

Black Cockatoo Habitat Assessment



Lot 3 (#392) Baldivis Road

Baldivis

August 2023

V1

On behalf of:

Coterra Environment
Level 3, 25 Prowse Street
WEST PERTH WA 6005

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SUMMARY

This report details the results of a black cockatoo habitat assessment over Lot 3 (#392) Baldivis Road, Baldivis (the survey area). The survey area covers about 4 hectares and is mostly comprised of grassland/bare sand with scattered/groves of planted non-endemic/exotic/native trees and shrubs (Figure 1).

The proponent is proposing to subdivide the existing lots into a number of smaller lots and therefore the removal/modification of habitats potentially in use by native fauna will possibly be required. The potential loss/modification of existing black cockatoo habitat has been identified as one possible issue.

The assessment reported on here has primarily been carried out to provide information that will be used to determine the scale of any impacts that may occur to black cockatoo habitat when the proposed works are undertaken.

The fauna assessment was carried out on 15 July 2023 by Greg Harewood (Zoologist).

Key Findings

- The entire survey area has been subject to considerable historical disturbance with the Lot now consisting of a mosaic of scattered/small groves of trees and shrubs with considerable expanses of totally cleared grassland/sand areas. The vegetation remaining is dominated by planted non-endemic/exotic trees and shrubs with a small number of planted native trees and shrubs. A number of buildings previously present in the survey area have recently been demolished and removed.
- Given the complex mosaic nature of the vegetation present the survey area has, for the purpose of this assessment, been placed into one broad habitat type – Cleared with scattered/groves of planted trees/shrubs over grassland.
- The assessment identified a total of 39 trees within the survey area with a DBH of >50cm. None of the trees within the survey area appear to contain hollows, a consequence of their relatively young age with most having been planted less than 50 or 60 years ago.
- The survey area has been assessed as being of low foraging value to all three species of black cockatoo (total score of 1 out of 10). The low foraging value score can be attributed to the limited extent of intact native vegetation and the paucity/absence of preferred foraging species.
- No evidence of black cockatoos roosting within trees located within the survey area was observed during the survey period.
- No evidence of any fauna species of conservation significance utilising the survey area was recorded. The highly degraded nature of the habitats present suggests that it is unlikely that any fauna species of conservation significance would be present and/or rely on the site to a degree that development of the survey area, at any scale, would result in significant impact on their overall status.

1. INTRODUCTION

This report details the results of a black cockatoo habitat assessment over Lot 3 (#392) Baldivis Road, Baldivis (the survey area - Figure 1). The survey area has a total extent of about 4.0 hectares (ha).

The proponent is proposing to subdivide the existing lot into a number of smaller lots and therefore the removal/modification of habitats potentially in use by native fauna will possibly be required. The potential loss/modification of existing black cockatoo habitat has been identified as one possible issue.

The assessment reported on here has primarily been carried out to provide information that will be used to determine the scale of any impacts that may occur to black cockatoo habitat when the proposed works are undertaken.

2. SCOPE OF WORKS

The scope of works was to conduct a targeted survey for black cockatoo habitat. An assessment of the potential for other fauna species of conservation significance to be present was also required. The assessment has therefore involved:

1. Targeted searches for black cockatoo habitat/site use (habitat trees, existing and potential nest hollows, foraging and roosting habitat);
2. Evidence of the presence or likely presence of other fauna species of conservation significance (or suitable habitat) was also searched for and recorded concurrent with the primary site survey.
3. Report for summarising methods and results.

Note: For the purposes of this proposal the term black cockatoo is in reference to Baudin's cockatoo *Zanda baudinii* (BBC), Carnaby's cockatoo *Zanda latirostris* (CBC) and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso* (FRTBC).

3. METHODS

The field component of the fauna assessment was carried out on the 15 July 2023. All survey work and reporting has been carried out by Greg Harewood (Zoologist).

3.1 FAUNA HABITAT ASSESSMENT

Vegetation units, landforms and soils observed during the site reconnaissance survey have been used to define broad fauna habitat types across the survey area.

The main objective of the assessment was to determine if it were likely that species of conservation significance would utilise the habitats identified as occurring within the survey area based on their documented habitat preference and current known distribution.

3.2 BLACK COCKATOO HABITAT ASSESSMENT

The following methods were employed to comply with the defined scope of works and are based on Commonwealth of Australia (2012 and 2022) guidelines which state that surveys for Carnaby's, Baudin's and forest red-tailed black cockatoo habitat should:

- be done by a suitably qualified person with experience in vegetation or cockatoo surveys, depending on the type of survey being undertaken;
- maximise the chance of detecting the species' habitat and/or signs of use;
- determine the context of the site within the broader landscape—for example, the amount and quality of habitat nearby and in the local region (for example, within 10 km);
- account for uncertainty and error (false presence and absences); and
- include collation of existing data on known locations of breeding and feeding birds and night roost locations.

The Commonwealth of Australia (2012) places habitats used by black cockatoos into the following three categories:

- Breeding Habitat;
- Foraging Habitat; and
- Night Roosting Habitat.

3.2.1 Breeding Habitat Assessment

The black cockatoo breeding habitat assessment identified all suitable breeding tree species within the survey area that have a diameter at breast height (DBH) equal to or greater than 50cm. The DBH of each tree was estimated using a pre-made "caliper".

Target tree species included marri, jarrah, tuart and flooded gum and any other *Corymbia/Eucalyptus* species of a suitable size that was present. Peppermints, *Banksia*, sheoak and *Melaleuca* tree species (for example) were not assessed as they typically do not develop hollows used by black cockatoos.

The location of each tree identified as being over the threshold DBH will be recorded with a GPS and details on tree species, number and size of hollows (if any) noted. Trees observed to contain hollows (of any size/type) will be marked with "H" using spray paint.

Hollow/potential hollows were placed into one of four categories, based on the size of the apparent hollow entrance, these being:

- Small = ~<5cm diameter (i.e. entrance too small for a black cockatoo);
- Medium = ~5cm-10cm diameter (i.e. entrance too small for a black cockatoo);
- Large = ~>10cm diameter (entrance large enough for a black cockatoo but hollow appears unsuitable for nesting i.e. wrong orientation, appears too small, too low or too shallow); or
- Large (cockatoo) = ~>10cm diameter (entrance and apparent hollow appears big enough and suitably sized/orientated for a black cockatoo to use for nesting).

Based on this assessment, trees present within the survey area were placed into one of four categories:

- Tree <50cm DBH or an unsuitable species (these were not assessed/recorded);
- Tree \geq 50cm DBH, no hollows seen;
- Tree \geq 50cm DBH, one or more hollows seen, none of which were considered suitable for black cockatoos to use for nesting; or
- Tree \geq 50cm DBH, one or more hollows seen, with at least one considered suitable for black cockatoos to use for nesting.

For the purposes of this assessment, a tree containing a potential black cockatoo nest hollow was defined as:

Generally, any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) or possible hollows potentially suitable for occupation by black cockatoo for the purpose of nesting/breeding. Hollows or possible hollows that had an entrance greater than about 10cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk, were recorded as a “potential nest hollow”.

Identified hollows, if observed, were to be examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Details recorded included hollow size, height, type, orientation, comments on suitability and any evidence of use.

3.2.2 Foraging Habitat Assessment

Foraging habitat is represented by plant species that are known to provide a food source for black cockatoos. This can be in the form of seeds, flowers and also boring grubs that are extracted from some plant species.

In addition to the vegetation/habitat mapping, the specific plant species present that represent potential foraging habitat have been documented. The location and nature of black cockatoo foraging activity (e.g. chewed fruits around base of trees) observed during the field survey was also recorded.

Based on these observations (and other relevant information) the black cockatoo foraging value of each of the identified vegetation units present has been assessed for each of the three black cockatoo species. This information has then been used to calculate a foraging score as outlined in Appendix A.

The system used here to determine a score for foraging values for each species of black cockatoo was developed by Bamford Consulting Ecologists (BCE) 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 system seeks to provide data applicable to the offset assessment guide (offsets guide) developed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for assessing black cockatoo foraging habitat which requires the calculation of a score out of 10.

The foraging value score used provides a numerical value that reflects the significance of vegetation as foraging habitat for black cockatoos. This numerical value is designed to provide information to assist in the assessment of impact significance and offset requirements by the relevant regulatory authorities. 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 below. These three components are drawn from the DCCEEW offsets guide but the scoring approach was developed by BCE and includes a fourth (moderation) component (BCE 2020).

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

- Site Condition: Determining a score out of six for the vegetation composition, condition and structure;
- Site Context: Determining a score out of three for the context of the site;
- Species Stocking Rate: Determining a score out of one for species density; and.
- Moderation: Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 if context and species density are also considered. The score out of 10 is calculated only for vegetation of at least Low to Moderate foraging value (vegetation characteristics score of ≥ 3). Vegetation with No, Negligible or Low foraging value is effectively assigned context and species density scores of '0' because the context and species density are of little relevance if the vegetation does not support regular foraging by the birds. Foraging value scores are calculated differently for the three black-cockatoo species depending upon the vegetation present (BCE 2020).

Calculation of scores and the moderation process are described in Appendix A.

3.2.3 Night Roosting Habitat Assessment

Direct and indirect evidence of black cockatoos roosting within trees on site was noted where observed (e.g. branch clippings, droppings or moulted feathers).

3.3 OTHER FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

Evidence of the presence or likely presence of fauna species of conservation significance (or suitable habitat) was searched for and recorded concurrent with other site surveys. Opportunistic observations of all fauna species were made during all field survey work and recorded where positive species identifications were made.

This aspect of the assessment included but was not limited to:

- Undertaking a series of transects across the survey area.
- Searching for evidence (i.e. individuals, tracks, scats, calls) of potential conservation significant species under logs, rocks and leaf litter.
- Observing bird species with binoculars.

4. SURVEY LIMITATIONS

No seasonal sampling was carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. It should be recognised that site conditions can change with time.

Lack of observational data on some species should also not necessarily be taken as an indication that a species is absent from the site or does not utilise it for some purpose at times.

During the survey, habitat trees with hollows were searched for. It should be noted that identifying hollows suitable for fauna species from ground level has limitations. Generally, the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of observations was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can increase or decrease beyond this range.

5. RESULTS

5.1 FAUNA HABITAT ASSESSMENT

The entire survey area has been subject to considerable historical disturbance with the Lot now consisting of a mosaic of scattered/small groves of trees and shrubs with considerable expanses of totally cleared grassland areas. The vegetation remaining is dominated by planted non-endemic/exotic trees and shrubs with a small number of planted native trees and shrubs. A number of buildings previously present in the survey area have recently been demolished and removed.

Given the complex mosaic nature of the vegetation present the survey area has, for the purpose of this assessment, been placed into one broad habitat type – Cleared with scattered/groves of planted trees/shrubs over grassland. Example images of the various fauna habitats present are provided in Table 1.

Table 1: Example images of the fauna habitats within the survey area.

Fauna Habitat Description	Example Images
Planted non-endemic Eucalypts.	
Planted non-endemic shrubs and exotic trees (<i>Pinus</i> spp.)	

Fauna Habitat Description	Example Images
<p>Planted sheoak (<i>Allocasuarina</i> spp.) and non-endemic eucalypts.</p>	
<p>Planted tuart (<i>E.gomphocephala</i>) trees</p>	

5.2 BLACK COCKATOO HABITAT ASSESSMENT

5.3 Breeding Habitat Assessment

Trees considered potentially suitable for black cockatoos to use as nesting habitat (subject to a suitable hollow being present and other factors) found within the survey area comprised the following species:

- Non-Endemic Eucalypts – *Eucalyptus* spp. (planted - several unidentified species);
- Marri – *Corymbia calophylla* (planted);
- Tuart – *Eucalyptus gomphocephala* (planted); and
- Dead Unknown – *Eucalyptus* spp.

A summary of the habitat trees observed is provided in Table 2. The locations of habitat trees are shown in Figure 2.

Table 2: Summary of potential habitat trees (DBH \geq 50cm) recorded.

Total Number of Habitat Trees (DBH > 50cm)	Number of Habitat Trees with <u>No Hollows Observed</u>	Number of Habitat Trees with <u>Possible Hollows</u> considered <u>Unsuitable</u> for Black Cockatoos	Number of Habitat Trees with <u>Possible Hollows</u> considered <u>Potentially suitable</u> for Black Cockatoos	Tree Species			
				Non-endemic Eucalypt	Marri	Tuart	Dead Unknown
39	39	0	0	29	1	8	1

The assessment identified a total of 39 trees within the survey area with a DBH of >50cm.

None of the trees within the survey area appear to contain hollows, a consequence of their relatively young age with most having been planted less than 50 or 60 years ago.

Additional details on each habitat tree observed can be found in Appendix B.

5.3.1 Foraging Habitat Assessment

The following flora species, known to be or potentially used as a direct food source (e.g. seeds, flowers, nectar, bark or grubs) by one or more species of black cockatoo were recorded within the survey area:

- Non-Endemic Eucalypts – *Eucalyptus* spp. (planted - several unidentified species);
- Marri – *Corymbia calophylla* (planted);
- Tuart – *Eucalyptus gomphocephala* (planted);
- Pine – *Pinus* spp. (planted);
- Sheoak - *Allocasuarina* spp. (planted); and
- Peppermint – *Agonis flexuosa* (planted).

It should be noted that most of the above-mentioned species (e.g. all small fruited eucalypts such a tuart, and several non-endemic eucalypt species in addition to peppermint) while foraged upon on occasions would make up only a small proportion of any one bird’s diet relative to more favoured plant species (e.g. marri). Marri itself is only represented by a single specimen and therefore also does not contribute to the overall foraging resource to a significant degree.

No foraging debris/activity attributed to black cockatoos was located within the survey area during the survey period.

The foraging values of the single identified vegetation/habitat unit for each black cockatoo species is given in Table 3. The table shows foraging value based upon vegetation characteristics, with the total value including context and species density (as outlined in Appendix A).

Table 3: Foraging values of vegetation recorded for black cockatoos.

Habitat Description	Vegetation Characteristics			Site Context			Species Density			Total Score		
	CBC	BBC	FRTBC	CBC	BBC	FRTBC	CBC	BBC	FRTBC	CBC	BBC	FRTBC
Cleared with scattered/groves of planted trees/shrubs over grassland	1	1	1	0	0	0	0	0	0	1	1	1

Vegetation within the survey area has been assessed as being of low foraging value to all three species of black cockatoo (Total Score = 1). The low foraging value score can be attributed to the limited extent of intact native vegetation and the paucity/absence of preferred foraging species.

5.3.2 Night Roosting Habitat Assessment

No evidence of black cockatoos roosting within trees located within the survey area was observed during the survey period.

5.4 OTHER FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

No evidence of any fauna species of conservation significance was recorded within the survey area during the survey period.

The highly degraded nature of the habitats present suggests that it is unlikely that any fauna species of conservation significance would be present and/or rely on the site to a degree that development of the survey area, at any scale, would result in significant impact on their overall status.

6. CONCLUSION

The fauna assessment within the survey area was primarily undertaken to document black cockatoo habitat and to determine the possible presence of other conservation significant fauna species and/or their habitat.

The entire survey area has been subject to considerable historical disturbance with the Lot now consisting of a mosaic of scattered/small groves of trees and shrubs with considerable expanses of totally cleared grassland areas. The vegetation remaining is dominated by planted non-endemic/exotic trees and shrubs with a small number of planted native trees and shrubs. Given the complex mosaic nature of the vegetation present the

survey area has, for the purpose of this assessment, been placed into one broad habitat type – Cleared with scattered/groves of planted trees/shrubs over grassland.

Overall the survey area can be regarded as representing low quality black cockatoo habitat given an absence of any existing nest hollows, low value foraging habitat and a lack of any apparent roosting activity.

No evidence of any fauna species of conservation significance was recorded within the survey area during the survey period.

7. REFERENCES

Bamford Consulting Ecologists (BCE) (2020). Scoring system for the assessment of foraging value of vegetation for black-cockatoos. Revised 5th June 2020.

Commonwealth of Australia (2012). *EPBC Act* Referral guidelines for three threatened Black Cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest Red-tailed Black Cockatoo (vulnerable) *Calyptorhynchus banksii naso*.

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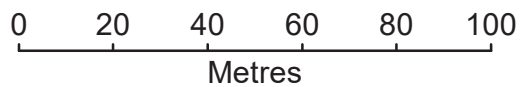
Peck, A., Barrett, G. & Williams, M. (2019). The 2019 Great Cocky Count: a community-based survey for Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*). BirdLife Australia, Floreat, Western Australia.

FIGURES



Legend

 Survey Area





Drawn: G Harewood
Date: 13-Aug-23
Scale: 1:1,600

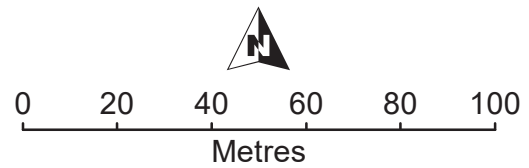
Lot 3 (#392) Baldvis Road
Baldvis

**Survey Area
Aerial Photograph**



Legend

-  Survey Area
-  Habitat Trees - No hollows observed



Drawn: G Harewood
Date: 13-Aug-23
Scale: 1:1,600

Lot 3 (#392) Baldvis Road
Baldvis

**Habitat Trees
(DBH >50cm)**

APPENDIX A

SCORING SYSTEM FOR THE ASSESSMENT OF FORAGING VALUE OF VEGETATION FOR BLACK-COCKATOOS (BCE 2020)

Scoring system for the assessment of foraging value of vegetation for Black-Cockatoos. Revised 5th June 2020

Bamford Consulting Ecologists

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.

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.

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"> • Water bodies (e.g. salt lakes, dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes. • Mown grass 	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits). 	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).
1	<p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees; • 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; • Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual). 	<p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 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 < 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"> Shrubland in which species of foraging value, such as shrubby banksias, have < 10% projected foliage cover; Woodland with tree banksias 2-5% projected foliage cover; Open eucalypt woodland/mallee of small-fruited species; 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. 	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover; Urban areas with scattered foraging trees. 	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah or Sheoak) 1-5% projected foliage cover; Urban areas with scattered food plants such as Cape Lilac, <i>Eucalyptus caesia</i> and <i>E. erythrocorys</i>.
3	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover; Woodland with tree banksias 5-20% projected foliage cover; Eucalypt Woodland/Mallee of small-fruited species; Eucalypt Woodland with Marri < 10% projected foliage cover. 	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover; Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability). 	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover; Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).

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"> Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover; Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover; Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover. 	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. Eucalypt Woodland/Forest with diverse, healthy understorey and known food trees (especially Marri) 10-20% projected foliage cover. Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits). 	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; Sheoak Forest with 40-60% projected foliage cover.
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover; Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; Pine plantations with trees more than 10 years old (but see pine note below in moderation section). 	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Forest with 40-60% projected foliage cover; Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. 	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> Marri-Jarrah Forest with 40-60% projected foliage cover; Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. Sheoak Forest with > 60% projected foliage cover.

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"> Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with > 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). 	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> Marri-Jarrah Forest with > 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). 	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> Marri-Jarrah Forest with > 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).

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, Carnaby's 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 DEE, provides a *guide* to the assignment 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 15km 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 (eg 0.5% of such habitat within 15km) 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. Assignment 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 (≥ 3). The approach to calculating a score out of 10 can be summarised as follows:

vegetation composition, condition and structure score (out of 6)	context score	Species density score
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.

Keighery (1994).

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(2)**, 421-430.

Stock, W.D., Finn, H., Parker, J. and Dods, K. (2013). Pine as Fast Food. Foraging Ecology of an Endangered Cockatoo in a Forestry Landscape. *PlosOne* 8: issue 4.

APPENDIX B

HABITAT TREE DETAILS

Habitat Trees (DBH >50cm)

Waypoint Number	Zone	mE	mN	Tree Species	DBH (cm)	Tree Height (m)	Number of Hollows	Potential Cockatoo Nest Hollow
wpt001	50H	389045	6424476	Non-endemic Eucalypt	>50	20+	0	No
wpt002	50H	389044	6424473	Non-endemic Eucalypt	>50	20+	0	No
wpt003	50H	389042	6424458	Non-endemic Eucalypt	>50	20+	0	No
wpt004	50H	389040	6424453	Non-endemic Eucalypt	>50	20+	0	No
wpt005	50H	389038	6424447	Non-endemic Eucalypt	>50	20+	0	No
wpt006	50H	389035	6424430	Non-endemic Eucalypt	>50	20+	0	No
wpt007	50H	388983	6424457	Non-endemic Eucalypt	>50	15-20	0	No
wpt008	50H	388932	6424458	Non-endemic Eucalypt	>50	15-20	0	No
wpt009	50H	388908	6424463	Non-endemic Eucalypt	>50	15-20	0	No
wpt010	50H	388888	6424446	Tuart	>50	15-20	0	No
wpt011	50H	388888	6424446	Tuart	>50	15-20	0	No
wpt012	50H	388834	6424449	Marri	>50	15-20	0	No
wpt013	50H	388785	6424438	Non-endemic Eucalypt	>50	20+	0	No
wpt014	50H	388785	6424433	Non-endemic Eucalypt	>50	15-20	0	No
wpt015	50H	388728	6424433	Non-endemic Eucalypt	>50	20+	0	No
wpt016	50H	388729	6424449	Non-endemic Eucalypt	>50	20+	0	No
wpt017	50H	388709	6424475	Tuart	>50	15-20	0	No
wpt018	50H	388706	6424484	Tuart	>50	15-20	0	No
wpt019	50H	388719	6424484	Non-endemic Eucalypt	>50	20+	0	No
wpt020	50H	388721	6424482	Non-endemic Eucalypt	>50	15-20	0	No
wpt021	50H	388715	6424498	Non-endemic Eucalypt	>50	20+	0	No
wpt022	50H	388755	6424487	Non-endemic Eucalypt	>50	15-20	0	No
wpt023	50H	388763	6424496	Non-endemic Eucalypt	>50	15-20	0	No
wpt024	50H	388760	6424513	Non-endemic Eucalypt	>50	15-20	0	No
wpt025	50H	388810	6424502	Tuart	>50	15-20	0	No
wpt026	50H	388812	6424502	Tuart	>50	15-20	0	No
wpt027	50H	388804	6424491	Tuart	>50	15-20	0	No
wpt028	50H	388859	6424500	Tuart	>50	15-20	0	No
wpt029	50H	388920	6424514	Non-endemic Eucalypt	>50	20+	0	No
wpt030	50H	388922	6424497	Non-endemic Eucalypt	>50	15-20	0	No
wpt031	50H	388920	6424488	Non-endemic Eucalypt	>50	20+	0	No
wpt032	50H	388950	6424496	Dead Unknown	>50	15-20	0	No
wpt033	50H	388954	6424497	Non-endemic Eucalypt	>50	20+	0	No
wpt034	50H	388962	6424498	Non-endemic Eucalypt	>50	20+	0	No
wpt035	50H	388971	6424499	Non-endemic Eucalypt	>50	20+	0	No
wpt036	50H	388973	6424513	Non-endemic Eucalypt	>50	15-20	0	No
wpt037	50H	388980	6424500	Non-endemic Eucalypt	>50	20+	0	No
wpt038	50H	388988	6424497	Non-endemic Eucalypt	>50	20+	0	No
wpt039	50H	388995	6424498	Non-endemic Eucalypt	>50	20+	0	No

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