are scattered; this is of relevance for the possum and phascogale which are generally arboreal as black-cockatoos will cross open areas. The survey area is located adjacent to a larger tract of remnant Marri/Jarrah woodland of greater structural and floral diversity, including mature trees, which is considered likely to provide fauna habitat for the target species, including hollows.

The target species are expected to be regular or irregular visitors to the survey area. The lack of hollows with evidence of use, the lack of dreys, the low canopy connectivity to nearby habitat, and the presence of more intact forest in the immediate vicinity suggest the western ringtail possum may not be resident in the survey area.

The loss of the habitat in the survey area is considered unlikely to result in loss of populations of the target species given its relatively small size and degraded/disturbed nature. It is recommended to retain, where possible, as many mature trees as possible, particularly those which contain hollows. It is also recommended to engage a fauna spotter during clearing (in addition to clearing methods which gently lower trees to the ground) to ensure any of these target species which may be encountered can be captured and relocated.

## 5 References

- DAWE. (2022). Referral guideline for 3 WA threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black-cockatoo. Department of Agriculture, Water and the Environment, Canberra, February.
- Keighery, B. J. (1994). Bushland Plant Survey: A guide to plant community survey for the community. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.
- Scott, J.K. and Black, R. (1981) Selective predation by white-tailed black cockatoos on fruit of *Banksia attenuata* containing the seed-eating weevil *Alphitopis nivea*. *Australian Wildlife Research*, 8, 421-30.
- Stock, W. D., Finn, H. C., Parker, J. and Dods, K. (2013). Pine as Fast Food. Foraging Ecology of an Endangered Cockatoo in a Forestry Landscape. *PlosOne* 8.

## 6 Appendices

**Appendix 1. Scoring system for the assessment of foraging value of vegetation for black-cockatoos; developed by BCE and based on EPBC guidance (taken from <https://ecologists.bamford.id.au>, reproduced with permission).**

### Introduction

Application of the Offset Assessment Guide (offsets guide) developed by the federal environment department for assessing Black-Cockatoo foraging habitat requires the calculation of a score out of 10. The following system has been developed by Bamford Consulting Ecologists (BCE) with assistance from Quessentia Consulting to provide an objective scoring system that is practical and can be used by trained field zoologists with experience in the environments frequented by the species.

The foraging value score provides a numerical value that reflects the significance of vegetation as foraging habitat for Black-Cockatoos, and this numerical value is designed to provide the information needed by the Federal Department of Agriculture, Water and the Environment (DAWE) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components as detailed above. These three components are drawn from the DAWE offsets guide but the scoring approach was developed by BCE and includes a fourth (moderation) component.

Note that the scoring system can only be applied within the range of the species or at least where the species could reasonably be expected to occur based upon existing information.

Calculating the total score (out of 10) requires the following steps:

- A. Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus
- B. Site context. Determining a score out of three for the context of the site; plus
- C. Species stocking rate. Determining a score out of one for species density.
- D. Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

The BCE scoring system places the greatest weight on site condition (scale of 0 to 6) because this has the highest influence on the foraging values of a site, which in turn is the fundamental driver in meeting ecological requirements for continued survival.

Site context has a lower weight (scale of 0 to 3) in recognition of the mobility of the species, which means they can access good foraging habitat even in fragmented landscapes, but allowing for recognition of the extent of available habitat in a region and context in relation to activity (such as breeding and roosting). The application of scoring site context is further discussed below.



Species stocking rate is given a low weight (0 to 1) as it is a means only of recognising that a species may or may not be abundant at a site, but that abundance is dependent upon site condition and context and is thus not an independent variable. The abundance of a species is also sensitive to sampling effort, and to seasonal and annual variation, and is therefore an unreliable indicator of actual importance of a site to a species.

Calculation of scores and the moderation process are described in detail below.

**A. Site condition. Vegetation composition, condition and structure scoring**

| Site Score | Description of Vegetation Values  |   |   |
|------------|---|---|---|
|            | Carnaby's Black-Cockatoo  | Baudin's Black-Cockatoo   | Forest Red-tailed Black-Cockatoo  |
| 0          | <p>No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>Water bodies (e.g. salt lakes, dams, rivers);</li> <li>Bare ground;</li> <li>Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes.</li> <li>Mown grass</li> </ul>   | <p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>Water bodies (e.g. dams, rivers);</li> <li>Bare ground;</li> <li>Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).</li> </ul> | <p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>Water bodies (e.g. dams, rivers);</li> <li>Bare ground;</li> <li>Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).</li> </ul> |
| 1          | <p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Scattered specimens of known food plants but projected foliage cover of these is &lt; 2%. This could include urban areas with scattered foraging trees;</li> <li>Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source;</li> <li>Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).</li> </ul> | <p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these &lt; 1%. This could include urban areas with scattered foraging trees.</p>   | <p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these &lt; 1%. Could include urban areas with scattered foraging trees.</p>  |

| Site Score | Description of Vegetation Values  |  |   |
|------------|---|--|---|
|            | Carnaby's Black-Cockatoo  | Baudin's Black-Cockatoo  | Forest Red-tailed Black-Cockatoo  |
| 2          | <p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Shrubland in which species of foraging value, such as shrubby banksias, have &lt; 10% projected foliage cover;</li> <li>• Woodland with tree banksias 2-5% projected foliage cover;</li> <li>• Woodland with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &lt;10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Open eucalypt woodland/mallee of small-fruited species;</li> <li>• Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source.</li> </ul> | <p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with &lt;10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants &lt;10% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants &lt;10% projected foliage cover (establishing food sources with good long-term viability);</li> <li>• Urban areas with scattered foraging trees.</li> </ul> | <p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah) 1-5% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with &lt;10% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Sheoak Woodland with &lt;10% projected foliage cover;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants &lt;10% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants &lt;10% projected foliage cover (establishing food sources with good long-term viability);</li> <li>• Urban areas with scattered food plants such as Cape Lilac, <i>Eucalyptus caesia</i> and <i>E. erythrocorys</i>.</li> </ul> |

| Site Score | Description of Vegetation Values   |   |  |
|------------|--|---|--|
|            | Carnaby's Black-Cockatoo   | Baudin's Black-Cockatoo   | Forest Red-tailed Black-Cockatoo   |
| 3          | <p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover;</li> <li>• Woodland with tree banksias 5-20% projected foliage cover;</li> <li>• Woodland with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Eucalypt Woodland/Mallee of small-fruited species;</li> <li>• Eucalypt Woodland with Marri &lt; 10% projected foliage cover.</li> </ul> | <p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).</li> </ul> | <p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>• Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover;</li> <li>• Marri-Jarrah Woodland with 10-40% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>• Sheoak Forest with 10-40% projected foliage cover;</li> <li>• Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management);</li> <li>• Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).</li> </ul> |



| Site Score | Description of Vegetation Values  |   |   |
|------------|---|---|---|
|            | Carnaby's Black-Cockatoo  | Baudin's Black-Cockatoo   | Forest Red-tailed Black-Cockatoo  |
| 4          | <p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover;</li> <li>Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover;</li> <li>Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover.</li> </ul> | <p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover;</li> <li>Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management);</li> <li>Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability);</li> <li>Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).</li> </ul> | <p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover;</li> <li>Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Sheoak Forest with 40-60% projected foliage cover;</li> <li>Parkland-cleared Eucalypt Woodland/Forest with known food plants 40-60% projected foliage cover (poor long-term viability without management);</li> <li>Younger areas of (managed) revegetation with known food plants 40-60% projected foliage cover (establishing food sources with good long-term viability).</li> </ul> |

| Site Score | Description of Vegetation Values  |  |  |
|------------|---|--|--|
|            | Carnaby's Black-Cockatoo  | Baudin's Black-Cockatoo  | Forest Red-tailed Black-Cockatoo   |
| 5          | <p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover;</li> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 40-60% projected foliage cover;</li> <li>Marri-Jarrah Forest with 40-60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> <li>Pine plantations with trees more than 10 years old (but see pine note below in moderation section).</li> </ul> | <p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with 40-60% projected foliage cover;</li> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Parkland-cleared Eucalypt Woodland/Forest with known food plants &gt;60% projected foliage cover (poor long-term viability without management);</li> <li>Younger areas of (managed) revegetation with known food plants &gt;60% projected foliage cover (establishing food sources with good long-term viability).</li> </ul> | <p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with 40-60% projected foliage cover;</li> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Sheoak Forest with &gt; 60% projected foliage cover;</li> <li>Parkland-cleared Eucalypt Woodland/Forest with known food plants &gt;60% projected foliage cover (poor long-term viability without management);</li> <li>Younger areas of (managed) revegetation with known food plants &gt;60% projected foliage cover (establishing food sources with good long-term viability).</li> </ul> |

| Site Score | Description of Vegetation Values  |  |  |
|------------|---|--|--|
|            | Carnaby's Black-Cockatoo  | Baudin's Black-Cockatoo  | Forest Red-tailed Black-Cockatoo   |
| 6          | <p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> <li>Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have &gt;60% projected foliage cover;</li> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> </ul> | <p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> </ul> | <p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> </ul> |

Vegetation structural class terminology follows Keighery (1994).

## **B. Site context.**

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access foraging sites. Based on BCE observations, Black-Cockatoos are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with the DAWE (2022), provides a *guide* to the assignation of site context scores. Note that 'local area' is defined as within a 15 km radius of the centre point of the study site. This is greater than the maximum distance of 12km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

| Site Context Score | Percentage of the existing native vegetation within the 'local' area that the study site represents. |                           |
|--------------------|--|---------------------------|
|                    | 'Local' breeding known/likely  | 'Local' breeding unlikely |
| 3                  | > 5%   | > 10%                     |
| 2                  | 1 - 5%   | 5 - 10%                   |
| 1                  | 0.1 - 1%   | 1 - 5%                    |
| 0                  | < 0.1%   | < 1%                      |

The table above provides weighting for where nearby breeding is known (or suspected) and for the proportion of foraging habitat within 15 km represented by the site being assessed. Some adjustments may be needed based on the judgement of the assessor and in relation to the likely function of the site. For example, a small area of foraging habitat (e.g. 0.5% of such habitat within 15 km) could be upgraded to a context of 2 if it formed part of a critical movement corridor. In contrast, the same sized area of habitat, of the same local proportion, could be downgraded if it were so isolated that birds could never access it.

## **C. Species density (stocking rate).**

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignation of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate

condition score that is part of a network of such habitat where a black-cockatoo species is known would get a species density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low.

**D. Moderation of scores for the calculation of a value out of 10.**

The calculation out of 10 requires the vegetation characteristics (out of 6) to be combined with the scores given for context and species density. It is considered that the context and density scores are not independent of vegetation characteristics; otherwise habitat of absolutely no value for black-cockatoo foraging (such as concrete or a wetland) could get a foraging score out of 10 as high as 4 if it occurred in an area where the species breed (context score of 3) and are abundant (species density score of 1). Similarly, vegetation of negligible or low characteristics which could not support black-cockatoos could be assigned a score as high as 6 out of 10. In that case, the score of 6 would be more a reflection of nearby vegetation of high characteristics than of the foraging value of the negligible to low scoring vegetation. The Black-Cockatoos would only be present because of vegetation of high characteristics, so applying the context and species density scores to vegetation of low characteristics would not give a true reflection of their foraging value.

For this reason, the context and species density scores need to be moderated for the vegetation characteristic score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. A simple approach is to assign a context and species density score of zero to sites with a Condition score of low (2), negligible (1) or none (0), on the basis that birds will not use such areas unless they are adjacent to at least low-moderate quality foraging habitat ( $\geq 3$ ). The approach to calculating a score out of 10 can be summarised as follows:

| <b>Vegetation composition, condition and structure score</b> | <b>Context score</b>    | <b>Species density score</b> |
|--|-------------------------|------------------------------|
| 3-6 (low/moderate to high value)                             | Assessed as per B above | Assessed as per C above      |
| 0-2 (no to low value)  | 0                       | 0                            |

Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances. Such as when very close to a major breeding area or if strategically located along a movement corridor.

### Pine plantations

Pine plantations are an important foraging resource for Carnaby's Black-Cockatoo (only) but are not directly comparable with native vegetation. In comparing native vegetation with pine plantations for the purpose of calculating offsets, the following should be noted:

- Pine plantations are a commercial crop established with the intention of being harvested and thus have short-term availability (30-50 years), whereas native vegetation is available indefinitely if protected. Due to the temporary nature of pines as a food source, site condition and context differs between pines and native vegetation.
- Although pines provide a high abundance of food in the form of seeds, they are a limited food resource compared with native vegetation which provides seeds, insect larvae, flowers and nectar. The value of insect larvae in the diet of Carnaby's Black-Cockatoo has not been quantified, but in the vicinity of Perth, the birds forage very heavily on insect larvae in young cones of *Banksia attenuata* in winter, ignoring the seeds in these cones and seeds in older cones on the same trees (Scott and Black 1981; M. Bamford pers. obs.). This suggests that insect larvae are of high nutritional importance immediately prior to the breeding season.
- Pine plantations have very little biodiversity value other than their importance as a food source for Carnaby's Black-Cockatoos. They inhibit growth of other flora. While this is not a factor for direct consideration with respect to Carnaby's Black-Cockatoo, it is a factor in regional conservation planning of which offsets for the cockatoos are a part.

Taking the above points into consideration, it is possible to assign pine plantations a foraging value as follows:

- Site condition. The actual foraging value of pines is high. Stock *et al.* (2013) report that it takes nearly twice as many seeds of *Pinus pinaster* to meet the daily energy requirements for Carnaby's Black-Cockatoo compared with Marri, and three times as many *P. pinaster* seeds compared with Slender Banksia. However, pines are planted at a high density so the food supply per hectare can be high. Taking account of the lack of variety of food from pines, this suggests a site condition score of 4 or 5 out of 6 (5 is used in Section A above). As a source of food, pines are thus comparable to the best banksia woodland. This site condition score then needs to be adjusted to take account of the short-term nature of the food supply (for pine plantations to be harvested. Where pines are 'ornamental, such as in some urban contexts, they can be treated as with other trees in urban landscapes). The foraging value of a site after pines are harvested will effectively be 0, or possibly 1 if there is some retention. It is proposed that this should approximately halve the site condition score; young pine plantations could be redacted slightly less than old plantations on the basis that a young plantation provides a slightly longer term food supply. If a maximum site condition score of 5 is given, then a young plantation (>10 but <30 years old) could be assigned a score of 3, and an old plantation (>30 years old) could be assigned a score of 2. Plantations <10 years old and thus not producing large quantities of cones could also get a score of 2, but recognising they may increase in value.
- Site context. Although a temporary food source, pines can be very important for Carnaby's Black-Cockatoo in some contexts; they could be said to carry populations in areas where there is little native vegetation. The system for assigning a context score as outlined above (Section B) also applies to pines. Thus, a context score of 3 can be given where pines are a significant



proportion of foraging habitat (>5% if breeding occurs; >10% if no breeding), but where pines are a small part of the foraging landscape they will receive a context score of less than this.

- Species density. As outlined above (Section C), pines will receive a species density score of 1 where Carnaby's Black-Cockatoo are regular visitors. This is irrespective of an old plantation having a moderated condition score of 2.

Based on the above, pine plantations that represent a substantial part of the foraging landscape, such as in the region immediately north of Perth, would receive a total score (out of 10) of 6; young plantations in this area would receive a score of 7. In contrast, isolated and small plantations in rural landscapes could receive a score of just 2 if they are only a small proportion of foraging habitat and Carnaby's Black-Cockatoos are not regularly present.

**Appendix 2. Details of trees which met minimum DBH of 500 mm.**

| <b>Species</b> | <b>DBH</b> | <b>Black-cockatoo Nesting Rank</b> | <b>Presence of any hollows</b> | <b>Alive/dead</b> | <b>Easting</b> | <b>Northing</b> |
|----------------|------------|------------------------------------|--------------------------------|-------------------|----------------|-----------------|
| Tuart          | 500        | 5                                  | No                             | Alive             | 380770         | 6329453         |
| Jarrah         | 500        | 4                                  | Many small hollows             | Alive             | 380769         | 6329477         |
| Tuart          | 800        | 3                                  | Many small hollows             | Alive             | 380752         | 6329471         |
| Tuart          | 800        | 3                                  | Many small hollows             | Dead              | 380730.4       | 6329484         |
| Tuart          | 700        | 5                                  | Several small hollows          | Dead              | 380727.2       | 6329488         |
| Tuart          | 800        | 5                                  | No                             | Alive             | 380728         | 6329491         |
| Tuart          | 1000       | 5                                  | No                             | Alive             | 380710.8       | 6329515         |
| Jarrah         | 650        | 5                                  | No                             | Alive             | 380751.3       | 6329502         |
| Marri          | 500        | 5                                  | No                             | Alive             | 380920.3       | 6329471         |
| Tuart          | 1000       | 5                                  | No                             | Alive             | 380873.5       | 6329505         |
| Marri          | 900        | 5                                  | No                             | Alive             | 380953.1       | 6329509         |
| Blackbutt      | 500        | 5                                  | No                             | Alive             | 380939.1       | 6329380         |
| Tuart          | 500        | 5                                  | No                             | Alive             | 380891.2       | 6329257         |

### **Appendix 3. Species recorded opportunistically in survey area**

#### **Birds**

Black-faced cuckoo-shrike  
Western corella  
Grey butcherbird  
Willie wagtail  
Australian ringneck  
Whistling kite  
Rufous whistler  
Red wattlebird  
Spotted pardalote  
Common bronzewing  
Western gerygone  
Weebill  
Horsfield bronze-cuckoo  
Australian raven  
Kookaburra  
Galah

#### **Mammals**

Western grey kangaroo (scats and tracks)  
Rabbit (scats)

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