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# Black Cockatoo Research Project

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WESTERN  
AUSTRALIAN  
MUSEUM

R.E. JOHNSTONE and T. KIRKBY



Baudin's Cockatoo ♂



Carnaby's Cockatoo ♀



Forest Red-tailed Black Cockatoo ♀

Final Report for Housing Authority 2019

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## **BACKGROUND**

In August 2014, the Department of the Environment granted approval for the development of Housing Authority owned land subject to the Housing Authority providing compensation by way of financial assistance to the Western Australian Museum for research on black cockatoo's protection and long-term conservation.

This report details the process and outcomes of the project against the objectives, and provides interpretation of the data collected and advice on the implications of land clearing, nest competition, fire and climate change.

## **OBJECTIVES OF PROJECT**

Key objectives of the Western Australian Museum's cockatoo research activities were to:

- a. Undertake targeted surveys for breeding, feeding and roosting sites to map critical breeding, feeding and roosting habitat.
- b. Develop artificial nest hollows and protocols for their use and installation.
- c. Conduct studies on current population numbers and distribution of Black Cockatoos including identifying isolated populations.
- d. Determine patterns of migration, movements and changes in foraging ecology.
- e. Develop and implement ways to remove feral species, including European honeybees, from nesting hollows.
- f. Regularly monitor important Black Cockatoo sites.
- g. Update information on the breeding biology, ecology and conservation of Black Cockatoos.

## **APPROACH – METHODS**

### Survey methodology and techniques

Between 2015 and 2019 we carried out field investigations throughout the south-west corner of Western Australia covering the entire range of Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos. This included some targeted surveys for breeding, feeding and roosting sites in important regions including the Swan Coastal Plain (especially the southern plain), the mid-western wheatbelt, and the Perth Hills.

Birds were located by stopping at regular intervals along the road network to listen for calls and search for signs of feeding activity such as chewed Marri nuts and evidence of cockatoo grubbing for insects. Birds were also recorded opportunistically. We also recorded the number of activities of all birds sighted, i.e. feeding, flight direction and breeding calls. The locality of all sightings was made with a GPS unit and the date, time of day and habitat details were also noted (including forest type, e.g. Karri *Eucalyptus diversicolor*, Jarrah *Eucalyptus marginata*-Marri *Corymbia calophylla*, Wandoo *Eucalyptus wandoo* and *Banksia* woodlands).

A number of roost sites used by cockatoos are being monitored especially a number used by Baudin's Cockatoos during the autumn-winter non-breeding season as these give a good indication of the health of the population. Most roosts are located by following the birds returning to the roost in the evening or by listening for the calls of large numbers of birds at dawn on windless mornings when their high-pitched calls travel greater distances. Birds were counted at roosts by locating a good position in the flight path that birds will cross, preferably with an open skyline. Counts were made at dawn and dusk which involved, where possible, the pairs, family groups and small flocks as they departed or returned. We used photographs at a number of sites to obtain accurate counts of individuals. At roost sites we also noted details of roost trees including species, height, circumference at breast height (CBH) and distance between trees. On a few occasions flocks were followed from roost sites to feeding locations in early morning and back to roost sites in late afternoon.

In most cases nests were located by ground-truthing surveys by experienced workers, combined in

many cases with observations of breeding behaviour. About 95% of nests and potential nests (i.e. hollows prospected and chewed but not used) could be located using this method. This involves following lone males suspected of breeding back to nest sites in the late evening when they would return to, or near the nest tree, and call to an incubating female. She would then leave the nest hollow to preen, feed, and be fed by the male, before returning to the nest hollow just before dark. The male would then return to the roost site. Once located, nest trees were tagged and the position recorded using a GPS. Tree data were collected firstly at ground level then, if possible and safe, climbed using aluminium extension ladders, wire cave ladders or ropes. For checking dangerous or unstable trees we used a pole camera to determine if the hollow was in use. For each nest tree we recorded tree species, circumference at breast height (CBH), tree height, height of hollow entrance above ground, position of hollow in the tree, aspect of hollow i.e. direction towards which it opens, width and height of hollow entrance, depth of hollow from lowest point of entrance to floor, maximum and minimum width of floor space, tree health scored using the Whitford Senescence Scale type or, if dead, the Whitford Stag Class (Dead Branch Order) and details of tree position in landscape, slope and surrounding vegetation type (Whitford 2002).

Trials on the use and effectiveness of artificial nest hollows have been carried out for Carnaby's Cockatoo in the mid-western wheatbelt and for the forest cockatoos at Bungendore Park, Serpentine hills, Whicher Range, Albany and Binningup. Since 2000 we have been conducting ongoing experimentation with timber nest boxes and polypipe (PE pipe) or tubes at a number of sites in the south-west. The development of artificial nest hollows that were suitable for cockatoos, but unsuitable for feral bees and invasive native competitor species *viz.* Galahs and corellas, was a high priority as was the development of protocols for the use and installation of these hollows. The installation of timber nest boxes and polytubes was done in conjunction with repairing sub-standard and damaged hollows in study areas.

Recordings of the calls of all three species were made at various sites throughout their ranges and at nest sites.

## **KEY OBJECTIVES**

Undertake targeted surveys for breeding, feeding and roosting sites to map critical breeding, feeding and roosting habitat.

Targeted surveys for breeding, feeding and roosting sites have been undertaken at a number of locations in the mid-west including Eneabba, Badgingarra, Cataby and sections of the Great Northern Highway; on the Swan Coastal Plain at sites including around Lancelin, Gingin, Bindoon, Wanneroo, Armadale, Serpentine, Mandurah, Lake Clifton, sections of the Perth-Bunbury Highway (Forrest Highway) and Capel; and in areas on or near the western edge of the Darling Scarp including east of Bindoon, Mundaring, Bedfordale, Wungong catchment, Serpentine hills and Whicher Range. In the Whicher Range area we carried out an assessment of habitat use for Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo to look at the regional and local conservation status of these species. Our main focus here was to look at species distribution, status, breeding, food, movements and historical changes within the region. Major foraging and breeding sites were mapped (see Figure 1, Figure 2 and Figure 3 in Whicher range area).

Visits were also carried out in the Margaret River, Denmark, Albany and Porongurup Range regions and throughout much of the Jarrah-Marri forest of the Darling Range.

The Swan Coastal Plain has been identified as an important region for cockatoos especially Carnaby's Cockatoo and in certain areas the Forest Red-tailed Black Cockatoo however, there has been little research carried out to determine the potential impacts of current and future urban expansion and habitat loss. Accurate mapping of both the historical and current range of these birds has assisted planners to make informed decisions and help develop a policy in relation to land usage for the future conservation of black cockatoos within the region. Transects mostly east-west across the southern Swan Coastal Plain between Byford and Harvey carried out between 2015 and 2019 have helped determine habitat use by cockatoos (especially Forest Red-tails ) in roadside verges. These

targeted surveys were to search for evidence of feeding both old and recent evidence to determine if there was a change in the status of birds during different times of the year and from year to year.

These targeted surveys between Byford and Harvey have highlighted habitat use during the year for Forest Red-tailed Black Cockatoos and also highlighted areas that had little feeding habitat. Between May and August 2015 there was very little evidence of recent foraging and indeed few sightings of birds within the region. This is in stark contrast to surveys in September–October 2015 where there was extensive evidence of birds foraging within that region. While there were still some birds observed foraging within the adjacent hills Jarrah-Marri forest there was obviously considerable movement of birds from the hills onto the coastal plain to take advantage of the extensive nutting of the Marri in these road verges. This appears to be the case and birds have continued to forage on Marri on the coastal plain throughout 2016. This study highlighted how birds used the landscape and took advantage of the extensive Marri nut crop in 2016. There was very little flowering of Marri in 2015–16.

In April and May 2017 there was an obvious decline in the number of birds feeding on Marri in northern areas surveyed (between Serpentine and Yarloop) but an increase in birds feeding on Jarrah in this region. In late May 2017 very little recent evidence of foraging was found in this area of the coastal plain and no birds were observed. This is in contrast with many birds still feeding on Marri along the western edge of the Darling Scarp (e.g. at Gobby Road and Scarp Road) during April, May and June. By July 2017 numbers of birds were again back on the coastal plain around Serpentine foraging mainly on Marri.

In 2018 there was little evidence of birds foraging on Marri throughout the study area (between Byford and Harvey) during the autumn-winter period (see Figure 4), but with a large increase in the August and October surveys (see Figure 5).

Mapping the available food resources throughout this region, over the four year period, to show how birds use the landscape (including which areas are not used) has provided valuable information for future urban planning in this region. With declining food supply in some areas of the Swan Coastal Plain there is now competition for food resources and a need for changing foraging ecology.

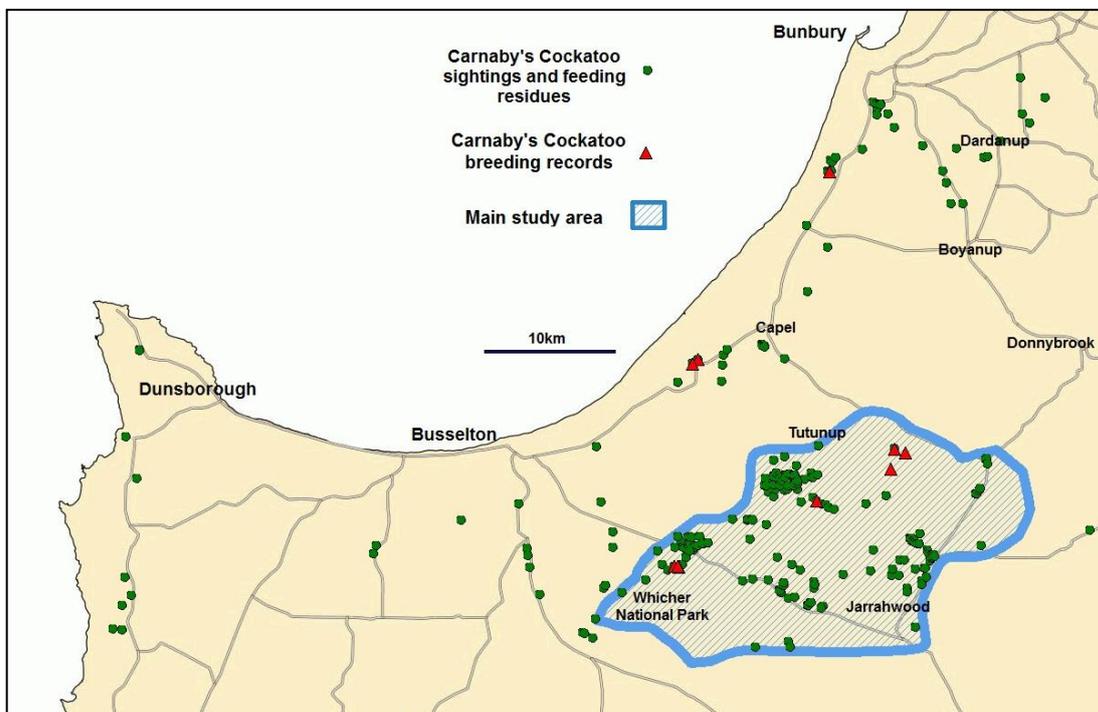


Figure 1. Regional map showing Carnaby's Cockatoo sightings and feeding residues

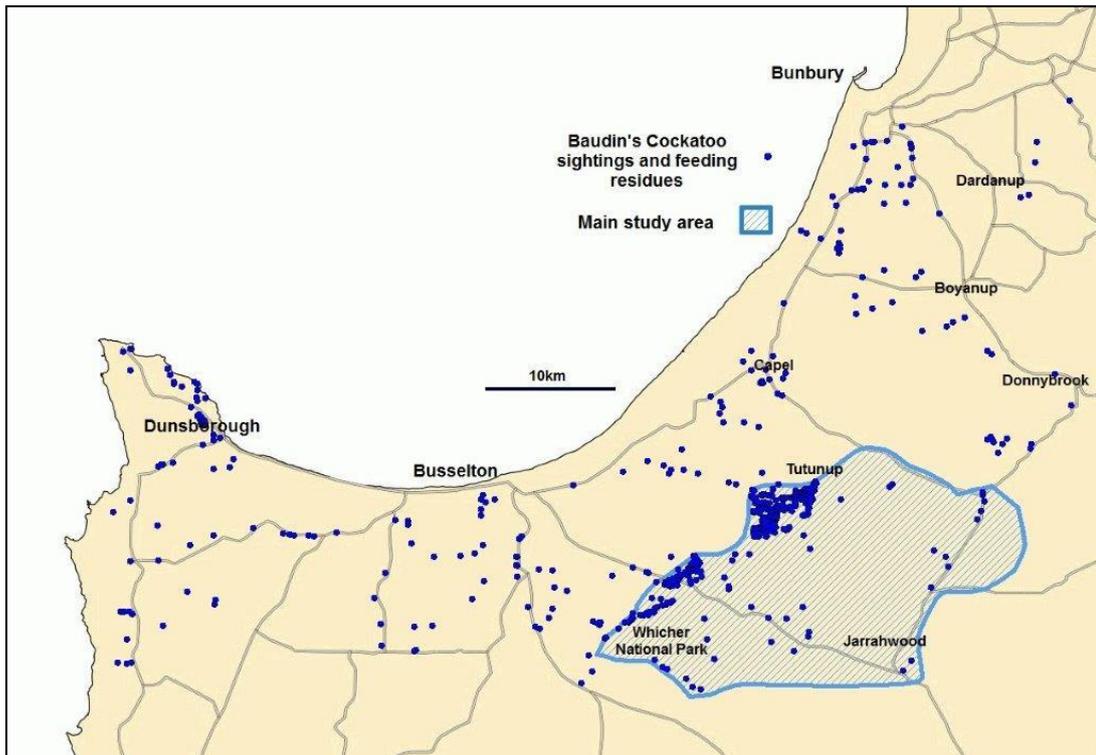


Figure 2. Regional map showing Baudin's Cockatoo sightings and feeding residues

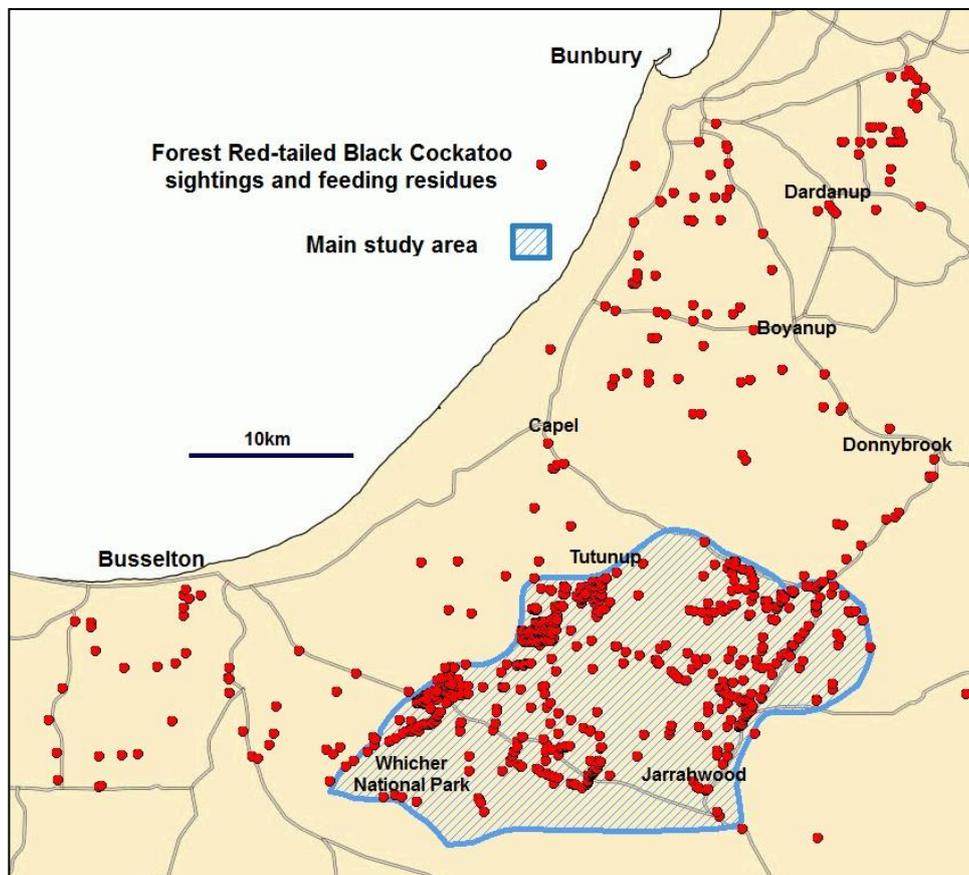


Figure 3. Regional map showing Forest Red-tailed Black Cockatoo sightings and feeding residues

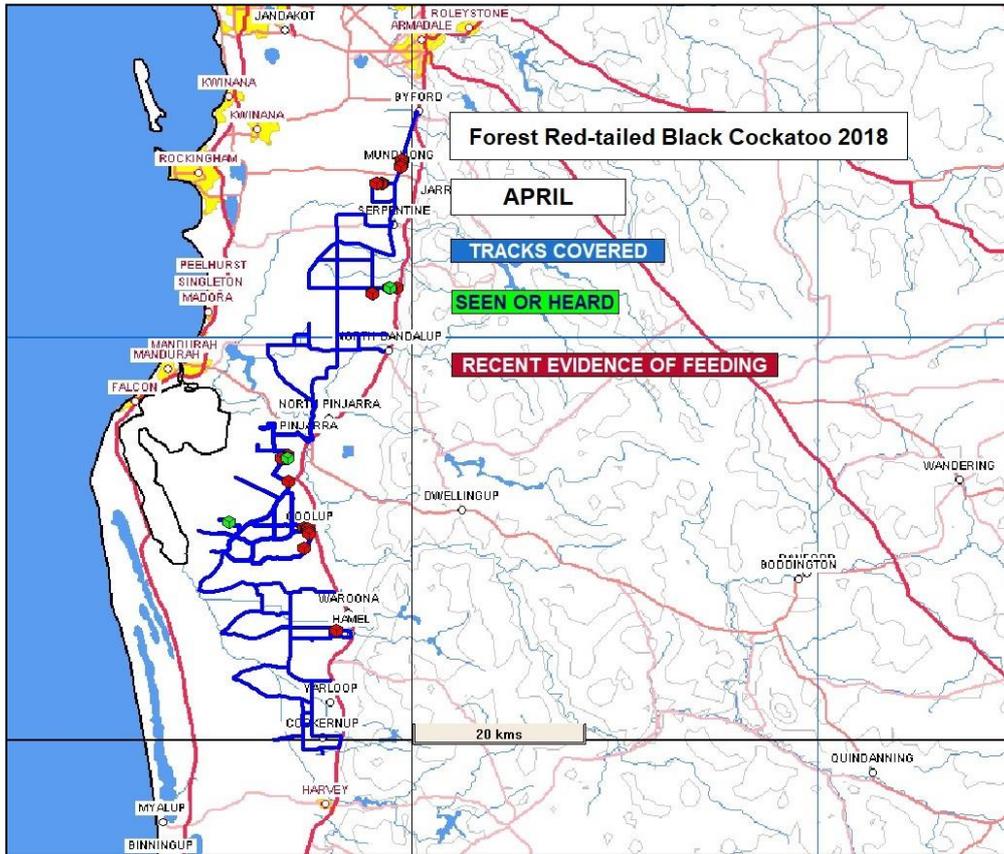


Figure 4. Transects showing recent evidence of FRTBC feeding, April 2018

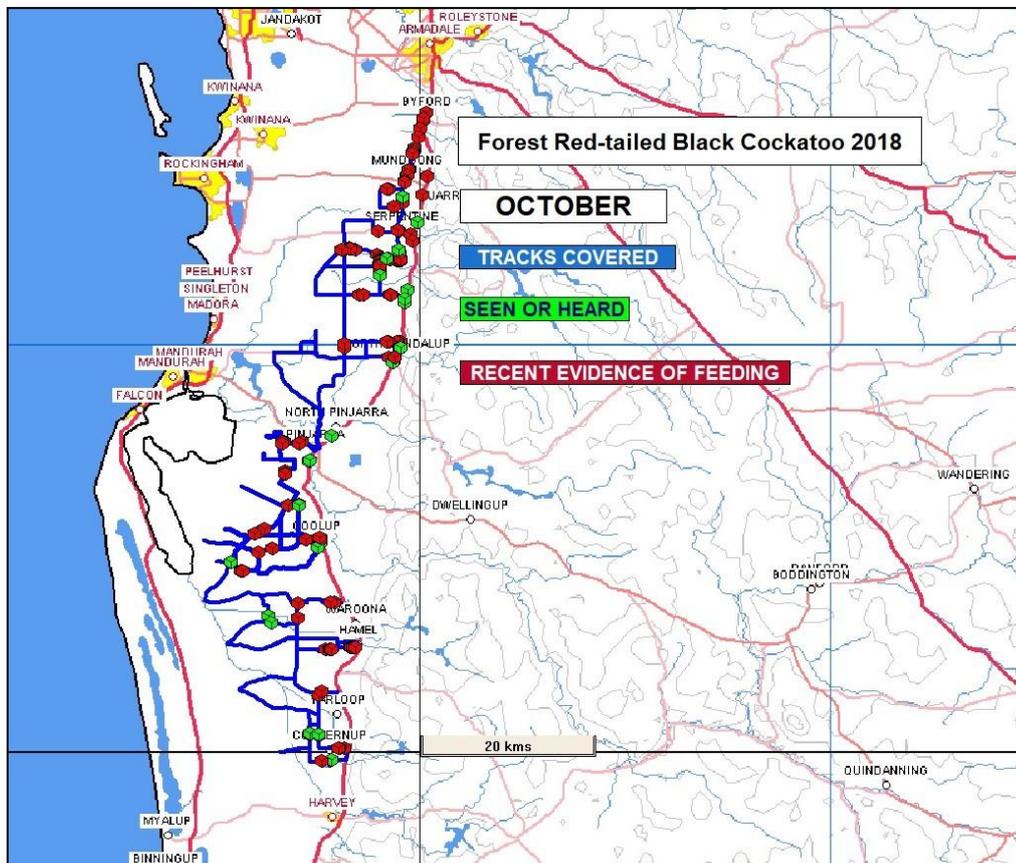


Figure 5. Transects showing recent evidence of FRTBC feeding, October 2018

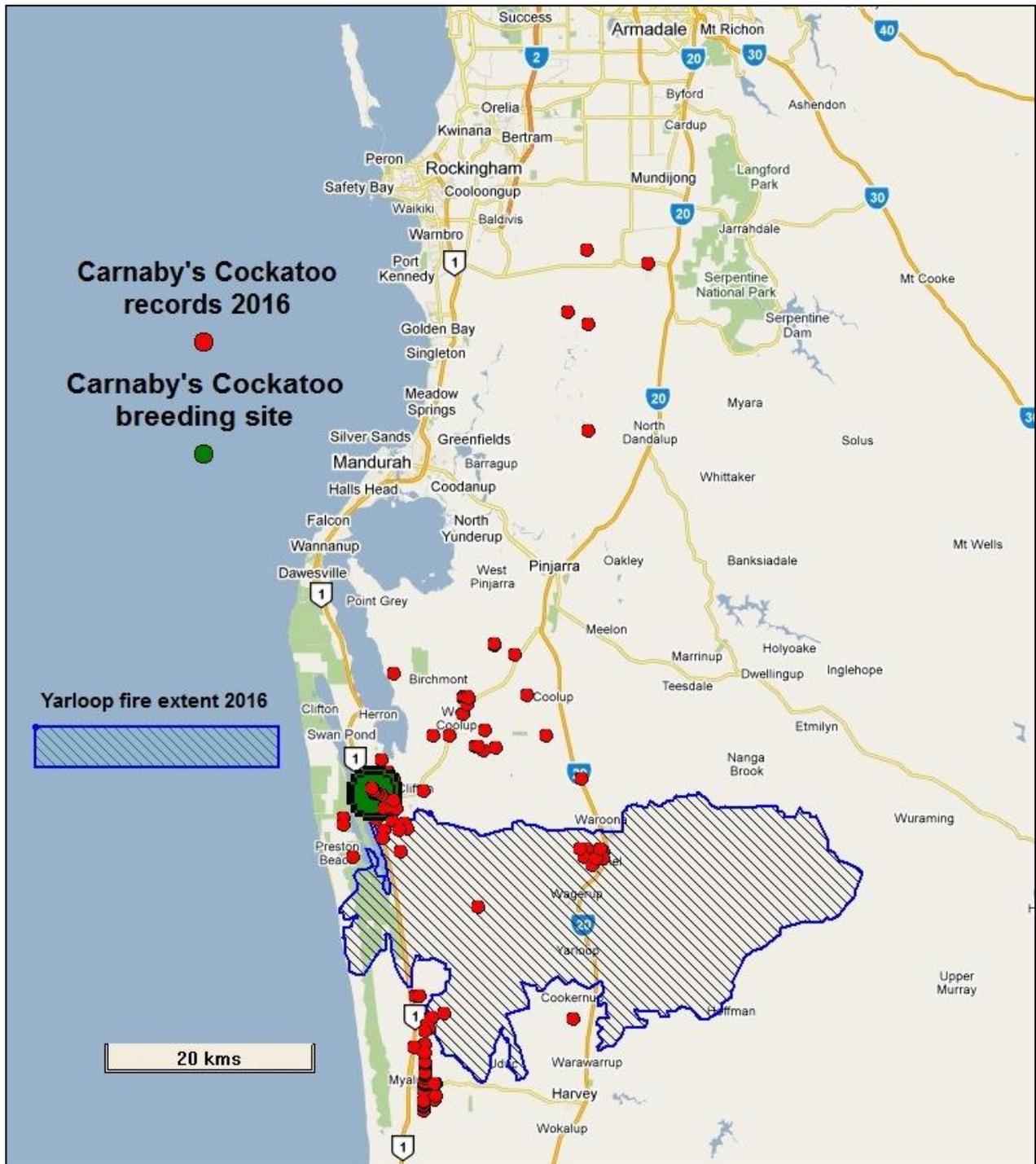


Figure 6. Locations of old and recent evidence of feeding by Carnaby's Cockatoo in 2016.

### Breeding

Aspects of our breeding biology program for each species have involved:

- Researching the breeding biology of all three species and threats to their survival.
- Documenting and monitoring nests with details of nest trees including hollow size, height and aspect of hollow, circumference of nest tree at breast height, distance apart of nests and details of local vegetation. This has provided a profile of a preferred nest site for each of the species.
- Documenting clutch size, incubation period, fledging period, breeding behaviour and movements.
- Locating nests during the breeding season and trees with nests marked, measured and photographed. Hollow characteristics also taken including entrance size, depth, facing direction and floor space.

Critical breeding habitat has been mapped for all three species.

We have also conducted targeted surveys for breeding sites in important areas of the south-west including parts of the northern Darling Range, Swan Coastal Plain (including areas around Lancelin, Gingin, Bindoon, Wanneroo, Armadale, Serpentine, Mandurah, Lake Clifton and sections of the Perth-Bunbury (Forrest) Highway and around Capel), Whicher Range, Albany-Walpole region, parts of mid-western wheatbelt (including Eneabba, Badgingarra, Cataby and sections of the Great Northern Highway) and parts of the Great Southern especially Hyden.

Noteworthy with Carnaby's Cockatoo has been the apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 30–50 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain. Important breeding sites for Carnaby's Cockatoos were located during these surveys in the Lake Clifton, Bunbury in the Whicher Range regions, in parts of the northern Jarrah-Marri forests and in parts of the mid-western wheatbelt. Judging from our surveys there is also an indication that this species is expanding its breeding range in the far south-east i.e. around Lake King and Ravensthorpe.

Baudin's Cockatoo has been recorded breeding in the deep south-west, at Walpole, Northcliffe, Mt Frankland National Park, Margaret River, Nannup, the Whicher Range and Lowden and small isolated populations in the Wungong Catchment, Gleneagle, Serpentine (hills area), Myara, Mount Solus and Collie. There are also unconfirmed breeding records from near Lake Muir, Albany and the Porongurup Range. There is very little breeding information and the breeding biology of this species is poorly known. A number of nests have been monitored as part of this study and observations on breeding behaviour, timing of nesting events, nest tree and nest hollow characteristics, clutch size, incubation period and fledging period have been obtained at nest at Myara, Mount Solus and Wungong over the past decade as well as information on diet, social organisation and migration and movements. Some nest hollows are used very irregularly, but one has been used on a regular basis in late November since 2014.



Figure 7. Forest Red-tailed Black Cockatoo nestling being banded July 2018, Bedfordale (TK).

Based on our current research, the breeding population of Baudin's Cockatoo is disjunct with most birds breeding in the deep south-west and small isolated breeding population near the northern limit of its range. Breeding recorded at Myara every year since 2015 and in Wungong in 2017.



Figure 8. Female Baudin's Cockatoo at Nest 047, 31 Mile Road.



Figure 9. Female Carnaby's Cockatoo at Nest 954, Dragon Rocks near Hyden.



Figure 10. Female FRTBC at Nest 039, Lesley.

We have continued to monitor over 130 nests of the Forest Red-tailed Black Cockatoo. Breeding has now been recorded in all months, with peaks in autumn-winter and spring with few records in January and February. Most nests are in very large and very old Marri *Corymbia calophylla* which is the most important tree throughout its range. The rate of fall or loss of nest trees is very high.

In 2018 as part of this nest monitoring, 83 Forest Red-tailed Black Cockatoo nest trees were revisited that were located in the period 1992–2008. A total of 32 trees with nest hollows were lost completely and 6 nest hollows were lost through falling limbs and fire, but the tree was still standing giving an overall loss rate of 46%. This overall loss rate of 46% per-decade has profound implications for the relative number of hollows available and for population sustainability of both Forest Red-tailed Black Cockatoos and the forest-inhabiting Baudin’s Cockatoo.

This study has highlighted the net loss of actual and potential nest trees by fire and this should be considered as a Key Threatening Process in the Jarrah-Marri forest.

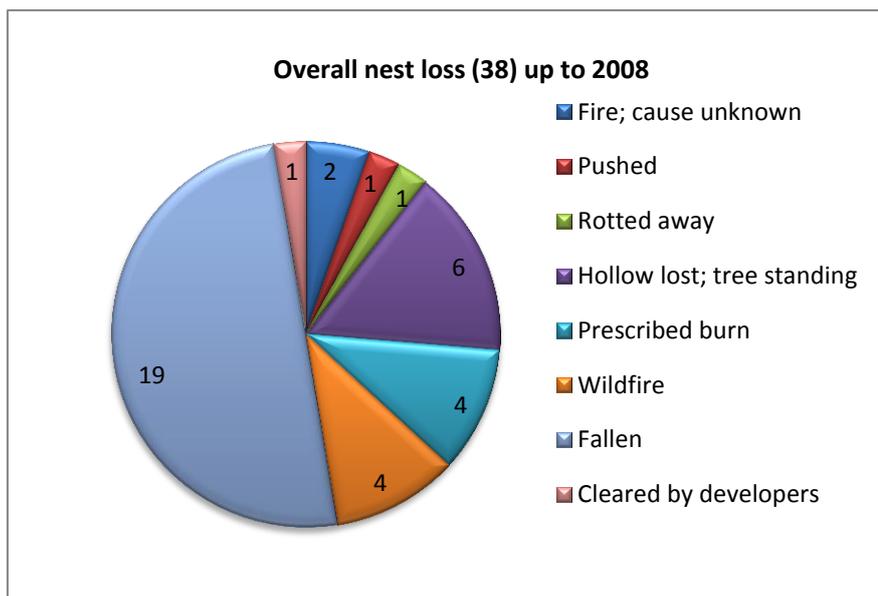


Figure 11. Overall nest loss up to year 2008



Figure 12. Roadside feeding vegetation affected by wildfire – Waroona 2016.



Figure 13. Nest tree #045 – August 2005 (L) and same tree May 2011 (R) after “biodiversity burn”.

Roosting sites

We were the first to identify the importance of roost sites for cockatoos and developed techniques for counting birds at roosts to gain information on abundance and demography. These techniques are now used by other individuals and groups such as Birds Australia (e.g. for the Great Cocky Count).

There has been a recent decline in the number of Baudin’s Cockatoos returning to traditional roost sites in the northern Darling Range during the autumn–winter period. In 2017 we provided evidence to the Department of the Environment to support the listing of Baudin’s Cockatoo for inclusion on the EPBC Act threatened species list in the Endangered category. Counts at traditional roost sites between 1998 and 2018 show a trending decline in population numbers. Based on recent surveys and roost counts, the current population size would be considerably less and further declining. Our current population estimate is between 5,000–8,000 birds.

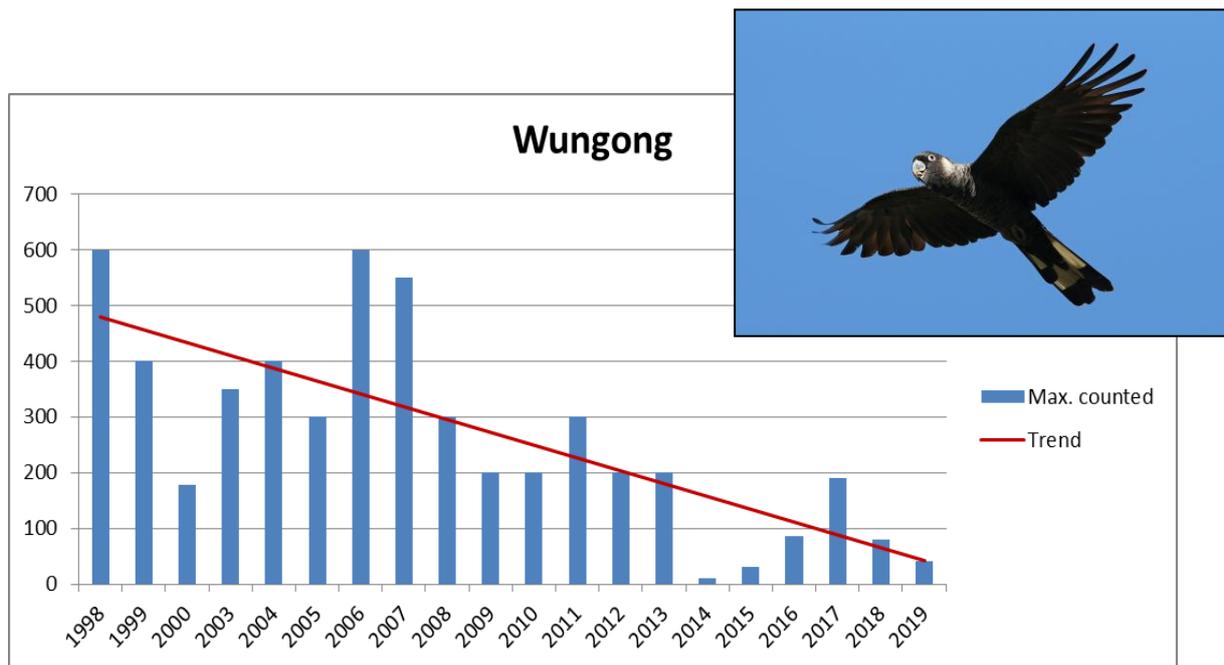


Figure 14. Roost counts of Baudin’s Cockatoo at Wungong.

Develop artificial nest hollows and protocols for their use and installation.

Trials on the use and effectiveness of artificial nest hollows for black cockatoos began in 2000 and is ongoing; the monitoring of both wooden nest boxes and PE pipe tubes has continued at a number of sites in the south-west. A scientific paper dealing with trials of nest boxes for Carnaby’s Cockatoo at Dandaragan was published in February 2015 (see Trials On The Use And Effectiveness Of Artificial Nest Hollows For Carnaby’s Cockatoo At Cataby, Western Australia, R.E. Johnstone, T. Kirkby and M. Mannion). This work clearly showed that the PE polytubes specifically designed for black cockatoos, provide an extremely effective nest hollow and improve breeding success in areas of wheatbelt where there is lack of suitable hollows due to competition with feral European honey bees and superabundant pest birds including Galahs and Corellas.

We have carried out repairs on sub-standard and damaged hollows e.g. replacing collapsed floors and fixing sidewalls for weather protection and to prevent predation.

Study on the effectiveness of artificial nest hollows for the forest species (Forest Red-tail and Baudin’s cockatoos) is continuing. In 2018, Forest Red-tailed Black Cockatoos were recorded breeding in a wooden nest box and in a PE tube at Bedforddale and young were fledged from both nests.



Figure 15. Carnaby's Cockatoo nestlings in PE tubes. Note ladder and sacrificial post.

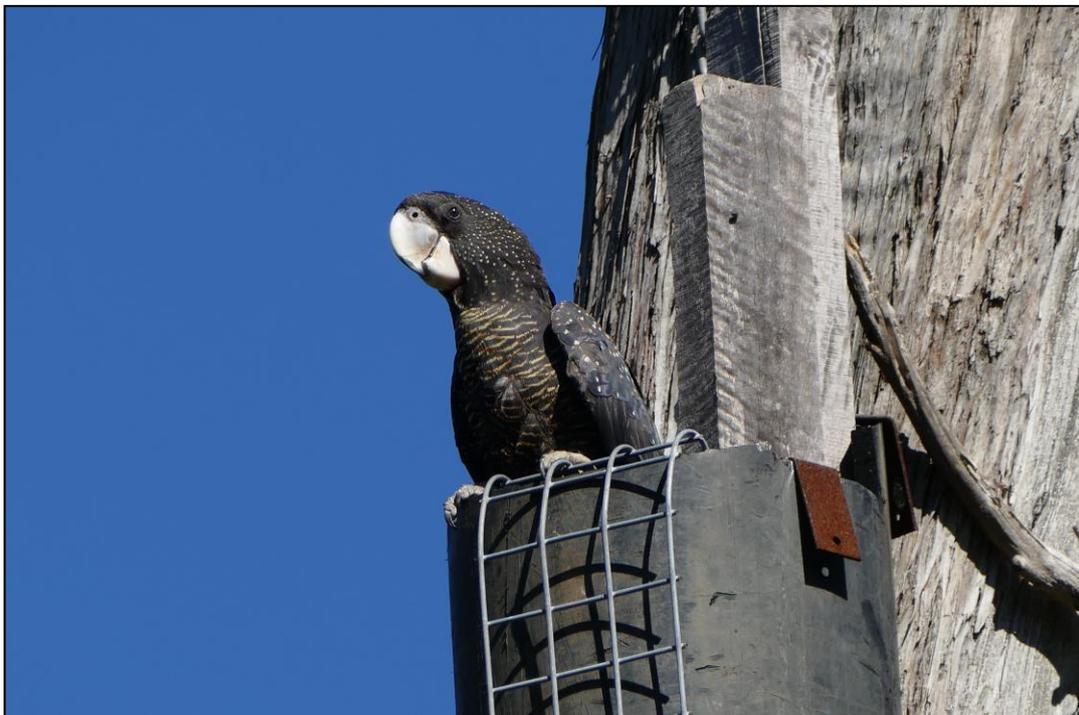


Figure 16. Female FRTBC at PE tube, Bedforddale. Note ladder and sacrificial post.

Conduct studies on current population numbers and distribution of Black Cockatoos including identifying isolated populations.

As well as our field surveys, relevant data was extracted from the extensive information held in the unpublished 'Storr-Johnstone, Western Australian Bird Data Bank' to help review and interpret existing information on black cockatoos to map past and current distributions and to review literature and data from other sources including the WA Museum collections and the Cockatoo Care Programme (contains over 18,000 records). This has enabled not only the mapping of past and current distributions of all three species and identify isolated populations and changes in status or abundance throughout their range.

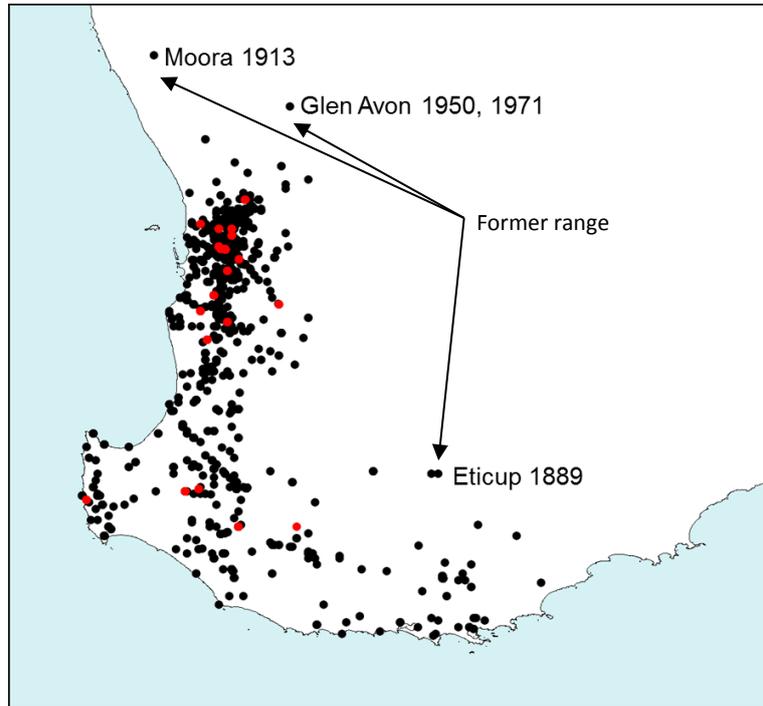


Figure 17. Distribution of FRTBC including historical records.

Judging from the historical data, there has been enormous changes in the distribution, status and relative abundance of Carnaby's Cockatoo and Baudin's Cockatoo in the past 60 years.

Rainfall has declined significantly over the entire south-west in the past 50 years, and changes in the distribution of these cockatoos is already occurring. Over the past 50 years the distribution of Carnaby's Cockatoo has shifted considerably westwards and southwards (Johnstone and Storr 1998).

Judging from the historical accounts it is clear that while the overall distribution of Carnaby's Cockatoo on the Swan Coastal Plain has not changed since the early 1900s, its relative abundance has declined greatly. Furthermore as its foraging habitat has been reduced it appears that the remnant Banksia woodlands and the remaining pines are not large enough to provide adequate food resources for the existing population. In the past 10 years there appears to be a marked increase in birds foraging in suburban gardens often on single trees and in some small remnant patches of Banksia woodland on the Swan Coastal Plain have been heavily stripped of cones and flowers and there is little or no recruitment of trees.

As part of this study we have also been able to map the expansion of some superabundant native species e.g. Galah and corellas (including the Eastern Long-billed Corella) into the south-west. These species compete for nest hollows and food with cockatoos.

Determine patterns of migration, movements and changes in foraging ecology.

The autumn-winter migration and movements of both Carnaby's cockatoo and Baudin's Cockatoo have been mapped using banding, tail marking and vast observational data (see Figure 18 and Figure 19).

As the climate warms and rainfall declines in the south-west species that currently undergo extensive movements may either shorten their migration distance or even stop migrating and remain year-round in certain rainfall zones. There appears to be a steady shift in distribution southwards and westwards of Carnaby's Cockatoo and increasing temperatures may allow a greater penetration into the western section of the forest block. If rainfall does decrease, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo could be expected to contract towards the high rainfall zones in the south-west and this appears to be happening. Other aspects of climate change could be the loss of large veteran trees (and their hollows) in parts of this region. Although we usually consider range expansion in terms of breeding populations, the establishment of a new wintering range or migration route is no doubt also important to both Carnaby's and Baudin's cockatoos, especially with destruction of feeding habitat at various stages along their migratory flyways.

Not all populations migrate during the autumn-winter. For example Carnaby's Cockatoo at Badgingarra and in the Stirling Range that are largely resident and flocks and Baudin's in Leeuwin-Naturaliste Ridge and near Manjimup that appear to remain in those areas throughout the year.

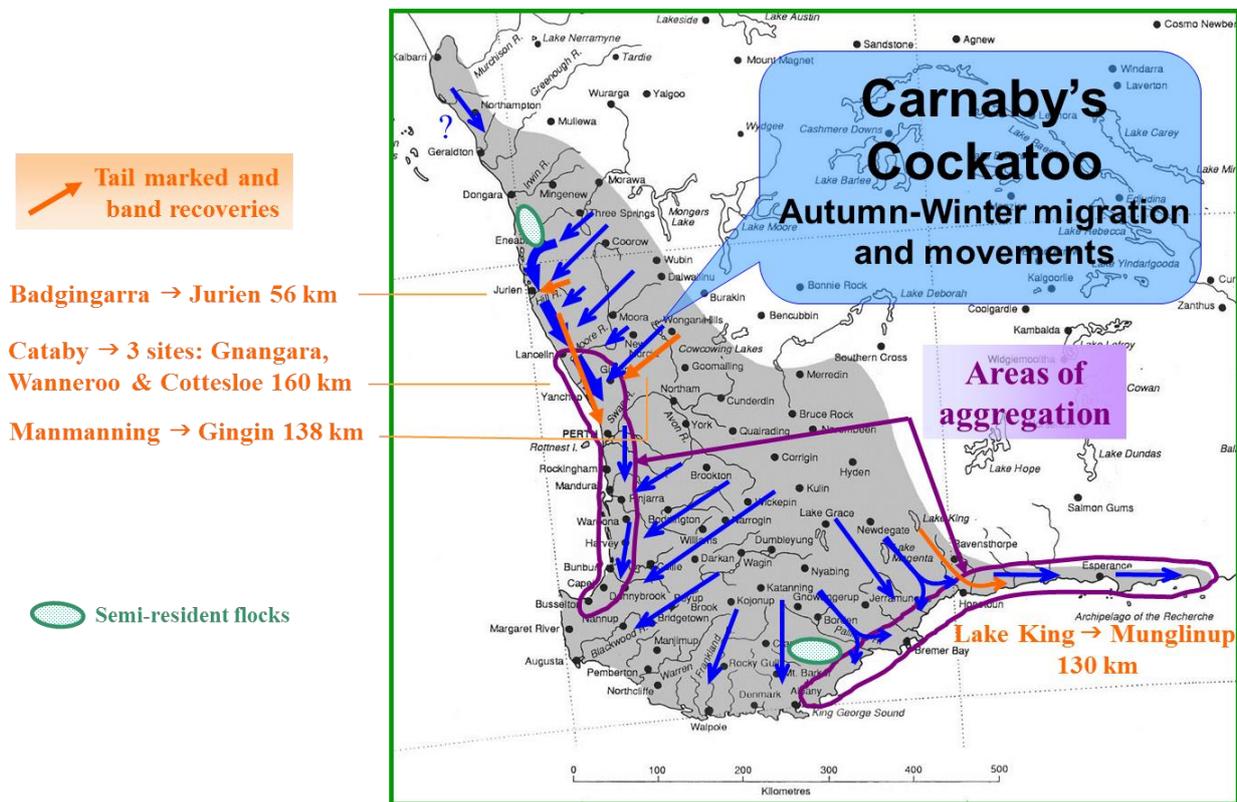


Figure 18. Migration and movements of Carnaby's Cockatoo.

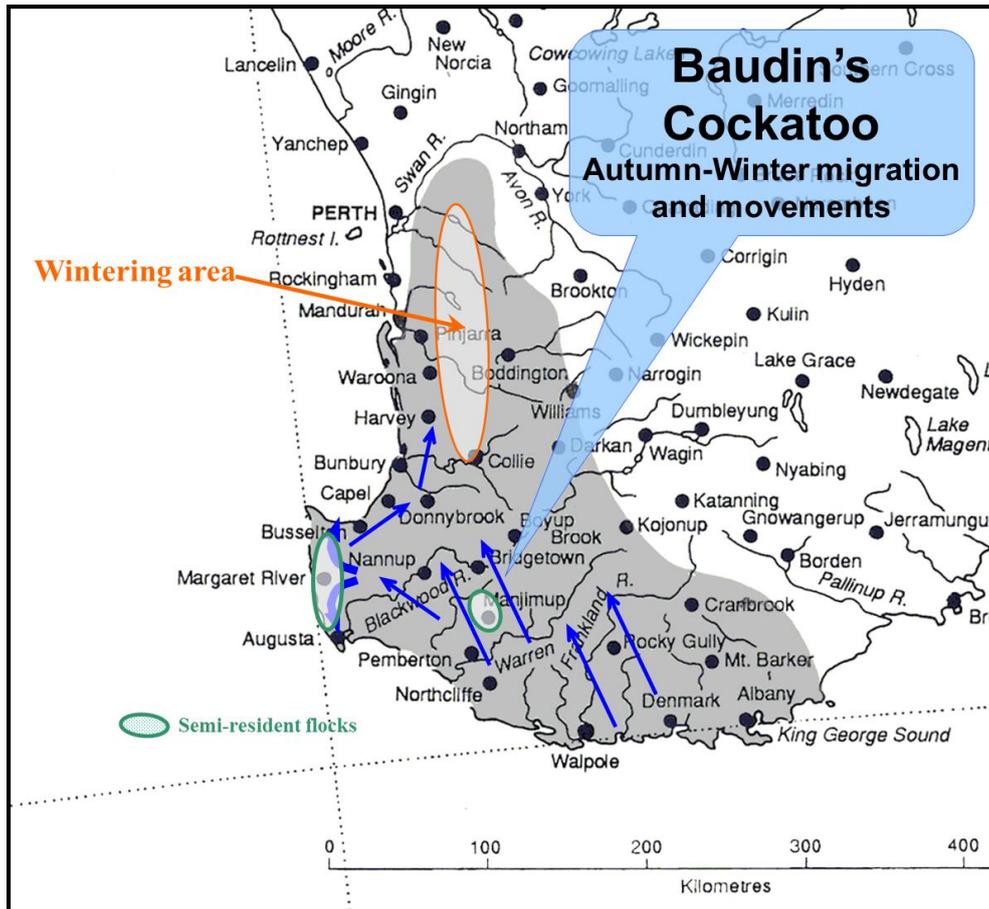


Figure 19. Migration and movements of Baudin's Cockatoo.

There has also been a dramatic change in the foraging ecology of Forest Red-tailed Black Cockatoos in the Perth region in the past 20 years with birds foraging west onto the Swan Coastal Plain and east into the wheatbelt.

The foraging ecology of some populations of Forest Red-tail Black Cockatoo in the northern Jarrah-Marri forest in recent times has meant that flocks that were largely sedentary have now developed regular movements onto the Swan Coastal Plain and in some places established new roost sites and breeding sites. This has led to an erroneous impression in the Perth region that this subspecies is expanding its range and increasing in abundance. This movement has been facilitated by their discovery of Cape Lilac (*Melia azedarach*) as a new food source.

This has implications for this population that has developed a dependence on this introduced food and it may well be an ecological trap that will impact on their breeding biology. Almost no birds were recorded breeding in 2016, perhaps a result of food quality rather than quantity, or the result of the energy required with extensive movements to and from foraging sites.



Figure 20. Immature male feeding on Cape Lilac (KL).

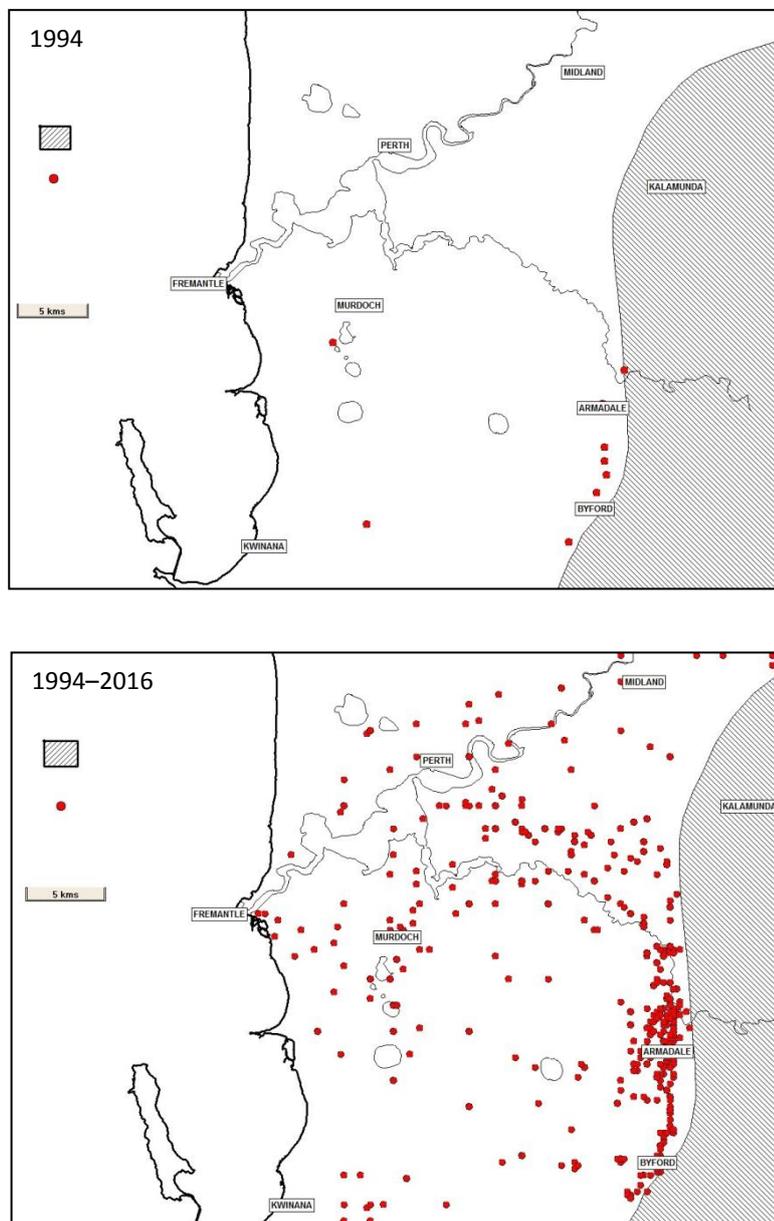


Figure 21. Records of foraging expansion on to the Swan Coastal Plain from 1994 to 2016.

Develop and implement ways to remove feral species, including European honeybees, from nesting hollows.

Apart from the dwindling supply of nest hollows in the urban, agricultural and forest landscapes, cockatoos and other hollow users must also compete with the introduced European honeybee and with invading superabundant species including Galahs and corellas. Our studies have revealed the devastating impact feral European honeybees are having on cockatoos and other obligate hollow-nesting fauna. In a number of cockatoo study sites in the south-west, up to 50% of nest hollows have been lost to feral European honeybees.

Trials on the use and effectiveness of artificial nest hollows for black cockatoos began in 1990s and is ongoing and monitoring both wooden nest boxes and PE tubes has continued at a number of sites in the south-west. The development of artificial nest hollows that were suitable for cockatoos, but unsuitable for feral bees and invasive native competitor species has been a high priority as was the development of protocols for the use and installation of these hollows. This work has clearly showed that the PE polytubes, specifically designed for black cockatoos, provide an extremely effective nest hollow and improve breeding success especially in areas of the wheatbelt where there is a lack of suitable hollows due to competition with feral bees, superabundant pest birds or the impact of fire. Study on the effectiveness of these artificial hollows for the forest species Forest Red-tailed Black Cockatoo and Baudin's Cockatoo is continuing. Recently there has been some success of Forest Red-tailed Black Cockatoos using PE tubes in the Armadale hills, Mundaring, Murdoch and Mandurah.

Regularly monitor important Black Cockatoo sites.

Data generated from this project has been used by State and Federal Government agencies especially information on distribution, status, movements and important habitats to enable the conservation of critical areas.

Regular monitoring of Baudin's Cockatoos at traditional roost sites between 1998 and 2018 and regular surveys throughout the south-west has enabled us to provide evidence to the Department of the Environment to upgrade the conservation status of Baudin's Cockatoo from Vulnerable to Endangered.

Regular monitoring of nest sites has provided information on the timing of nesting events and providing details of nest trees, distance apart of nests, fledging success and details of local vegetation. This will help provide a profile of a preferred nest site.

Monitoring areas in southern wheatbelt in which Carnaby's Cockatoo no longer exist that contain suitable breeding habitat of Salmon Gum and Wandoo, but lack suitable foraging habitat viz. around Corrigin, Kondinin, Kalgarin and Hyden regions.

Update information on the breeding biology, ecology and conservation of Black Cockatoos.

As part of this project, three important studies are in progress; one on the distribution, status, movements and diet of the Forest Red-tailed Black Cockatoo in the south-west with emphasis on the greater Perth region (see Johnstone, Kirkby and Sarti 2017); another dealing with cockatoos on the southern Swan Coastal Plain and the third dealing with the breeding biology of Baudin's Cockatoo.

## **MAJOR OUTCOMES AND ACHIEVEMENTS OVER THE PAST FIVE YEARS**

The major achievements of this project include:

1. Reassessing the status of Baudin's Cockatoo. Following our conservation advice to the Department of the Environment and Energy – Baudin's Cockatoo had its status transferred from the **Vulnerable** category to the **Endangered** category in February 2018.
2. Documenting and mapping the changing foraging ecology of many Forest red-tailed black Cockatoos in the northern Darling Range west onto the Swan Coastal Plain and east into the wheat belt. Over the past 20 years the foraging ecology of some populations in the northern Jarrah-Marri forest has changed with flocks that were once largely sedentary have now developed regular movements onto the Swan Coastal Plain and in some places established new roost sites and breeding sites. This movement has led to an erroneous impression in the Perth region that this subspecies is expanding its range and increasing in abundance. Furthermore, the

altered foraging behaviour has led to changes in distribution and roosting patterns that appear to influence breeding success. In 2016 almost no Forest Red-tailed Black Cockatoo were recorded breeding at any of our study sites and no juveniles were recorded in the northern Jarrah forest or on the Swan Coastal Plain. This indicates that this population may be at greater risk than originally thought (see Johnstone, Kirkby and Sarti 2017).

3. Identifying and monitoring Baudin's Cockatoo breeding sites in northern Jarrah-Marri forest. Now a much better understanding of breeding sites, timing of breeding events and breeding biology in this area.
4. Prioritising targeted surveys on southern Swan Coastal Plain (Perth-Peel region) to determine habitat use (study of food resources) by cockatoos especially Forest Red-tailed Black Cockatoos in roadside verges.
5. Data generated from this program used by State and federal government agencies especially information on distribution, status, movements and important habitats to enable the conservation of critical areas.
6. Analysing nest tree mortality. Monitoring nest hollows. The Jarrah-Marri forests of south-western Western Australia occupy about 1.6 million hectares (Whitford and Williams 2001). Logging of these forests since the 1860s has preferentially removed the larger trees that are most likely to provide nesting hollows suitable for Forest Red-tailed Black Cockatoo and Baudin's Cockatoo. Tree hollows tend to occur in mature, senescent and dead (stag) trees and the useful habitat life of these trees is limited by natural factors such as fire, decay, wind throw or storm damage and purposeful destruction by further clearing. Of the 53 trees revisited in 2018 that were located in the period 1992–2003, a total of 25 trees with nest hollows were lost completely and 4 nest hollows were lost through falling limbs and fire, but the tree was still standing giving an overall loss of 29 trees giving a loss rate of 54.7%. This highlights the fact that managing fire in a way that maintains habitat resources for hollow dependent cockatoos requires further detailed research on the impact of fire (both wildfire and control burns), but not the status quo.
7. Identifying fire as major threat. Fire is obviously the major cause of tree fall of actual nest trees and of future or potential nest trees and hence the retention of the right type and number of hollow-bearing trees is essential to prevent the rapid collapse of hollow-bearing trees in the Jarrah-Marri forest.  

The continuing net loss of actual and potential nest trees by fire should be considered as a Key Threatening Process in the Jarrah-Marri forest.
8. Evaluating differences in contact Calls. Early in 2015 we began to analyse the vocalisations of both Baudin's and Carnaby's Cockatoos. From these it was evident that Baudin's Cockatoo has a much shorter contact call compared to Carnaby's Cockatoo. Furthermore there are distinct differences between male and female contact calls of Baudin's Cockatoo in contrast to the contact calls of Carnaby's Cockatoo where both male and female contact calls are identical (see Contact Calls of Baudin's Cockatoo *Calyptorhynchus baudinii*, R. E. Johnstone and T. Kirkby, 2015). This work has important implications in showing that Baudin's Cockatoo and Carnaby's Cockatoo are indeed separate species and must be managed as separate entities. As part of this project, further study on cockatoo vocalisations continued throughout 2018.
9. Implementing broad scale surveys. Surveys over the past five years have highlighted the importance of: parts of the southern Swan Coastal Plain, Bindoon region, Wungong Catchment, Serpentine hills, Whicher Range area, Frankland National Park and Hyden region.
10. Developing a food library, photographic library and audio library (including regional dialects) for all three species.
11. Mapping the expansion of some super abundant native species e.g. Galah, Rainbow Lorikeet, and corellas into the south-west. These species compete for hollows and food with cockatoos.
12. Publicising and raising awareness of the status and conservation needs of these birds through information sheets, scientific papers and seminars (see Figure 23).

13. Development by Tony Kirkby of a pole camera for monitoring nest hollows. In 2012 he observed window cleaners using an 18 m pole to clean windows in the United Kingdom. We also developed a method of measuring nest hollow depth and width using the same poles.

14. Baudin's Cockatoo was named in 1832 by the famous English artist and poet Edward Lear in 1832. Unfortunately Lear's painting gave no description, measurements or locality data and the whereabouts of the type (reference) specimen was a mystery, assumed lost.

Lear's illustration was assumed by cockatoo researchers to be the long-billed form, and looking at the drawing it appears that way. The other white-tail, Carnaby's Cockatoo *Calyptorhynchus latirostris*, was described by Ivan Carnaby from WA in 1948 and it differed from Baudin's in its short heavy bill and call. The "lost" specimen used by Lear was recently rediscovered in the National Museums Liverpool and to our amazement it was the short-billed Carnaby's Cockatoo. This proved a dilemma as to how we could conserve the long-established names of *baudinii* for the long-billed Baudin's Cockatoo and maintain *latirostris* as the valid name for Carnaby's Cockatoo. The scientific solution was to have the holotype of *baudinii* Lear, set aside and replaced with a neotype of a specimen of Baudin's Cockatoo so as not to destabilise long-established names. A scientific paper was prepared for the Bulletin of Zoological Nomenclature that was published in September 2014.

This highlights the value of collaborative research on an international level involving researchers in Australia, United Kingdom, France and the United States and also the value of museum specimens, both old and new, in resolving biodiversity questions.



Figure 22. Neotype of Baudin's Cockatoo, specimen A11524 Western Australian Museum.

## ACKNOWLEDGEMENTS

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### Information Sheet

## Baudin's Cockatoo

*Calyptorhynchus baudinii*



Male (left), Female (right)



Adult male



Adult female

**Other names:**  
Baudin's Black Cockatoo and Long-billed Black Cockatoo. Named in honour of French explorer Nicolas Baudin (1754–1803).

**Threatened Status:**  
"Listed Endangered: Schedule 1 – Western Australian Wildlife Conservation Act".  
"Endangered: under Federal Environmental Protection and Biodiversity Conservation Act".

Scarce to moderately common (most numerous in deep southwest). Mainly in flocks (up to 300), occasionally larger aggregations (up to 1200) at roosts. It has declined in the last 50 years, its low rate of reproduction (0.6 chick per year) precluding it from replacing the large numbers shot by orchardists.

**Description:**  
Length 50–60 cm. Weight 560–770 g.  
Upper bill narrower and longer than Carnaby's Cockatoo.  
**Adult male:** mostly brownish black, the feathers edged with dusky white giving a scalloped appearance; ear coverts dusky white; white band towards tip of tail, broken in middle; bill black; bare skin around eye pink.  
**Female:** like male but differs in having the ear coverts a brighter yellowish white; bill greyish with dark tip and eye skin grey.

**Call:**  
A short "whicker whicker" and "bunyip bunyip" flock call. Breeding call a repeated low "arr" followed by a high-pitched whistle.

**Breeding:**  
Nesting in hollows of Karri, Marri, Wandoo and Bullich trees. Eggs laid in August–December; clutch 1–2 (only one young reared) and only the female incubates and broods the chick.

**Life span:** 25–50 years.

**Distribution:**  
Occurs in south-western humid and subhumid zones, north to Gidgegannup, east to Clackline, Wandering, Guindanning, the Perup River, Lake Muir and King River, and west to eastern strip of Swan Coastal Plain including West Midland, Gosnells, Byford, North Dandalup, Yarloop, Wokalup and Bunbury also the Stirling and Porongurup Ranges and along the south coast to Waychinicup National Park. It is endemic to Western Australia.

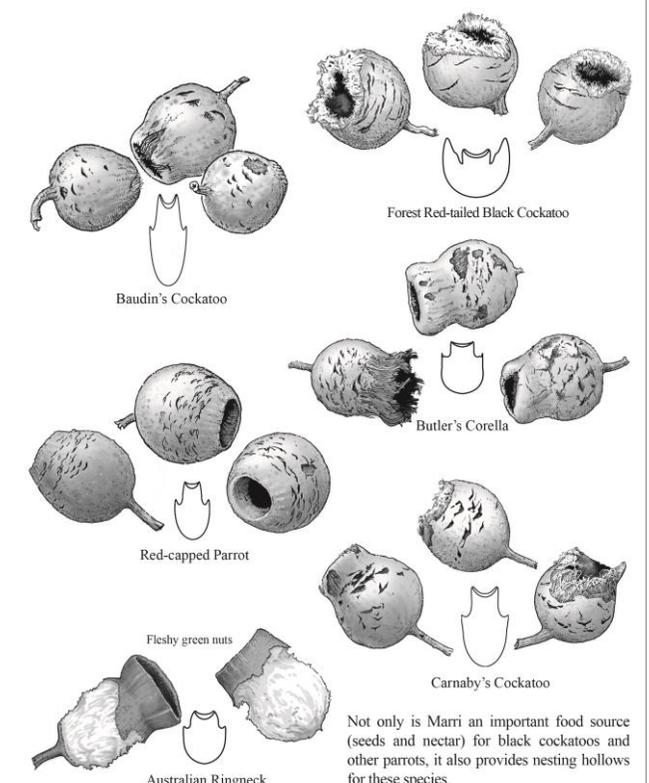
**Habitat and food:**  
Southern eucalypt forests of mainly Jarrah, Marri and Karri. Feeds on seeds of eucalypts, Banksia, Hakea and fruiting apples and pears. Also nectar, buds and flowers and strips bark from dead trees in search of beetle larvae. Forages at all levels from canopy to ground.

				
<p>à long bec. ur français Nicolas</p> <p>australien Wildlife tection and</p> <p>aux dans l'extrême 300), parfois en plus ur nombre; a décliné ble de reproduction e grand nombre</p> <p>celui du Cacaotès</p> <p>les plumes sont re festonnée; les e bande blanche vers noir, la peau nue</p> <p>auriculaires d'un e bout foncé et la</p> <p>bunyip bunyip". Le cri ivi par un sifflement</p> <p>arbres Karri, Marri, écembre; 1–2 œufs melle couve l'oisillon.</p> <p>humides du Sud- usqu'à Clackline, au lac de Muir et à la st de la plaine littorale osnells, Byford, et les chaînes du jusqu'au parc l'Australie</p>	<p>(1754–1803)에서</p> <p>입", 조립". 장 공부). 주프 (약 의 1200 개체까지) 년 동안 계속해서 새끼(1년)로 인해</p> <p>붉은 희백색으로 희백색이다; 꼬리 갈아져있다; 부리는 다. 은 노랑빛을 띄는 테두리의 피부는</p> <p>부리를 부른다; 고 높은 음조의</p> <p>영 나무들의 구멍에 남는데 만 칸 다.</p> <p>은 북쪽의 Janning, the Perup Midland, Gosnells, Bunbury 등 고 the Stirling 파 ional Park 등</p>	<p>Pico Largo. Baudin (1754 a</p> <p>de Conservación</p> <p>Ambiental y</p> <p>en el suroeste te vez en en dormitorios. sa de stutur el gran</p> <p>lúa Carnaby. jordes oscuros osuro blanco; edio; pico negro;</p> <p>s coberteras de eco con la punta</p> <p>ada de bandaada. un silbido</p> <p>Bullich. Los –2 (sólo un pollo.</p> <p>al sur-oeste, del to, y, y al oeste con do West op. Wokalup y p y a lo largo de s endémico de</p> <p>g Jarrah, Marri y s, Hakea y las</p>	<p>aketoe. Baudin (1754</p> <p>t Australisch</p> <p>cherming en</p> <p>onder in het rotore. riomen in de iken per jaar ote aantallen</p> <p>an de Carnab</p> <p>te veren rand verborgen gebroken in t in. il dat de oren ge snavel me</p> <p>te roep. De pa een hoge fluit.</p> <p>Bullich bomen (alleen een jo uit en brengt h</p> <p>ge gebieden. t ne, Wandering River, en ten lain inclusief V p. Wokalup en lans de zuid in West Austr</p>	

### Information sheets (as PDFs) translated into numerous languages.

Available on the Cockatoo Care website

### Identification of chewed Marri nuts eaten by cockatoos and parrots with an end-on view of lower mandible of each species



Not only is Marri an important food source (seeds and nectar) for black cockatoos and other parrots, it also provides nesting hollows for these species.

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