

Carnaby's Cockatoo *Calyptorhynchus latirostris* in the Eneabba Region



CARNABY'S COCKATOO *CALYPTORHYNCHUS LATIROSTRIS* IN THE ENEABBA REGION

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SPECIES BACKGROUND INFORMATION

Carnaby's Cockatoo *Calyptorhynchus latirostris* (subgenus *Zanda*)

Carnaby's Cockatoo is listed as Schedule 1 (Endangered) under the Western Australian Wildlife Conservation Act, and the EPBC Act.

Distribution

Endemic to the south-west of Western Australia north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noogar (Moorine Rock), Lake Cronin, Hatters Hill, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Coodingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

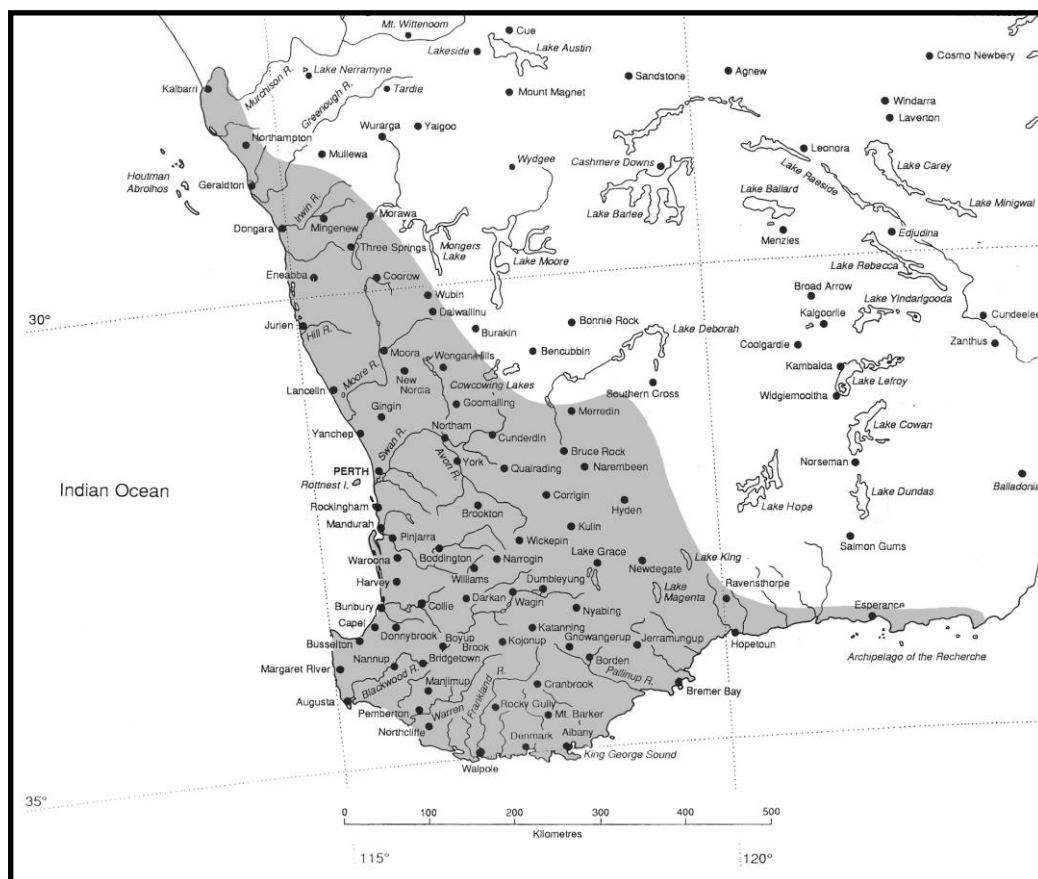


Figure 1. Distribution map of Carnaby's Cockatoo

Status

This species is a postnuptial nomad, tending to move west after breeding. For example; most birds breeding in Badgingarra, Dandaragan and Moora region tend to move west after breeding into higher rainfall areas especially the near-coastal *Banksia* scrubs e.g. at Wanagarren Nature Reserve, Nilgen Nature Reserve and Yanchep area, then many of these move further south on the Swan Coastal Plain to areas such as Neerabup, Gnangarra, Wanneroo, Burns Beach and including the Perth metropolitan area.

It is uncommon to common in the subhumid zone and wetter parts of the semiarid zone, scarce and patchily distributed in the drier parts of its range (north of Arrowsmith Lake and east of Marchagee, New Norcia, Toodyay, Tarin Rock and Lake Magenta) and scarce to moderately common in deep south-west (south of Margaret River, Nannup and Bridgetown and east of Albany).

Usually occur in pairs or small flocks, also large flocks (up to 10,000) in non-breeding season (late spring to mid-winter), especially at *Banksia* scrubs and pine plantations on the northern Swan Coastal Plain. Because of the large-scale post-war clearing of semiarid sandplains, this species has declined in much of the wheatbelt. There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 10–40 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain.

Preferred Habitat and Food

Generally, favours proteaceous scrubs and heaths and adjacent woodlands and forests, this species has also adapted to feeding on plantations of *Pinus* spp. which were introduced in the early 1930s. They have been observed feeding on a wide range of foods including seeding *Banksia*, *Dryandra*, *Corymbia*, *Eucalyptus*, *Hakea*, *Grevillea*, *Lambertia*, *Melaleuca*, *Pinus*, *Callitris*, *Jacaranda*, *Helianthus*, *Macadamia*, *Prunus*, *Liquidambar*, *Mesomelaena*, *Citrullus* and *Erodium*; also flower buds, flowers and nectar of *Banksia*, *Callistemon*, *Corymbia*, *Dryandra*, *Eucalyptus*, *Grevillea* and *Protea*, and insect larvae and insects from under bark and from wood of live or dead trees and shrubs. Also farmlands, especially with crops of Canola and weeds including storksbill.

Roost sites include stands of River Gums, Flat-topped Yates, exotic eucalypts and pines.

Breeding

Breeding is recorded from early July to mid-December. Mainly in semiarid and subhumid interior from the lower Murchison, Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regans Ford, Gingin, Yanchep, Serpentine, Mandurah, Lake Clifton, Bunbury, Nannup and Tone River and east to Manmanning, Kellerberrin, Woolundra, Lake Cronin, Hatters Hill and near Ravensthorpe (Storr–Johnstone Bird Data Bank). There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past thirty years in the Darling Range and Tuart forests of the Swan Coastal Plain.

Breeding Requirements

Carnaby's Cockatoo display strong pair bonds and mate for life. They nest in hollows of smooth-barked eucalypts especially Salmon Gum *Eucalyptus salmonophloia* and

Wandoo *Eucalyptus wandoo* but nests have also been found in other eucalypts including York Gum *Eucalyptus loxophleba*, Flooded Gum *Eucalyptus rudis*, Tuart *Eucalyptus gomphocephala* and the rough-barked Marri *Corymbia calophylla*. On the Swan Coastal Plain most nests are in Tuart.

In the central wheatbelt, Three Springs, Watheroo, Badgingarra and Dandaragan region, pairs begin to move back to their breeding sites in September-October (some as late as mid-November) and begin renovating or looking for a suitable nest hollow. Eggs are laid on a mat of wood chips at the bottom of a large hollow (mostly top entry hollows) ranging from a few centimetres to 5 m deep; clutch 1-2 (mostly two but only one young rarely two reared). Incubation lasts 29 days and only the female incubates and broods. The nestling is brooded by the female during which time both rely on the male for food. The female then leaves the nest each day at dawn, sometimes returning mid-morning (with the male) to feed the chick. After about 2-3 weeks she ceases to brood, and the chick is fed by one or both parents in the morning and late evening. Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick.

Social Organisation, Flocking and Migration and Movements

Most breeding in the northern wheatbelt is completed by the end of January or early February and family groups begin to move west towards the coast and amalgamate into larger foraging flocks on the northern section of the Swan Coastal Plain. During the late summer and autumn-winter period (February, March, April and occasionally into May) large transit flocks forage in *Banksia* or *Kwongan* heaths and *Pinus* plantations on the Swan Coastal Plain, especially between Lancelin and Perth. During February, March, April and occasionally lingering into May-June, large transit flocks forage at major food sources including *Banksia* or *Kwongan* heaths and *Pinus* plantations in the Jurien Bay area and on the northern Swan Coastal Plain, the reverse movement of transient birds returning to their wheatbelt breeding quarters is evident in July, August and September.

However, there are some exceptions to this westward and southward yearly movement. For example, tracking data has shown post-breeding movement from Cataby to as far north as Dongara and the Chapman Valley (approximately 290 km) in late March-April. Additionally, a flock of 300–400 birds (including adult and juvenile) remain during the autumn-winter period in the Eneabba area – see Figure 3. These birds roost in tall river gums in and around the township and forage in both remnant native vegetation and adjacent farmlands.

Judging from the few banding recoveries and tail marked birds there is a strong movement of birds from the northern wheatbelt west and south onto the coastal plain. For example a female banded at a breeding site at Manmanning on 1 December 1971, was shot near Gingin on 27 February 1972 (a distance of 138 km WSW); a bird banded at Badgingarra on 15 November 1970 was hit by a car near Jurien Bay on 21 April 1973 (a distance 56 km WNW); and three tail-marked chicks from Cataby were recorded in the Perth region (Gnangarra pine plantation, at Wanneroo and at Cottesloe, a distance of approximately 160 km SSW from their fledging site).

The latter tail marking study provided valuable information on the migration pathway of birds from the central wheatbelt west and south onto the Swan Coastal Plain.

Of interest also was a female tagged and tracked from Cataby to Chapman Valley. On 2 March 2023 she was at Cataby, on 5 March 30 km north of Geraldton, and by 6 March 2023, had relocated 250 km north of Cataby to the Chapman Valley. A flock

of about 150–170 was estimated at the Chapman valley autumn roost on 26 April 2023 (Z. Kissane pers. comm). This northward movement is unusual for mid-west populations, with most birds in the past moving south-west onto the Swan Coastal Plain in autumn-winter.

Judging from recent surveys there is a proportion of populations in the mid-west that are becoming more sedentary, and remaining in or near their breeding area post breeding.



Figure 2. Female Carnaby's Cockatoo at a nest hollow

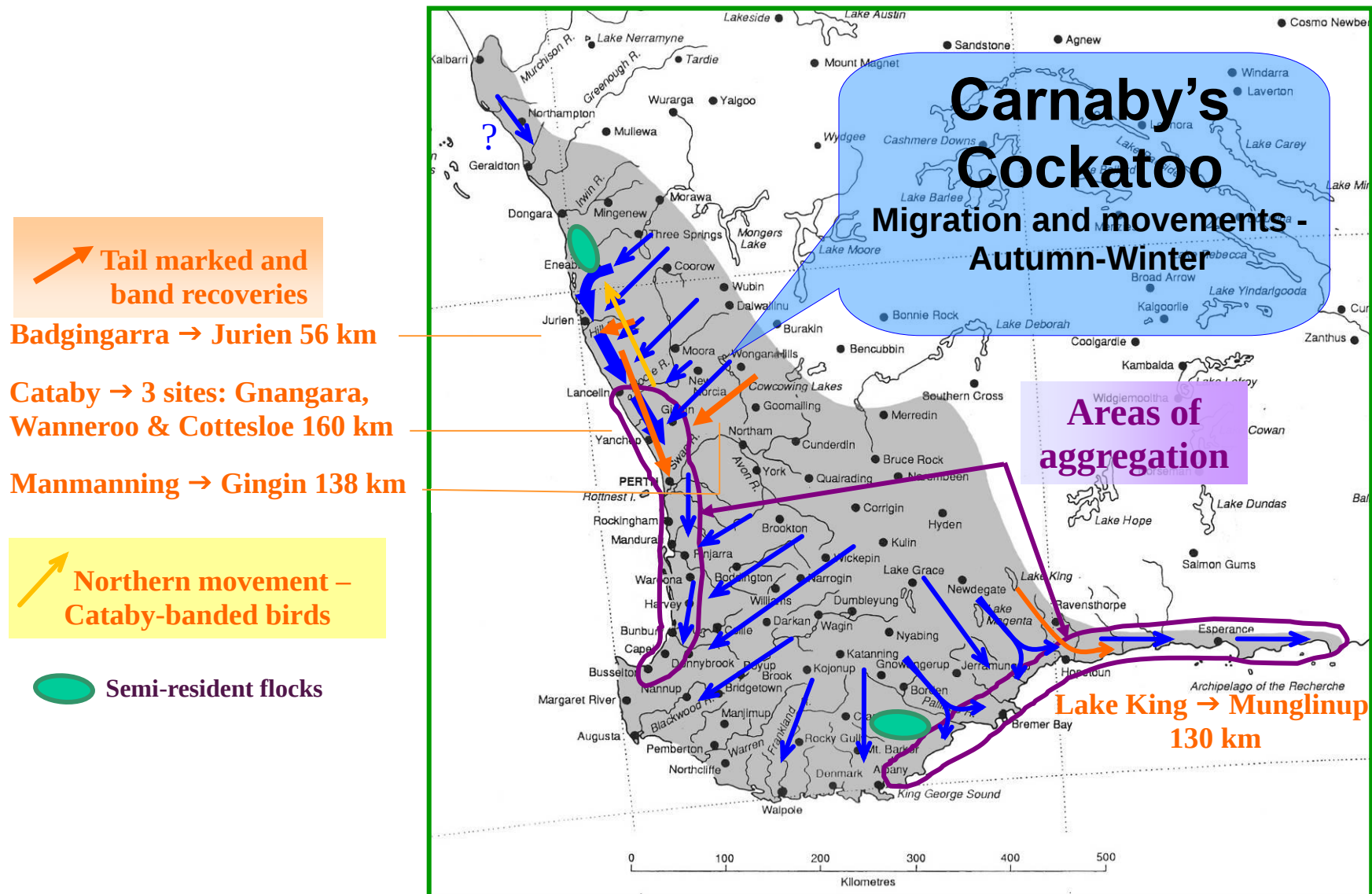


Figure 3. Migration and movements of Carnaby's Cockatoo

Significance of the Eneabba Region

There is no evidence of Carnaby's Cockatoo breeding or any suitable breeding habitat for this cockatoo has been found in the vicinity of Eneabba. The Carnaby's Cockatoo that occur in the area are non-breeding autumn-winter visitors probably from breeding sites well to the north-east and east of Eneabba i.e. Three Springs-Carnamah region and west in the Mt Peron-Lesueur region (Cockleshell Gully and Stockyard Gully). Virtually all the Carnaby's Cockatoos that breed in the northern and mid-western parts of the wheatbelt are post-nuptial migrants, tending to move west after breeding in January-February to the coast then south onto the Swan Coastal Plain. Judging from our data bank all birds from the Three Springs, Carnamah, Coorow, Badgingarra and Moora regions completely vacate their breeding sites by the end of February and aggregate into large flocks in the Kwongan heaths and pine plantations on the northern Swan Coastal Plain. Occasionally a flock of 60–100 birds remain in the Badgingarra National Park area into March-April. The reverse migration occurs in July-August (sometimes later) as birds return to their breeding sites. The exception to this movement is the large flock of about 300–400 that remain in the Eneabba region throughout the entire autumn-winter period – see Figure 3.

The Eneabba flock roosts in the township in tall river gums and leave the roost at dawn each day to forage in patches of native vegetation including remnant vegetation and mine site rehabilitation areas and in adjacent farmlands.

This flock has been observed foraging mainly in patches of remnant bushland on Eneabba Creek just north of Eneabba township, areas west of the Eneabba mine, areas around Lake Indoon and cleared farmlands to the east and west of the township. One of the main foods reported on farmlands were the seeds of the Afghan or Pie Melon *Citrullus lanatus* a summer growing annual native to Africa that is widespread in paddocks and along roadsides in the Eneabba area. The melon has a large spherical fruit (up to 15 cm across) that is produced in the autumn at a time when Carnaby's Cockatoos are arriving in the area. It has large seeds and Carnaby's Cockatoos were observed feeding on the seeds of recently broken green melons and old yellow and rotted melons. This cockatoo has not been recorded feeding on Pie Melons in any other part of its range.

Important roosting sites used since the mid1990s to 2024 (counts at roost made in 2006-2010) include the main Eneabba town roost in exotic River Gums and a satellite roost area on Woodada Road also in exotic River Gums. Important foraging sites are mainly in rehabilitated mining areas, native vegetation areas, in a small patch of burnt remnant woodland in the Eneabba township and *Banksia* woodlands west of Eneabba. Also noteworthy on a regional basis are reports of large numbers feeding in *Banksia* woodland in the Arrowsmith floodout 20 km north of Eneabba and the Lake Logue and Beekeepers Nature Reserve areas in July 2008. Also, more recently in July 2022 a flock of over 500 was photographed feeding in *Banksia* woodland near Jurien Bay, no doubt birds returning to mid-west breeding sites.

Observations for Eneabba Region from Storr-Johnstone Bird Data Bank

D. L. Serventy. August1954, recorded flocks roosting in river gums at Padbury Farm.

J. R. Ford. 27 March 1964, Cockleshell Gully (Wandoo-Marri) recorded.

- J. R. Ford. 28 March 1964, Arrowsmith Lake flock of 100-120 came in to drink in evening.
- J. R. Ford. 26 September 1965, flock of 10, 63 km NNW Badgingarra.
- J. R. Ford. 15 May 1979, Cockleshell Gully flock of ca.100.
- Storr. G.M. 27 March 1959, big flock 24 km WNW Badgingarra also 2 in Marri-banksia.
- G.M. Storr. 27 March 1959, big flock at Cockleshell Gully farm.
- G.M. Storr. 28 March 1959, flock of 25, 24 km NNE Jurien Bay.
- G.M. Storr. 22 October 1961, two birds 24 km east Jurien Bay and flock of 25 7 km SSE Badgingarra.
- G.M. Storr. 27 March 1964, two birds at Mt Lesueur.
- G.M. Storr. 28 March 1964, flock of 100 at Lake Arrowsmith came in at 5:30 pm.
- G. M. Storr. 20 January 1965, 24 km west Watheroo ca. 100 in *E. todtiana*, *B. prionotes*, *Macrozamia*, *Jacksonia*, *Calythrix*, *Acacia* etc.
- R. E. Johnstone. 4 October 1970, 2 birds flying north 120 km north of Gingin.
- R. E. Johnstone. 14 May 1973, small flock near Badgingarra townsite.
- Recovery Round up 1972. Adult female banded by D.A. Saunders at Manmanning on 1 December 1971, shot near Gingin on 27 February 1972, (138 km WSW).
- Recovery Round up 1973. Bird banded at Badgingarra on 15 November 1970, hit by car near Jurien Bay on 21 April 1973 (56 km WNW).
- J. Dell, and R.E. Johnstone. 1977. Cockleshell Gully Report. Moderately common in low forest of *E. Wandoo*, *E. accedens* and *E. calophylla* on dissected plateau. Flock of 11 observed in May 1974; between 22 and 29 October 1973 small flocks of up to 9 birds seen throughout hilly country including feeding in heath. On 29 October these small flocks began massing into a group of ca. 100.
- B. Haberley, 21 July 1982. Flock of ca. 160 seen in *Eucalyptus todtiana* and Xmas trees on the western boundary of Watheroo National Park.
- G. Carruthers, 6 January 2002. Flock of 6 over Eneabba flying south- west and later 2 birds in town.
- A. Meyer, 7 June 2006. Observed a large flock estimated at 1500 birds in Beekeepers Nature Reserve. Presumably the same mob estimated at 1000 + that were seen yesterday in same area. Presumably the same flock that have been seen in the *Banksia hookeriana* areas around the Eneabba townsite.
- B. Wynne pers. comm, 26 October 2006. On 8 October 2006 he located about five nests in gums 15 km SSE of Leeman near Stockyard Gully Caves.
- M. Mannion pers. comm. 22 January 2007. Observed about 100 birds roosting on eastern side of Eneabba town. They have been here for about a week, not as many as last year's flock that was in the order of 300 but this will probably increase as more return from breeding sites.
- M. Mannion, 25 April 2007. At 0:6:30 Eneabba flock moved from roost to north and north-east of town. In evening at 17:20 hrs, returning in two flocks from NE and N.

- M. Mannion, 26 April 2007. At 0:6:30 Eneabba flock moved north-west from town.
- M. Mannion, 17 May 2007. At 0:6:30- 0:700 Eneabba flock spent first hour in native vegetation to east of town, then flew east up the Three Springs Road to forage in farm paddocks.
- M. Mannion, 24 May 2007. At 0:6:30- 0:900. Eneabba flock tree-hopping along the Three Springs Road before stopping in farm paddocks to feed on Pie Melons.
- M. Mannion, 25 May 2007. Reports of flocks still in the Arrowsmith area along the highway (some killed by traffic). In Eneabba the flock is spending time in paddocks and have been seen eating Paddy Melons along the side of the Three Springs Road. They return to town most nights but have been absent on a couple of occasions. The larger roosting group has been splitting up into smaller groups most days with initial morning flights to north and east of town.
- M. Mannion, 20 June 2007. Observed flock returning to Eneabba roost from SSE at 1700 hrs.
- M. Mannion pers. comm. End of July 2007. Birds noted flying south in morning and returning from east at night, but no birds seen or heard since returning to Eneabba on 19 August. Between 31 July and 20 August, the large town flock had left the roost site.
- T. White, 14 February 2007. Flock of 7 feeding on pine cones on Campbell -White Road ; 2 feeding on pine cones on 9 March and 2 on 19 April.
- B. White, 26 August 2007. Observed a flock of 40-60 flying south over paddocks at Campbell -White Road, and has seen small groups feeding on pine cones at his homestead.
- M. Mannion, 29 August 2007. Cockatoos have moved their roosting area to trees around Lake Logue, so have not disappeared altogether.
- K. Conder pers. comm. 29 August 2007. Flock of 40-50 roosting in river gums at edge of farmland and Lake Logue Reserve on Woodada Road at 29 50 35.8 S, 115 10 54.5 E. Came into roost at 17:30 hrs.
- R.E. Johnstone & T. Kirkby, 30 August 2007. Woodada Road area, Lake Logue Reserve. Extensive evidence of feeding on *Banksia attenuata* (seeds and flowers), *B. prionotes*, *Dryandra sessilis* (flowers) and *Lambertia*. Also several birds calling to east and at 18:30 hrs 8 birds came into roost in river gums.
- R.E. Johnstone & T. Kirkby, 31 August 2007. Woodada Road area, Lake Logue Reserve. Several pairs and flock of 61 from line of river gums at dawn flew into banksia woodland then moved to SW into heath feeding and spreading out into native vegetation and by 0:700 well spread.
- M. Mannion, 1 September 2008. Group of birds feeding in mixed native vegetation and pasture east of Brand Highway, 55 km south of Eneabba.
- M. Mannion, 30 September 2008. Large flock roosting in pine trees on farm opposite Watto Nature Reserve.
- M. Mannion, 12 October 2008. Small flock roosting in pine trees on farm opposite Watto Nature Reserve.
- M. Mannion, 26 December 2008. Large flock roosting and flying around Eneabba townsite.

- M. Mannion, 19 January 2009. Flock of 100 flying across Brand Highway from tall pines on east of highway down Banovich Road in westerly direction at Warradarge . A few minutes later the same group observed in low heath north of Banovich road flying low along valley near powerline corridor in northerly direction. Birds stopped and foraged in farm paddocks near native vegetation.
- M. Mannion, 21 January 2009. Small group flying over mine administration building Eneabba.
- M. Mannion, 27 January 2009. Flock of 6 roosting in eucalypts near mine administration building, Eneabba. Flock of 10 feeding in heath with *E. tottiana* near Eneabba mine access rail crossing. Also small group in mature eucalypts on King Street Eneabba.
- M. Mannion, 29 January 2009. At 0700 hrs flock of 50 roosting in Eneabba town overnight at Banksia Village. They then flew low to south-east.
- M. Mannion, 30 January 2009. At 0600 hrs flock of about 100 flew into Eneabba from west (west roost) tree hopping through town from Banksia Village vthrough King Street. After short stay spread out in broad easterly direction. Splitting up into many smaller groups before rejoining into two groups, one going east along Three Springs Road the other south towards Eneabba mine concentrator.
- M. Mannion, 25 February 2009. At 05:45 hrs flock of 6 from Eneabba roost flying down Coolimba Road. A 18:50 hrs 10-12 birds flying south from Eneabba Golf Course and about 60 flying north towards town.
- M. Mannion, 3 March 2009. Eneabba, flock of 100 resting- roosting at mine administration area south of town , they return about midday stay until mid afternoon then around 8 pm fly north to town.
- M. Mannion, 17 March 2009. Eneabba roost flock breaking up into smaller groups , some flying east along Three Springs Road, others remain in town area.
- S. Plozza, 18 March 2009. Eneabba, large flock back in town but left flying east along Three Springs Road and returning by 18:00.
- M. Mannion, 23 April 2009. At 1600 hrs several small groups behind Eneabba town pool and 100 flying in from west.
- M. Mannion, 2 June 2009. Eneabba, Lake Logue flock of 200+feeding to west of Woodada Gas Road.
- M. Mannion, 3 June 2009. Large flock feeding in native vegetation just south of Eneabba Golf Course. Lots of smaller flocks flying in from south.
- R. E. Johnstone and T. Kirkby, June 2009 small flocks (up to 20) were observed near the Eneabba township. Also a flock of 50 birds was observed near the Arrowsmith floodout (50 km north of Eneabba).
- R. E. Johnstone and T. Kirkby, 22 June 2009 flocks of 150 and 70 were observed feeding on *Banksia* nectar and *Pinus* seeds near the Marchagee Track turn off.
- R. E. Johnstone and T. Kirkby, 22 June 2009 old evidence of feeding on *Dryandra sessilis* was found in the road verge at White Gums Reserve. Also at 1750 hr (just on dark) a flock of 130 were observed flying in towards Eneabba from the south to the town roost site.

- R. E. Johnstone and T. Kirkby, on 23 June 2009 a total of 388 birds left the Eneabba roost site just after sunrise at 0710 hr. This flock was followed for several hours as they foraged in *Banksia* woodland to the south and south-west of town. Birds were recorded feeding on *Banksia attenuata* and *Banksia leptophylla* var. *melletica* flowers for nectar and also taking seeds of *Dryandra sessilis* and *Eucalyptus todtiana*. The longest foraging distance from the roost that day for this flock was 5.5 km.
- M. Mannion, 1 August 2009. Eneabba, 17:00 hrs flock of 100 mooching around the Road Nature Reserve at intersection of Eneabba and Three Springs Road.
- M. Mannion, 4 August 2009. Eneabba, flock of 12 flying east along Three Springs Road at 17:00 hrs and not heading back to town roost.
- M. Mannion, 8 August 2009. Flock of 50 in scrub west of Lake Indoon (Caves access Road).
- M. Mannion, 11 August 2009. Eneabba, flock of 300 feeding and resting in scrub on farm property (Victoria Location 10895).
- M. Mannion, 14 August 2009. Eneabba, flock of about 80 in mine rehab block.
- R. E. Johnstone and T. Kirkby, on 17 August 2009 a flock of 32 was observed including some pairs in breeding display flights and giving the mating call, near the Eneabba mine administration building. Some from this flock were also noted tearing at the trunk just below the canopy of several garden palms and feeding on nectar from a red flowering eucalypt in the same gardens. Also old evidence was found of birds feeding on *Banksia attenuata* on the Leeman Road at 29. 51. 29.6 S, 115. 09. 28.1 E. At 1720 hr on the 17 August a flock of about 80 flew into Eneabba from the ESE and went to drink at roadside pools on King Street (31. 49. 06.0 S, 115. 16. 23.0 E), this group included adults making the mating call and some begging juveniles. At the same time and place another 20 birds flew in from the west and joined the main flock at the drinking site before heading to the main roost site. A total of 113 were recorded flying to the roost site at 1720 hr and many were giving the mating call.
- R. E. Johnstone and T. Kirkby, on 18 August 2009 at 0630 hr a flock of 73 left the Eneabba roost site (Darling Street at 29. 49. 22.6 S, 115. 16. 23.2 E) and flew, fast and direct to the south. At the same time a small group was heard heading west. At 0715 hr the flock of 73 was recorded feeding on *Dryandra sessilis* and seeds from *Banksia attenuata* near the Eneabba rubbish tip access road at 29. 50. 27.6 S, 115. 16. 39.2 E. At one stage this group flew up to meet a group of Red-tailed Black Cockatoos flying high towards the west. This mixed flock then flew north for a short distance before the Carnaby's Cockatoos returned.
- Another interesting observation is a flock of 30 and later 40 playing on thermals and moving north to join another flock when a Wedge-tailed Eagle was overhead. Recent evidence was also found of birds feeding on *Dryandra sessilis* and *Dryandra* spp. at 29. 54. 42 S, 115. 17. 09 E.
- A. Tinker, early September 2009 small flocks (up to 5) were recorded in the Arrowsmith floodout area.
- R. Woods, 22 September 2009 a flock of 200 – 300 was observed at the northern end of Logue Lake, bathing in a pool. Judging from the size of this flock we suspect

that it was the Eneabba flock and that most pairs had not yet returned to their breeding quarters.

- R.E. Johnstone and T. Kirkby, September 2009 pairs and small flocks were recorded flying into Wandoo woodland at 1700 hr at Dookanooka Nature Reserve at 29°36'00" S, 115°38'09" E. Also two nest trees were located in the Dookanooka Nature Reserve at 29. 35. 55 S, 115. 38. 28.1 E. Adjacent to this site were other patches of woodland that were potential breeding areas including areas of woodland at 29. 35. 21 S, 115. 41. 17 E and 29. 34. 35 S, 115. 41. 58 E on both sides of road.
- R.E. Johnstone, 25 September 2009 a breeding pair was observed (female flushed from hollow) at a hollow in a Wandoo at a creek crossing on the Green Head Road at 30. 04. 10.8 S, 115. 14. 35.7 E. A flock of 50 had been feeding for the past month in *Banksia* woodland near Jurien opposite the turn off to Drovers Cave Road (G. Briggs pers. comm). This is the westernmost breeding record for this region and judging from the habitat available there is probably a small breeding population in this patch of Wandoo.
- R. E. Johnstone, some sections of the Dandaragan – Moora and Dandaragan – Gingin Roads, road verges contain trees with suitable hollows, but no evidence of breeding has been reported. The Storr – Johnstone Bird Data Bank contains breeding records at 15 and 17 km south of Dandaragan on the Gingin Road.
- Storr–Johnstone Bird Data Bank and W. Kerkoff pers. comm. About 50 – 60 pairs of Carnaby's Cockatoos breed in and around Moora and in small reserves to the north and south of the township Breeding was recorded in roadside verges with tall Wandoo and Salmon Gums between Moora and Watheroo e.g. in verge at 30. 37. 08 S, 116. 00. 21.4 E and near Dallaroo East Road junction at 30. 29. 22.9 S, 116. 01. 47 E, at 30. 29. 22.1 S, 116. 01. 58.8 E and just south of Watheroo in Salmon Gum at 30. 20. 54.9 S, 116. 03. 41.3 E and at 30. 20. 09 S, 116. 03. 59 E (2 km south of Watheroo). Also two well chewed hollows were located in Salmon Gums just north of Marchagee at 29. 55. 23 S, 116. 02. 29 E.
- R. E. Johnstone and T. Kirkby. Small numbers are recorded breeding on the central section and western end of the Marchagee Track at Coomallo Creek and Herschell Range area (Johnstone and Kirkby 2008); and about 40 – 50 pairs breed in the Waddi Forest area west of Coorow (Storr – Johnstone Bird Data Bank). North of Coorow we located patches of York Gum and Salmon Gum woodland with potential breeding hollows at 29. 50. 51 S, 116. 00. 49 E and patches of Salmon Gum woodland at 29. 49. 12 S, 116. 00. 01 E and at Petah Creek crossing at 29. 46. 45 S, 115. 56. 03 E. There was also an extensive patch of Wandoo woodland with many large trees at 29. 28. 38.7 S, 115. 40. 12.4 E (on private property).
- S. Talbot pers. comm to REJ 2022. Large flock 300 + still roosting in Eneabba townsite.
- G. Dyer pers. comm to REJ October 2024. Large flock or flocks, observed around the Eneabba town and mine site for past 30 years. Flock of 150-200 observed near mine office area in June 2024.

Important foods in the Eneabba region

Major food in the Eneabba region includes *Banksia* spp. (especially *B. attenuata*, *B. hookeriana*, *B. leptophylla*, *B. kippistiana* and *B. sessilis*), *Hakea* spp. (especially *H. eneabba*, *H. spathulata*, *H. smilacifolia*, *H. polyanthema*, *H. psilorrhyncha*, *H. flabellifolia* and *H. costata*) and *Lambertia multiflora*. Also flower buds, flowers and nectar and insect larvae and insects from under bark and from wood of live or dead trees and shrubs. In farmland, Canola, Wild Radish *Raphanus raphanistrum*, Storksbill *Erodium botrys*, Pie Melon *Citrullus lanatus* and Lupins *Lupinus* are important foods.

Foraging Habitat

In the Eneabba region foraging mainly in patches of remnant bushland on Eneabba Creek just north of the Eneabba township; uncleared areas west of mine; areas around Lake Indoon and in cleared farmlands to east and west of township. Also important foraging in rehabilitated native vegetation areas throughout the mining area and large reserves north of Eneabba at Arrowsmith Floodout, Lake Logue and Beekeepers Nature Reserve.

General Observations of Habitat Usage and Potential Impacts of Wind Turbines

Carnaby's Cockatoo usually fly just above the ground in open areas, or just above the vegetation in heathlands or continuous tracts of vegetation. There are very few reports of birds flying at Turbine Rotor Sweep height. At Cataby, pairs and flocks flew between foraging sites and over cleared farmland at about 5-15 m and occasionally at 15-40 m and avoided the adjacent windfarm turbines and the power transmission towers.

On several occasions at Eneabba birds have been observed using thermals from large buildings, and on one occasion a flock was observed circling very high when pursued by pair of hunting Wedge-tailed Eagles. Also a literature record of White-tailed Black Cockatoos in acrobatics in hot air pillars formed by a fire in vent of huge hollow trunk of tree (D. Keast, WA Naturalist Vol 13, 8 p.205.).

At windfarms at Cataby, Walkaway, Emu Downs and Joanna Plains cockatoos appear to show a high avoidance of turbines and avoid or manoeuvre around them. Carnaby's Cockatoos also avoid power towers but will occasionally perch on power lines and there is a one record of a bird being killed by electrocution on power line in the Perth metro area.

P. Kirk pers. comm to R.E. Johnstone on 3 September 2021 and September 2024 monitored the Warradarge Windfarm daily for a period of two years and recorded a total of five bird deaths from turbine strikes (namely Australian Kestrel *Falco cenchroides*, Barn Owl *Tyto javanica*, Wedge-tailed Eagle *Aquila audax*, Australian Raven *Corvus coronoides* and Brown Songlark *Cincloramphus cruralis*).

Birds most at risk of turbine strikes would be those visiting remnant bushland adjacent to turbines to feed e. g. Carnaby's Cockatoos; migrant species flying at night and birds of prey and other species using the updrafts and thermals to gain height e.g. Wedge-tailed Eagles, Kestrel and corvids (Australian Raven and Little Crow) that also favour high vantage points to perch as lookouts.

Threats or Regional Impacts

The combination of extensive foraging habitat, permanent water for drinking sites and safe roosts enables this population to remain in the Eneabba area during the autumn –

winter period. The main threat to this flock would be the removal of the major roost sites. Intensive wildfire could also have a major impact on the availability of food in the region. To date, the breeding region of the Eneabba flock is as yet unknown and impacts at breeding sites within the broader region could affect this flock. Overall the clearing of important roost and foraging sites especially remnant bushland could have a significant impact on the local movements of this flock.

Major threats include the following:

- Loss or degradation of foraging habitat.
- Loss or degradation of roost sites.
- Change in fire regimes.
- Altered hydrology and water abstraction that may affect woodlands and drinking sites.
- Dieback *Phytophthora*.
- Competition for hollows at regional breeding sites (especially by European Honeybees and superabundant Galahs and Corellas).
- Vehicle strikes, none recorded so far for the Eneabba region but extensive losses in the Catby area on Brand Highway and on the northern Swan Coastal Plain on major roads.

CONCLUSION

Despite the Eneabba region (including the Project area) being a very fragmented landscape it is still environmentally suitable for Carnaby's Cockatoos, especially in relation to feeding habitat (i.e. food resources) drinking and roosting sites. This has no-doubt enabled the Eneabba flock to alter its traditional migration and movements westwards and southwards, and enabled them to remain closer to their breeding grounds in an environment that supports this in terms of foraging and roosting opportunity over the autumn-winter time. The establishment of a new wintering range could be important for the future conservation of this species in this area considering the rapid loss of foraging habitat in its traditional wintering zone (i.e. Swan Coastal Plain). Birds would be migrating south into an increasingly hostile environment.

For migrating birds the most important factor for their survival hinges primarily on food availability. Food availability is mainly controlled by the effects of climate on the habitat and superimposed on this is variability from year to year. Judging from our surveys over the past 20 years the Eneabba flock has evolved a pattern of timing that assures their arrival when sufficient food is available including both native and exotic foods.

Targeted surveys for breeding sites within the region have located important breeding sites in the following areas: Moora (within the township and in road verges to the north and south of town); between Moora and Watheroo (in roadside verges); Watheroo (just south of township); Marchagee (just north of township); Marchagee Track (central and western areas); Coorow (especially the Waddi Forest area) and just north of township; Dookanooka Nature Reserve; Green Head Road (at 30. 04. 10.8 S, 115. 14. 35.7 E); Dandaragan (near township); Dandaragan – Gingin Road (15 km & 17 km south of Dandaragan); Catby; Minyulo.

It would appear most likely that the region of origin of the 300 + birds that spend the autumn – winter in the Eneabba area come from these areas.

APPENDIX - STATEMENT COCKATOOS AND WINDFARMS

Risk of windfarm related mortality.

The principle threat to cockatoos from windfarms is from direct bird strikes by the turbines or by catching birds in the wind currents created by the turbines. Carnaby's Cockatoos generally fly at about 5-40 m above ground, rarely 40-200 m above the ground (i.e. about turbine height) in thermals or avoiding birds of prey. Overall, we believe that the probability of birds encountering and flying into turbines is very low for the following reasons.

1. There is a low rate at which Carnaby's Cockatoos appear to visit open farmland in the area. Generally small flocks (less than 50) occasionally flocks of several hundred are recorded as irregular visitors flying over cleared farmlands compared to very large aggregations (many hundreds) reported from uncleared bushland in the Eneabba and Badgingarra areas. This also applies to the operating windfarms in the Walkaway, Emu Downs, Joanna Plains and Cataby sites.
2. Birds would be most at risk flying to and from roosting, feeding and watering sites. Traditional and satellite roost sites are generally near water and should have a buffer zone of about 500 m from nearest turbine. Actual site utilization would be very low at the Eneabba site as this area is apparently mostly cleared and has little feeding, roosting, breeding and drinking habitat in close proximity to turbines. The Cataby wind farm is in similar habitat to that proposed at Eneabba site and at Cataby (which has a small breeding population of Carnaby's Cockatoo in adjacent remnant bushland) birds rarely flew across the wind turbine footprint, generally avoiding both turbines and transmission towers.
3. Although Carnaby's Cockatoos generally fly at about turbine height (5– 40 m.) above ground they are very competent flyers in poor light (dawn, dusk and twilight) and would be capable of avoiding wind turbines. Our data bank contains several records of small flocks flying through the canopy of eucalypt woodlands at dusk; flying into and through pine plantations at dusk and dawn; and small groups returning to nest hollows in eucalypt woodlands after dark.
4. The Storr-Johnstone Bird Data Bank contains no records of birds hitting power lines. There is however one record of a bird that died from electrocution after landing on a power pole and the Western Australian Museum receives about 10 road killed birds each year from the Perth area. Most road kills come from busy roads near pine plantations and from birds feeding in street trees or on road verges. Flocks of Carnaby's Cockatoos are regularly observed in Perth suburbs between late spring and mid-winter visiting pine groves and street trees and negotiating a maze of power lines and buildings.
5. Bird Impact Monitoring at existing windfarms has so far listed Australian Kestrel, Brown Songlark, Barn Owl, Wedge-tailed Eagle and Australian Raven.

R.E. Johnstone

