Carnaby's Cockatoo *Calyptorhynchus Latirostris* Appendix

This Appendix is an accumulation of Reports on Carnaby's Cockatoo *Calyptorhynchus Latirostris* prepared over the past 3 years.

The reports accumulated here are as follows.

Johnstone, R.E & C and Kirkby, T (2007) Assessment of Significant Habitat for Carnaby's Cockatoo Calyptorhynchus Latirostris in the Eneabba Region. Unpublished Report Prepared for Iluka Resources Ltd. December 2007.

Johnstone, R.E & C and Kirkby, T (2008) Further Assessment of Significant Habitat for Carnaby's Cockatoo Calyptorhynchus Latirostris in the Eneabba Region. Unpublished Report Prepared for Iluka Resources Ltd. August 2008.

Johnstone, R.E & C and Kirkby, T (2009) Carnaby's Cockatoo Calyptorhynchus Latirostris in the Eneabba Region. Unpublished Report Prepared for Iluka Resources Ltd. February 2009.

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ASSESSMENT OF SIGNIFICANT HABITAT FOR CARNABY'S COCKATOO *CALYPTORHYNCHUS LATIROSTRIS* IN THE ENEABBA REGION.

R.E. & C. JOHNSTONE AND T. KIRKBY.

The main aim of this work was to assess the potential future mining areas at Eneabba for any significant breeding, feeding and roosting sites for Carnaby's Cockatoos, in particular the priority mining areas of IPL North, IPL South, South Tails and Allied Tails (Figure 1). A further aim was to assess and confirm the significance of any breeding, feeding and roosting sites within the potential future mining areas at local, regional and national levels and to advise on whether the removal of the vegetation from these areas was likely to result in a significant impact to the species.

Ground Truthing

Field visits to the survey area and to various sections of the region were carried out by R.E. Johnstone and T. Kirkby on 22 September 2006, 23 – 24 April 2007, 12 – 13 July 2007 and 30 – 31 August 2007. The approach was to provide a detailed assessment of the level of usage of the project area by cockatoos and a broad-scale assessment of the level of usage of the Eneabba region by cockatoos. All trees with large hollows that were possible nest hollows were inspected for signs of use by cockatoos e.g. wear around the hollow, chewing, scarring and scratch marks on trunks and branches. Several hollows were also inspected using ladders. All observations of cockatoos including flock size and movements etc. were noted and all feeding sites (both recent and old evidence of feeding) were logged using a GPS (see spreadsheet).

Important roosting sites identified include; the main town roost area in exotic River Gums and the satellite roost area on Woodada Road also in exotic River Gums. Important foraging areas identified include; areas of remnant bushland on Eneabba Creek just north of Eneabba Township, areas west of IPL North, areas around Lake Indoon and cleared farmlands to east and west of the Eneabba township.

BACKGROUND INFORMATION

Carnaby's Cockatoo *Calyptorhynchus latirostris*

Listed as Schedule 1 (Endangered) under the *Western Australian Wildlife Conservation Act*, and as Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999.*

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, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Coondingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Status

This species is a postnuptial nomad, tending to move west after breeding. For example; most birds breeding in Three Springs, Carnamah, Coorow, Badgingarra, Dandaragan and Moora regions 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 onto the southern Swan Coastal Plain including the southern Perth metropolitan area Baldivis, Lake Clifton and Myalup areas.

Carnaby's Cockatoo 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 the deep south-west (south of Margaret River, Nannup and Bridgetown and east of Albany).

Estimate of total population 40,000.

Usually in pairs or small flocks, also large flocks (up to 10,000) in non-breeding season (late spring to mid-winter), especially in *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 – 30 years into the Jarrah – Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain. There are now numerous breeding records for the northern Darling Scarp, including Bindoon, Bullsbrook, Mundaring, Lower Darkin River, near Canning Dam, Bedfordale, Serpentine and near Collie, and on the Swan Coastal Plain at Gingin, Mooliabeenee, Yanchep, Baldivis, near Mandurah, Lake Clifton and near Bunbury (Storr – Johnstone Bird Data Bank).

There is also an indication that this species is expanding its breeding range in the far south-east i.e. Lake Cronin, Lake King and Ravensthorpe region.

Breeding

Breeding is recorded from early July to mid-December. Mainly in the semi-arid and subhumid interior from the 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 and near Ravensthorpe (Storr – Johnstone Bird Data Bank).

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.

Judging from breeding records in the Storr – Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including Lake Clifton and near Bunbury.

In the midlands region of the wheatbelt pairs begin to move back to their breeding sites in July – August (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 2 but only one young reared). Incubation lasts 29 days and only the female incubates and broods. The nestling is brooded by the female for up to three weeks after hatching during which time both rely on the male for food. The female then broods only at night and leaves the nest each day at dawn, returning mid-morning (with the male) to feed the chick.

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 Movements

Most breeding in the northern and midlands regions of the 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 February, March, April and occasionally lingering into May large transient flocks (up to 7,000) forage at major food sources including *Banksia* or Kwongan heaths and *Pinus* plantations on the northern Swan Coastal Plain between Lancelin and Perth.

On the northern Swan Coastal Plain the reverse movement of transient birds returning back to their wheatbelt breeding quarters is also evident in July – August with large flocks recorded in *Banksia* and *Dryandra* scrubs in the Yanchep – Lancelin region. There are, however, some exceptions to this westward and southward yearly movement. For example, a flock of over 300 (including adult and juvenile birds) remain during the autumn – winter period in the Eneabba area. These birds roost in tall river gums in and around the township and forage in both remnant native vegetation and adjacent farmlands. While the region of origin of these birds is unknown, it is noteworthy that they remain here during the autumn – winter period when virtually all other Carnaby's Cockatoos from the broader region (i.e. Three Springs, Moora and Badgingarra) vacate it after breeding.

Food

Carnaby's Cockatoo has been observed feeding on a wide range of foods including the seeds of *Banksia attenuata, B. baxteri, B. coccinea,B. hookeriana, B. menziesii, B. grandis, B. prionotes, B. speciosa, B. ilicifolia, B. longifolia, B. ericifolia, B. quercifolia, Dryandra carlinoides, D. fraseri, D. praemorsa, D. squarrosa, D. sessilis, Corymbia calophylla, C. citriodora, Eucalyptus patens, E. todtiana, E. marginata, E. caesia, E. salmonophloia, Hakea candolleana, H. erinacea, H. laurina, H. incrassata, H. lasiantha, H. lissocarpha, H. stenocarpa, H. trifurcata, H. prostrata, H. lasianthoides, Grevillea* spp., *Pinus* spp. (including *P. radiata, P. caribaea* and *P. canariensis), Callitris, Jacaranda, Helianthus, Macadamia, Prunus, Carya, Liquidambar styraciflua, Mesomelaena* spp. and *Erodium;* flower buds, flowers and nectar of *Banksia attenuata, B. ericifolia, B. grandis, B. ilicifolia, B. menziesii, Callistemon* spp., *Corymbia calophylla, Dryandra lindleyana, D. squarrosa, D. sessilis, Eucalyptus gomphocephala, E. patens, E. robusta, Grevillea robusta, Protea* spp., insect larvae and insects (including weevils) from under bark, from wood of live and dead trees and shrubs, from galls and from flowers and flower stems of *Acacia* spp. (including *A. saligna* and *A. pentedenia*) *Banksia* spp., *Eucalyptus* spp., *Jacksonia, Agonis* and *Xanthorrhoea;* also the flesh and juice of apples and persimmons.

Ground Truthing Results
R.E.Johnstone and T.Kirkby

23 April 2007

Small flock calling at Iluka administration site at 0.9:00 at 29. 52. 35.5 S, 115. 17. 07.06 E.

Old evidence of feeding on *Dryandra sessilis* and *Banksia* in heath at 29. 56. 22.3 S, 115. 18. 50.5 E.

Old evidence of feeding on *Dryandra sessilis* at 29. 56. 20.5 S, 115. 18. 31.6 E.

Old evidence of feeding on *Dryandra sessilis* on power line track at 29. 56. 22.0 S, 115. 18. 37.8 E.

Old evidence of feeding on *Dryandra sessilis* on power line track at 29. 56. 18.2 S, 115. 18. 32.6 E.

Old evidence of feeding on *Banksia hookeriana* at 29. 56. 19.8 S, 115. 18. 26.3 E.

Old evidence of feeding on *Dryandra sessilis* and *Banksia* at 29. 56. 19.0 S, 115. 18. 33 E.

Evidence of feeding on *Lambertia multiflora,Dryandra carlinoides* and *Melaleuca leuropoma* at 29. 56. 04.0 S, 115. 18. 19.3 E.

Evidence of feeding on *Dryandra sessilis* and *Hakea* sp. at 29. 56. 20.5 S, 115. 16. 50.5 E.

Flock of 200 observed at 18:00 flying in low from north and perching in tall river gum in Eneabba town. This flock contained many adults with juveniles (pairs observed feeding juveniles), adults also observed allopreening and bill cleaning. At 18:10 this flock was joined by another 60 – 70 birds also flying in from north and perching in tops of river gums. Flock roosted in these tall river gums at 29. 49. 06 S, 115. 15. 45.2 E.

24 April 2007

Eneabba township, 06:00 birds calling from roost site just before dawn. At 06:25 about 100 birds flew from roost to paddocks west of town. Flocks of 63 and 38 left the roost and flew north into area of natural vegetation with low *Banksia.* Counts of ca. 200, 35, 62, 62 and 4 were made as birds left the roost to forage in heath just north of Eneabba township. Overall estimate of 350 birds at this roost site.

Observed feeding (grubbing for insect larvae) on old flower

	spikes and trunks of *Xanthorrhoea* spp. (also old evidence of feeding here) on *Hakea candolleana* at 29. 48. 49.9 S, 115. 16. 16.7 E.
24 April 2007	Flock of 150 – 200 landed on Eneabba – Three Springs Road (bitumen road, apparently attracted to what appeared to be a water mirage on the road, landed as if to drink then flew into a line of river gums at edge of road. These birds then moved into an adjacent paddock and began feeding on the seeds of Pie Melons *Citrullus lanatus* both fresh green and old brown melons that had been recently broken open. Extensive feeding area here on melons and also on seeds in cow dung at 29. 48. 44.5 S, 115. 16. 55.7 E. After feeding in this area for about 40 minutes the flock then moved east into other paddocks with pie melons then south-east of Ocean Hill. Old evidence of feeding on seeds of *Hakea erinacea* and *Lambertia multiflora* var *multiflora* in road verge at 29. 48. 16.6 S, 115. 17. 57.7 E. Evidence of grubbing for insect larvae on flower spikes and trunks of *Xanthorrhoea* spp. at 29. 48. 36.3 S, 115. 16. 26.4 E. Evidence of feeding on *Hakea* sp. at 29. 48. 36.3 S, 115. 16. 26.4 E. Old evidence of feeding on flowers of *Banksia prionotes* At 29. 52. 21.0 S, 115. 15. 29.6 E. Evidence of grubbing for insect larvae on *Banksia prionotes* At 29. 52. 10.5 S, 115. 15. 01.1 E. Old evidence of feeding on *Dryandra sessilis* (several bushes) At 29. 52. 49.9 S, 115. 15. 08.9 E. Evidence of feeding on *Xanthorrhoea* flower spikes at 29. 52. 55.2 S, 115. 15. 08.7 E. Evidence of feeding on *Xanthorrhoea* flower spikes at 29. 54. 30.5 S, 115. 14. 37.0 E. Evidence of possible grubbing for insect larvae on *Xanthorrhoea* flower spikes at 29. 57. 28.0 S, 115. 16. 25.5 E. (IPL South Tails). Old evidence of feeding on grubs from flower spike of *Xanthorrhoea* spp. at 29. 57. 58.7 S, 115. 16. 28.7 E.
12 July 2007	Two birds over Iluka office block at 11:00. Three birds, (male female and immature) and another pair, perched in river gums and palms at Iluka office area.

	Old evidence of feeding on *Banksia* spp. at 29. 49. 15.2 S, 115. 16. 43.1 E.
12 July 2007	Possible evidence of grubbing for insects on *Acacia* trunks and stems (2 trees) at 29. 50. 59.0 S, 115. 16. 56.1 E.
	Old evidence of feeding on *Dryandra sessilis* (3 shrubs) at 29. 51. 44.1 S, 115. 17. 01.5 E.
	Old evidence of feeding on *Dryandra sessilis* (2 shrubs) at 29. 52. 01.9 S, 115. 17. 02.1 E.
	Old evidence of feeding on seeds and flowers of *Banksia prionotes* (3 large trees) at 29. 52. 24 S, 115. 17. 12 E.
	Evidence of feeding on *Banksia attenuata* (several small trees) at 29. 50. 59.4 S, 115. 15. 50.0 E.
	Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 20.7 S, 115. 15. 34.5 E.
	Evidence of feeding on *Dryandra sessilis* at 29. 50. 17.7 S, 115. 15. 33.0 E.
	Old evidence of feeding on *Lambertia multiflora*. at 29. 50. 17.4 S, 115. 15. 32.5 E.
	Evidence of feeding on *Banksia attenuata* at 29. 50. 17.3 S, 115. 15. 33.5 E.
	Evidence of feeding on *Dryandra sessilis* at 29. 50. 15.4 S, 115. 15. 31.7 E.
	Old evidence of feeding on *Banksia attenuata* seeds (2 trees) at 29. 50. 14.5 S, 115. 15. 32.6 E.
	Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 13.5 S, 115. 15. 34.2 E.
	Evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 12.9 S, 115. 15. 34.4 E.
	Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 12.3 S, 115. 15. 33.9 E.
	Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 11.6 S, 115. 15. 34.1 E.
	Old evidence of feeding on *Dryandra sessilis* (several shrubs)

at 29. 50. 10.9 S, 115. 15. 34.6 E.

Old evidence of feeding on *Dryandra sessilis* at 29. 50. 10.3 S, 115. 15. 35.7 E.

12 July 2007 Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 09.8 S, 115. 15. 35.9 E.

Old evidence of feeding on *Dryandra sessilis* (many shrubs, extensive feeding area) at 29. 50. 07.7 S, 115. 15. 35.2 E.

Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 07.2 S, 115. 15. 35.6 E.

Old evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 05.9 S, 115. 15. 36.0 E.

Extensive evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 04.0 S, 115. 15. 36.1 E.

Old but extensive evidence of feeding on *Dryandra sessilis* at 29. 50. 02.8 S, 115. 15. 33.3 E.

Evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 03.5 S, 115. 15. 31.3 E.

Old but extensive evidence of feeding on *Dryandra sessilis* at 29. 50. 04.4 S, 115. 15. 29.7 E.

Evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 04.4 S, 115. 15. 26.6 E.

Old evidence of feeding on *Dryandra sessilis* at 29. 50. 06.7 S, 115. 15. 27.6 E.

Old evidence of feeding on *Dryandra sessilis* at 29. 50. 11.1 S, 115. 15. 28.3 E.

Evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 17.2 S, 115. 15. 35.8 E.

Evidence of feeding on *Dryandra sessilis* (several shrubs) at 29. 50. 15.5 S, 115. 15. 34.8 E.

Evidence of feeding on *Hakea* sp. (thin leaf) at 29. 50. 17.4 S, 115. 15. 32.5 E.

Evidence of feeding on *Banksia attenuata* at 29. 50. 17.3 S, 115. 15. 33.4 E.

Evidence of feeding on *Dryandra sessilis* and *Lambertia*

	multiflora at 29. 50. 14.3 S, 115. 15. 34.1 E.
	Evidence of feeding on *Dryandra sessilis* and *Hakea trifurcata* at 29. 50. 12.0 S, 115. 15. 35.2 E.
12 July 2007	Evidence of feeding on *Dryandra sessilis* at 29. 50. 11.2 S, 115. 15. 35.4 E.
	Evidence of feeding on *Dryandra sessilis* at 29. 50. 11.1 S, 115. 15. 37.4 E.
	Evidence of feeding on *Dryandra sessilis* and *Hakea trifurcata* at 29. 50. 13.2 S, 115. 15. 35.8 E.
	Evidence of feeding on *Dryandra sessilis* at 29. 50. 13.3 S, 115. 15. 37.6 E.
	Evidence of feeding on *Dryandra sessilis* at 29. 50. 15.8 S, 115. 15. 29.4 E.
	Evidence of feeding on *Hakea* sp. at 29. 50. 17.6 S, 115. 15. 31.5 E.
	Evidence of feeding on *Dryandra sessilis* at 29. 50. 17.5 S, 115. 15. 34.2 E.
	Old evidence of feeding on *Banksia attenuata* at 29. 50. 54.6 S, 115. 15. 32.6 E.
	Recent and old evidence of feeding on *Dryandra sessilis* (2 shrubs) at 29. 49. 54.7 S, 115. 15. 33.3 E.
	Extensive old evidence of feeding on *Dryandra sessilis* (many shrubs) at 29. 49. 51.1 S, 115. 15. 34.4 E.
	Old evidence of feeding on *Dryandra sessilis* at 29. 49. 48.1 S, 115. 15. 35.9 E.
	Evidence of grubbing for insects on *Acacia* stems at 29. 49. 46.6 S, 115. 15. 37.9 E.
	Evidence of feeding on *Banksia menziesii* seeds at 29. 49. 54.0 S, 115. 15. 34.8 E.
	Old evidence of feeding on *Dryandra sessilis* at 29. 49. 53.1 S, 115. 15. 35.4 E.
	Evidence of feeding on *Banksia menziesii* seeds at 29. 49. 52.3 S, 115. 15. 37.0 E.

12 July 2007	Flock of 225 observed flying in low from north of Eneabba to river gums at edge of town at 17:00. Joined at 17:15 by flock of 40. At 17:30 group began drinking at pool on edge of road. Also 50 – 60 birds feeding in *Eucalyptus caesia* (on flowers and seeds) and also on Marri *Corymbia calophylla* seeds (both trees in verge) at 29. 49. 06.9 S, 115. 15. 52.0 E. Flock then moved to main roost site in town river gums.
	About 300 birds roosting in river gums in Eneabba township at 29. 49. 06 S, 115. 15. 45.2 E. Roosting on thin outer branches of canopy in clumps of leaves. Some calling heard calling well after dark at 21.30 hrs.
13 July 2007	Flock of ca. 300 left roost site in Eneabba at 07:00 and flew in south-west direction.
	Old evidence of feeding on *Banksia attenuata* (2 trees) at 29. 49. 45.3 S, 115. 16. 43.8 E.
	Old evidence of feeding on *Banksia attenuata* at 29. 49. 45.5 S, 115. 16. 42.9 E.
	Old evidence of feeding on *Banksia attenuata* flowers and seeds at 29. 49. 45.2 S, 115. 16. 41.5 E.
	Evidence of feeding on *Banksia attenuata* at 29. 49. 43.3 S, 115. 16. 39.9 E.
	Evidence of feeding on *Banksia attenuata* at 29. 49. 44.9 S, 115. 16. 40.0 E.
	Old evidence of feeding on *Banksia attenuata* seeds at 29. 49. 43.0 S, 115. 16. 41.0 E.
	Old evidence of feeding on *Banksia prionotes* seeds and flowers at 29. 56. 08.1 S, 115. 16. 49.7 E.
	Old evidence of feeding on *Banksia prionotes* seeds on Mineral Sands Road at 29. 56. 08.1 S, 115. 16. 49.8 E.
30 August 2007	Old and recent evidence of feeding on *Banksia attenuata* at Lake Logue Reserve (Woodada Road) at 29. 50. 33.0 S, 115. 10. 54.8 E.
	Old evidence of feeding on grubs from *Xanthorrhoea* spp. at 29. 50. 04.0 S, 115. 08. 07.9 E.

	Old evidence of feeding on *Dryandra sessilis* at Lake Logue Reserve at 29. 50. 00.6 S, 115. 08. 49.6 E.
30 August 2007	Evidence of feeding on *Dryandra sessilis* flowers in Arrowsmith area at 29. 36. 35.5 S, 115. 07. 05.8 E.
	Old evidence of feeding on seeds of *Banksia attenuata* At 29. 49. 30.6 S, 115. 16. 23.7 E.
	Evidence of feeding on *Banksia prionotes* flowers at 29. 49. 30.0 S, 115. 16. 23.4 E.
	Old evidence of feeding on *Lambertia multiflora* at 29. 49. 30.5 S, 115. 16. 26.1 E.
	Old evidence of feeding on *Banksia attenuata* at 29. 49. 31.0 S, 115. 16. 25.2 E.
	Several heard on Woodada Road and 2 + 2 + 2 + 1 + 1 observed flying in to tall river gums at 18:30 hrs., at 29. 50. 33 S, 115. 10. 54.5 E. This is a new roost site located recently by K. Conder of Iluka. Apparently 40 – 50 birds roosted here on 29 August 2007.
31 August 2007	Two birds (?pair) plus others calling to east of Woodada roost site at 06:00. Flock of 61 flew into this area at dawn from a line of river gums nearby and all perched in several large *Banksia* trees at 29. 51. 00.2 S, 115. 11. 10.9 E. Some of the birds in this flock making the breeding call. Group of 30 on canopy of large *Banksia* calling repeatedly to a pair in distance and this pair answering as they approached to join the main flock from north-east at 18:30 hrs. Flock remained perched for about 20 minutes then flew to an area of low heath and began to spread out and forage at 29. 51. 00.5 S, 115. 11. 14.4 E. By 07:00 hrs. flock well spread out in native vegetation well to south-west.

Other Records

A. Meyer	pers.com. 1 June 2006. A large flock of around 1500 observed In Bee Keepers Nature Reserve. Presumably the same mob were seen again yesterday in the same area, guesstimated at 1000 +. UTM 50 T, 316312, 6714066.
A. Tinker	pers.com. 11 September 2006. Flock of ca. 150 currently roosting in Eneabba town. Have been here for about two years. Previously this flock roosted in the caravan park north

	of Eneabba in Marri trees. Roosted here until about four years ago. Recorded feeding on *Banksia leptophylla* and *Banksia spherocarpa*. Possibly breeding in eucalypts at the Arrowsmith floodout.
M. Mannion	pers.com. 24 October 2006. Flock of about 20 – 30 flew over the mine-site office at 07:30 heading towards town. Apart from todays sighting they have been absent. Also Bob Wynne reported a ? nest site (but this was not confirmed).
M. Mannion	pers.com. 22 January 2007. Group of birds roosting on eastern side of Eneabba town for about a week. Flock is not as large as last year (about 100 birds) but this will probably increase as more birds return from nesting. Last year flock was in order of 300 birds. 24 April 2007. 18:30 hrs. Returning to roost in town from north.
M. Mannion	pers.com., (map data). 25 April 2007. Flock moved from roost site to north and north-east of Eneabba town at 06:30. 25 April 2007. Flock returning in two lots from north-east and north of town at 17:20 hrs.
M. Mannion	26 April 2007. Flock moved north north-west and north from town at 06:30. 17 May 2007. 06:30 – 09:00, flock spent first hour among native vegetation to east of town, then flew east up the Three Springs Road to feed in paddocks. 24 May 2007. 06:00 – 09:00, flock observed tree-hopping along the Three Springs Road before stopping in farm paddocks to feed on pie melons. 6 June 2007. 06:00, flock flew with few stops to top of ridge Ocean Hill area. 20 June 2007. Flock returning from south south-east to town roost at 17:00 hrs. Also occasionally mid-morning roost, loafing or resting at administration area in gums. Just before the three-week break (end of July 2007) noted birds were flying south in morning and returning from east at night.

	Not seen or heard any birds since returning to town of 19 August.
M. Mannion	pers.com. 30 August 2007. Flock of 40 – 50 flying in to roost in river gums on Woodada Road at 5.30 pm.
B. White	pers.com. Flock of 50 – 60 flying south over paddocks along creekline Erindoon Road near Campbell – White Road on 26 August 2007.
T. White	pers.com. Seven birds feeding on pine cones at homestead (29. 59. 04.0 S, 115. 11. 17.0 E) on 14 February 2007; 2 birds feeding on pine cones at homestead on 9 March 2007; and 2 feeding on pine cones on 19 April 2007.
P. Cooper	pers.com. 31 August 2007. Has seen white-tails this year on his farm at North Eneabba, the first in 23 years.
B. Johnstone	pers.com. 13 July 2007. Noted that during the autumn – winter period flocks of up to 100 occasionally rest during the day in the river gums at Ocean Hill area. The birds often remaining in the river gums for much of the afternoon.

DISCUSSION

Conclusions

We found no evidence of Carnaby's Cockatoos breeding or any suitable breeding habitat for this cockatoo in the Project area or in the vicinity of Eneabba. The Carnaby's Cockatoos 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. 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 back to their breeding sites. The exception to this movement is the large flock of about 300 that remain in the Eneabba region throughout the entire autumn – winter period.

The obvious question to answer here was what food resource or resources were used by this flock to enable them to remain in the Eneabba region during the late summer and autumn – winter period. The Eneabba flock roost in the township in tall river gums and leave the roost at dawn each day to forage in patches of native vegetation including the Project area and in adjacent farmlands. Overall the main food for this flock appears to be the seeds of the Pie Melon *Citrullus lanatus* a summer growing annual native to Africa that is widespread in paddocks and along roadsides in the area. The Pie 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. The Pie Melon 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. The extensive patches of melons in this area provide a unique food resource that in combination with native foods, permanent water and safe roost site enables this population to remain in the Eneabba area. It is also noteworthy that in this area that large numbers of Western Long-billed Corellas and Galahs also utilize this food resource in Eneabba and the corellas in particular have become very adept at breaking into large green melons. Flocks of up to 400 Western Long-billed Corellas and pairs, small flocks and large aggregations (over 2000) of Galahs were observed in the area in the autumn.

The native vegetation in the proposed expansion area at IPL South, South Tails and IPL North provide some food resources for the wintering flock of Carnaby's Cockatoos in the Eneabba area. Judging from our surveys the most important areas of native vegetation are in reserves immediately to the north and west of the proposed expansion area. These reserves and other patches of remnant bushland, roadside verges and farmlands are collectively important for Carnaby's Cockatoos in this

region. We believe that clearing of vegetation from the project area if done in stages would not have a significant impact on Carnaby's Cockatoos in the Eneabba region.

Appendix 1. Table of Ground Truthing Results

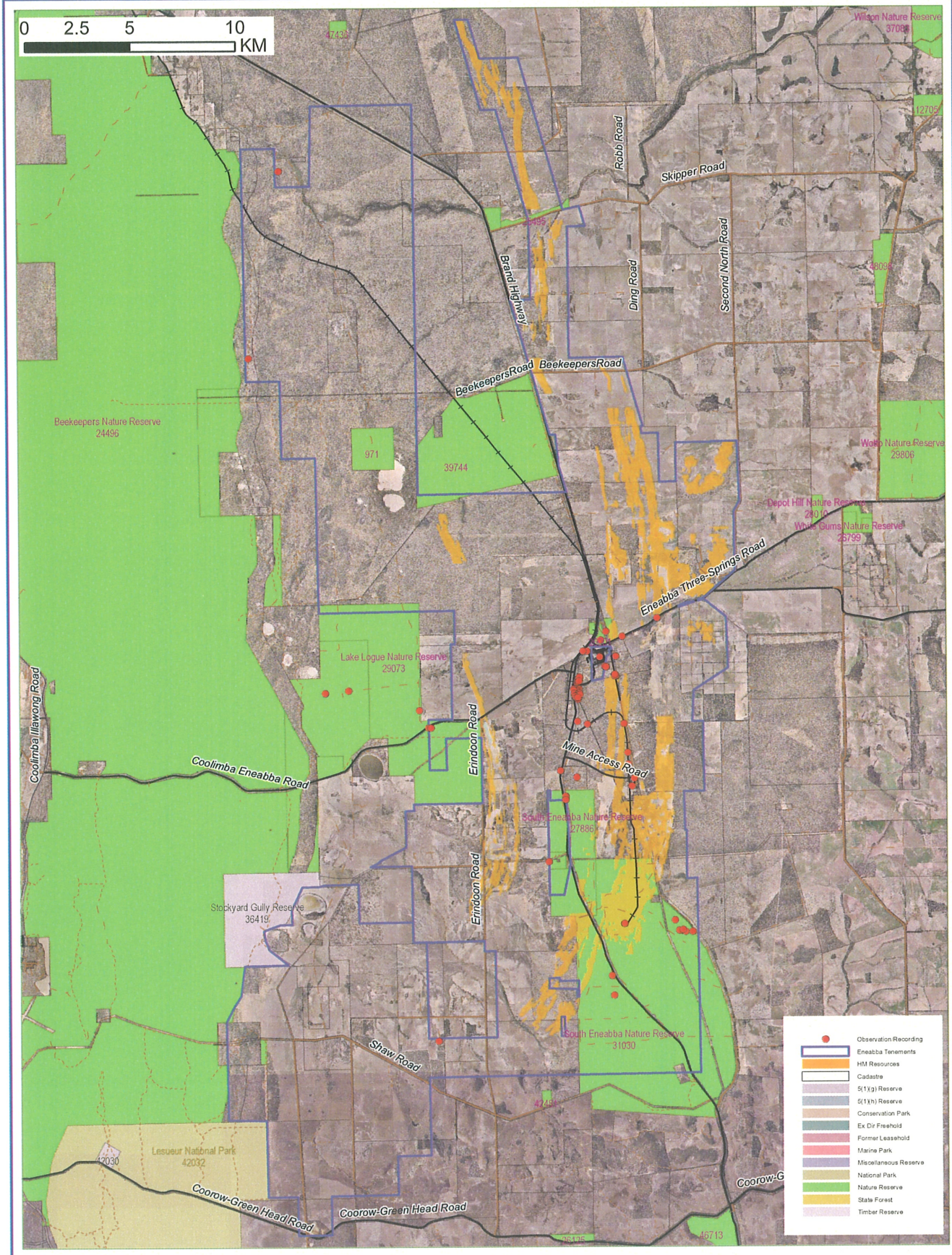
DATE	LOCATION	COMMENTS
23 April 2007	29. 52. 35.5 S, 115. 17. 07.06 E	Small flock calling at Iluka administration site at 09:00.
	29. 56. 22.3 S, 115. 18. 50.5 E	Old evidence of feeding on *Dryandra sessilis* and *Banksia* in heath.
	29. 56. 20.5 S, 115. 18. 31.6 E	Old evidence of feeding on *Dryandra sessilis.*
	29. 56. 22.0 S, 115. 18. 37.8 E	Old evidence of feeding on *Dryandra sessilis* on power line track.
	29. 56. 19.8 S, 115. 18. 26.3 E	Old evidence of feeding on *Banksia.*
	29. 56. 19.0 S, 115. 18. 33 E	Old evidence of feeding on *Dryandra sessilis* and *Banksia.*
	29. 56. 04.0 S, 115. 18. 19.3 E	Evidence of feeding on *Lambertia multiflora.*
	29. 49. 06.0 S, 115. 15. 45.2 E	Flock of 200 observed at 1800 flying in low from north and perching in tall river gum in Eneabba town. This flock contained many adults with juveniles (pairs observed feeding juveniles), adults also observed allopreening and bill cleaning. At 1810 this flock was joined by another 60 – 70 birds also flying in from north and perching in tops of river gums. Flock roosted in these tall river gums.
24 April 2007	29.82 S, 115.82 E	Eneabba township, 0600 birds calling from roost site just before dawn. At 0625 about 100 birds flew from roost to paddocks west of town. Flocks of 63 and 38 left the roost and flew north into area of natural vegetation with low *Banksia.* Counts of ca. 200, 35, 62, 62 and 4 were made as birds left the roost to forage in heath just north of Eneabba township. Overall estimate of 350 birds at this roost site.
	29. 48. 49.9 S, 115. 16. 16.7 E	Observed feeding (grubbing for insect larvae) on old flower spikes and trunks of *Xanthorrhoea* spp. (also old evidence of feeding here.
	29. 48. 44.5 S, 115. 16. 55.7 E	Flock of 150 – 200 landed on Eneabba – Three Springs Road (bitumen road, apparently attracted to what appeared to be a water mirage on the road, landed as if to drink then flew into a line of river gums at edge of road. These birds then moved into an adjacent paddock and began feeding on the seeds of Pie Melons *Citrullus lanatus* both fresh green and old brown melons that had been recently broken open. Extensive feeding area here on melons and also on seeds in cow dung. After feeding in this area for about 40 minutes the flock then moved east into other paddocks with pie melons then south-east of Ocean Hill.
	29. 48. 16.6 S, 115. 17. 57.7 E	Old evidence of feeding on seeds of *Hakea erinacea* in road verge
	29. 48. 36.3 S, 115. 16. 26.4 E	Evidence of grubbing for insect larvae on flower spikes and trunks of *Xanthorrhoea* spp.
	29. 48. 36.3 S, 115. 16. 26.4 E	Evidence of feeding on *Hakea* sp.
	29. 52. 21.0 S, 115. 15. 29.6 E	Old evidence of feeding on flowers of *Banksia prionotes.*
	29. 52. 10.5 S, 115. 15. 01.1 E	Evidence of grubbing for insect larvae on *Banksia prionotes.*
	29. 52. 49.9 S, 115. 15. 08.9 E	Old evidence of feeding on *Dryandra sessilis* (several bushes).
	29. 52. 55.2 S, 115. 15. 08.7 E	Evidence of feeding on *Xanthorrhoea* flower spikes.
	29. 54. 30.5 S, 115. 14. 37.0 E	Evidence of feeding on *Xanthorrhoea* flower spikes.
	29. 57. 28.0 S, 115. 16. 25.5 E	Evidence of possible grubbing for insect larvae on *Xanthorrhoea* flower spikes.
	29. 57. 58.7 S, 115. 16. 28.7 E	Old evidence of feeding on grubs from flower spike of *Xanthorrhoea* spp.
12 July 2007	29.87 S, 115.28 E	Two birds over Iluka office block at 1100. Three birds, (male, female and immature) and another pair, perched in river gums and palms at Iluka office area.

DATE	LOCATION	COMMENTS
	29. 49. 15.2 S, 115. 16. 43.1 E	Old evidence of feeding on *Banksia* spp.
	29. 50. 59.0 S, 115. 16. 56.1 E	Possible evidence of grubbing for insects on *Acacia* trunks and stems (2 trees).
	29. 51. 44.1 S, 115. 17. 01.5 E	Old evidence of feeding on *Dryandra sessilis* (3 shrubs).
	29. 52. 01.9 S, 115. 17. 02.1 E	Old evidence of feeding on *Dryandra sessilis* (2 shrubs).
	29. 52. 24 S, 115. 17. 12 E	Old evidence of feeding on seeds and flowers of *Banksia prionotes* (3 large trees).
	29. 50. 59.4 S, 115. 15. 50.0 E	Evidence of feeding on *Banksia attenuata* (several small trees).
	29. 50. 20.7 S, 115. 15. 34.5 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 17.7 S, 115. 15. 33.0 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 17.4 S, 115. 15. 32.5 E	Old evidence of feeding on *Lambertia multiflora.*
	29. 50. 17.3 S, 115. 15. 33.5 E	Evidence of feeding on *Banksia attenuata.*
	29. 50. 15.4 S, 115. 15. 31.7 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 14.5 S, 115. 15. 32.6 E	Old evidence of feeding on *Banksia attenuata* seeds (2 trees).
	29. 50. 13.5 S, 115. 15. 34.2 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 12.9 S, 115. 15. 34.4 E	Evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 12.3 S, 115. 15. 33.9 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 11.6 S, 115. 15. 34.1 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 10.9 S, 115. 15. 34.6 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 10.3 S, 115. 15. 35.7 E	Old evidence of feeding on *Dryandra sessilis.*
	29. 50. 09.8 S, 115. 15. 35.9 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 07.7 S, 115. 15. 35.2 E	Old evidence of feeding on *Dryandra sessilis* (many shrubs, extensive feeding area).
	29. 50. 07.2 S, 115. 15. 35.6 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 05.9 S, 115. 15. 36.0 E	Old evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 04.0 S, 115. 15. 36.1 E	Extensive evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 02.8 S, 115. 15. 33.3 E	Old but extensive evidence of feeding on *Dryandra sessilis.*
	29. 50. 03.5 S, 115. 15. 31.3 E	Evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 04.4 S, 115. 15. 29.7 E	Old but extensive evidence of feeding on *Dryandra sessilis.*
	29. 50. 04.4 S, 115. 15. 26.6 E	Evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 06.7 S, 115. 15. 27.6 E	Old evidence of feeding on *Dryandra sessilis.*
	29. 50. 11.1 S, 115. 15. 28.3 E	Old evidence of feeding on *Dryandra sessilis.*
	29. 50. 17.2 S, 115. 15. 35.8 E	Evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 15.5 S, 115. 15. 34.8 E	Evidence of feeding on *Dryandra sessilis* (several shrubs).
	29. 50. 17.4 S, 115. 15. 32.5 E	Evidence of feeding on *Hakea* sp. (thin leaf).
	29. 50. 17.3 S, 115. 15. 33.4 E.	Evidence of feeding on *Banksia attenuata.*
	29. 50. 14.3 S, 115. 15. 34.1 E	Evidence of feeding on *Dryandra sessilis* and *Lambertia multiflora.*
	29. 50. 12.0 S, 115. 15.	Evidence of feeding on *Dryandra sessilis* and *Hakea trifurcata.*

DATE	LOCATION	COMMENTS
	35.2 E	
	29. 50. 11.2 S, 115. 15. 35.4 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 11.1 S, 115. 15. 37.4 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 13.2 S, 115. 15. 35.8 E	Evidence of feeding on *Dryandra sessilis* and *Hakea trifurcata.*
	29. 50. 13.3 S, 115. 15. 37.6 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 15.8 S, 115. 15. 29.4 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 17.6 S, 115. 15. 31.5 E	Evidence of feeding on *Hakea* sp.
	29. 50. 17.5 S, 115. 15. 34.2 E	Evidence of feeding on *Dryandra sessilis.*
	29. 50. 54.6 S, 115. 15. 32.6 E	Old evidence of feeding on *Banksia attenuata.*
	29. 49. 54.7 S, 115. 15. 33.3 E	Recent and old evidence of feeding on *Dryandra sessilis* (2 shrubs).
	29. 49. 51.1 S, 115. 15. 34.4 E	Extensive old evidence of feeding on *Dryandra sessilis* (many shrubs).
	29. 49. 48.1 S, 115. 15. 35.9 E	Old evidence of feeding on *Dryandra sessilis.*
	29. 49. 46.6 S, 115. 15. 37.9 E	Evidence of grubbing for insects on *Acacia* stems.
	29. 49. 54.0 S, 115. 15. 34.8 E	Evidence of feeding on *Banksia menziesii* seeds.
	29. 49. 53.1 S, 115. 15. 35.4 E	Old evidence of feeding on *Dryandra sessilis.*
	29. 49. 52.3 S, 115. 15. 37.0 E	Evidence of feeding on *Banksia menziesii* seeds.
	29. 49. 06.9 S, 115. 15. 52.0 E	Flock of 225 observed flying in low from north of Eneabba to river gums at edge of town at 1700. Joined at 1715 by flock of 40. At 17:30 group began drinking at pool on edge of road. Also 50 – 60 birds feeding in *Eucalyptus caesia* (on flowers and seeds) and also on Marri *Corymbia calophylla* seeds (both trees in verge). Flock then moved to main roost site in town river gums.
	29. 49. 06 S, 115. 15. 45.2 E	About 300 birds roosting in river gums in Eneabba township. Roosting on thin outer branches of canopy in clumps of leaves. Some calling heard calling well after dark at 2130 hrs.
13 July 2007	29.82 S, 115.82 E	Flock of ca. 300 left roost site in Eneabba at 07:00 and flew in south-west direction.
	29. 49. 45.3 S, 115. 16. 43.8 E	Old evidence of feeding on *Banksia attenuata* (2 trees).
	29. 49. 45.5 S, 115. 16. 42.9 E	Old evidence of feeding on *Banksia attenuata.*
	29. 49. 45.2 S, 115. 16. 41.5 E	Old evidence of feeding on *Banksia attenuata* flowers and seeds.
	29. 49. 43.3 S, 115. 16. 39.9 E	Evidence of feeding on *Banksia attenuata.*
	29. 49. 44.9 S, 115. 16. 40.0 E	Evidence of feeding on *Banksia attenuata.*
	29. 49. 43.0 S, 115. 16. 41.0 E	Old evidence of feeding on *Banksia attenuata* seeds.
	29. 56. 08.1 S, 115. 16. 49.7 E	Old evidence of feeding on *Banksia prionotes* seeds and flowers.
	29. 56. 08.1 S, 115. 16. 49.8 E	Old evidence of feeding on *Banksia prionotes* seeds on Mineral Sands Road.
30 August 2007	29. 50. 33.0 S, 115. 10. 54.8 E	Old and recent evidence of feeding on *Banksia attenuata* at Lake Logue Reserve (Woodada Road).
	29. 50. 04.0 S, 115. 08. 07.9 E	Old evidence of feeding on grubs from *Xanthorrhoea* spp.
	29. 50. 00.6 S, 115. 08. 49.6 E	Old evidence of feeding on *Dryandra sessilis* at Lake Logue Reserve.
	29. 36. 35.5 S, 115. 07. 05.8 E	Evidence of feeding on *Dryandra sessilis* flowers in Arrowsmith area.
	29. 49. 30.6 S, 115. 16. 23.7 E	Old evidence of feeding on seeds of *Banksia attenuata.*

DATE	LOCATION	COMMENTS
	29. 49. 30.0 S, 115. 16. 23.4 E	Evidence of feeding on *Banksia prionotes* flowers.
	29. 49. 30.5 S, 115. 16. 26.1 E	Old evidence of feeding on *Lambertia multiflora.*
	29. 49. 31.0 S, 115. 16. 25.2 E	Old evidence of feeding on *Banksia attenuata.*
	29. 50. 33 S, 115. 10. 54.5 E	Several heard on Woodada Road and 2 + 2 + 2 + 1 + 1 observed flying in to tall river gums at 1830 hrs. This is a new roost site located recently by K. Conder of Iluka. Apparently 40 – 50 birds roosted here on 29 August 2007.
31 August 2007	29. 51. 00.2 S, 115. 11. 10.9 E	Two birds (?pair) plus others calling to east of Woodada roost site at 06:00. Flock of 61 flew into this area at dawn from a line of river gums nearby and all perched in several large *Banksia* trees. Some of the birds in this flock making the breeding call. Group of 30 on canopy of large *Banksia* calling repeatedly to a pair in distance and this pair answering as they approached to join the main flock from north-east at 1830 hrs.
	29. 51. 00.5 S, 115. 11. 14.4 E	Flock remained perched for about 20 minutes then flew to an area of low heath and began to spread out and forage. By 07:00 hrs flock well spread out in native vegetation well to south-west.
Other Records		
1 June 2006	UTM 50 T, 316312, 6714066	A. Meyer pers.com. A large flock of around 1500 observed in Bee Keepers Nature Reserve. Presumably the same mob were seen again yesterday in the same area, guesstimated at 1000 +.
11 September 2006		A. Tinker pers.com. Flock of ca. 150 currently roosting in Eneabba town. Have been here for about two years. Previously this flock roosted in the caravan park north of Eneabba in Marri trees. Roosted here until about four years ago. Recorded feeding on *Banksia leptophylla* and *Banksia spherocarpa*. Possibly breeding in eucalypts at the Arrowsmith floodout.
24 October 2006		M. Mannion pers.com. Flock of about 20 – 30 flew over the mine-site office at 07:30 heading towards town. Apart from todays sighting they have been absent. Also Bob Wynne reported a ? nest site (but this was not confirmed).
24 April 2007		18:30 hrs. Returning to roost in town from north.
25 April 2007		M. Mannion pers.com. Flock moved from roost site to north and north-east of Eneabba town at 06:30. Flock returning in two lots from north-east and north of town at 17:20 hrs.
26 April 2007		M. Mannion pers.com. Flock moved north north-west and north from town at 06:30.
17 May 2007		M. Mannion pers.com. 06:30 – 09:00, flock spent first hour among native vegetation to east of town, then flew east up the Three Springs Road to feed in paddocks.
24 May 2007		M. Mannion pers.com. 06:00 – 09:00, flock observed tree-hopping along the Three Springs Road before stopping in farm paddocks to feed on pie melons.
6 June 2007		M. Mannion pers.com. 06:00, flock flew with few stops to top of ridge Ocean Hill area.
20 June 2007		M. Mannion pers.com. Flock returning from south south-east to town roost at 17:00 hrs. Also occasionally mid-morning roost, loafing or resting at administration area in gums.
July 2007		M. Mannion pers.com. Just before the three-week break noted birds were flying south in morning and returning from east at night. Not seen or heard any birds since returning to town of 19 August.
30 August 2007		M. Mannion pers.com. Flock of 40 – 50 flying in to roost in river gums on Woodada Road at 5.30 pm.
26 August 2007		B. White pers.com. Flock of 50 – 60 flying south over paddocks along creekline Erindoon Road near Campbell – White Road.
14 February 2007	29. 59. 04.0 S, 115. 11. 17.0 E	T. White pers.com. Seven birds feeding on pine cones at homestead.
9 March 2007	29. 59. 04.0 S, 115. 11.	T. White pers.com. Two birds feeding on pine cones at homestead.

DATE	LOCATION	COMMENTS
	17.0 E	
19 April 2007	29. 59. 04.0 S, 115. 11. 17.0 E	T. White pers.com. Two birds feeding on pine cones.
31 August 2007		P. Cooper pers.com. Has seen white-tails this year on his farm at North Eneabba, the first in 23 years.
13 July 2007		B. Johnstone pers.com. Noted that during the autumn – winter period flocks of up to 100 occasionally rest during the day in the river gums at Ocean Hill area. The birds often remaining in the river gums for much of the afternoon.



ENEABBA

Carnaby's Cockatoo Survey Area

ILUKA

ORIG: BGB DRAWN: BGB SCALE: 1:175,000 (A4) DATE: 10/12/2007 DWG No: Cockatoo Survey

FIGURE: 1

FURTHER ASSESSMENT OF SIGNIFICANT HABITAT FOR CARNABY'S COCKATOO *CALYPTORHYNCHUS LATIROSTRIS* IN THE ENEABBA REGION.

JUNE – JULY 2008.

R.E. & C. JOHNSTONE AND T. KIRKBY.

INTRODUCTION

The main aim of this work was to continue surveys that began in 2007 to assess and confirm the significance of breeding, feeding and roosting sites for Carnaby's Cockatoos within the future mining areas. Also to advise on whether the removal of vegetation from these areas was likely to result in a significant impact to the species. A further aim was to provide a detailed assessment of the level of usage of the Eneabba region by Carnaby's Cockatoos. The recent discovery that the large Eneabba flock remain in the area during the autumn – winter period when all other Carnaby's Cockatoos from the broader region vacate it after breeding poses important questions about their social organisation, flocking and movements (see below).

RESULTS AND DISCUSSION

Field visits to the project area and to various other parts of the Eneabba region were carried out on the 16 and 17 June and 18 and 19 July 2008. All observations of cockatoos including flock size and movements etc. were noted and all feeding sites (both recent and old evidence of feeding) were logged using GPS (see attached).

Important roosting sites identified include the main Eneabba town roost in exotic River Gums, the roost in tall exotic River Gums at Iluka Administration building in the project area and a satellite roost area on Woodada Road also in exotic River Gums. In 2007 important foraging areas identified included areas of remnant bushland on Eneabba Creek just north of Eneabba Township, areas west of IPL North, areas around Lake Indoon and cleared farmlands to east and west of township. In 2008 important foraging sites were identified mainly in regeneration areas throughout the project area and in a small patch of burnt remnant woodland in Eneabba Township. Also noteworthy on a regional basis was evidence of large numbers of birds feeding on Banksias in the Arrowsmith floodout in mid July.

In 2007 and 2008 a flock of 300 – 350 Carnaby's Cockatoos (including adult and juvenile birds) was observed to remain during the autumn – winter period in the

Eneabba area. These birds roost in tall River Gums in and around the township and forage in remnant native vegetation, areas of native vegetation revegetated after mining and in adjacent farmlands. While the region of origin of these birds is as yet unknown, it is noteworthy that they remain here throughout the autumn – winter period when virtually all other Carnaby's Cockatoos from the broader region (i.e. Three Springs, Moora and Badgingarra) vacate these areas after breeding.

Despite the Eneabba region (including the project area) being a very fragmented landscape it is now 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 or movements westwards and southwards, and enabled them to remain closer to their breeding grounds in an environment that supports this successfully over the 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. Assuming that the management of the project area continues including the revegetation of expansion areas, then the impetus for this flock to continue to visit the area and survive through time would be high.

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 two 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.

Food

During the recent surveys ten new food plants were recorded for Carnaby's Cockatoo (all of these were in the revegetated areas) namely :
Banksia hookeriana; Banksia leptophylla; Banksia (Dryandra) kippistiana; Hakea spathalata; Hakea smilacifolia; Hakea polyanthema; Hakea eneabba; Hakea psilorrhyncha; Hakea flabellifolia; and *Hakea costata.*

GROUND TRUTHING RESULTS.

T. Kirkby

16 June 2008

Flock of 52 roosting in exotic eucalypts at mine administration building, 29. 52. 35.7 S, 115. 17. 07.3 E.
Pers. comm. M. Mannion that there is normally about 300 at this roost between 10 am and midday, sleeping, preening and allopreening.

Recent evidence of feeding on nectar of *Hakea smilacifolia, Dryandra carlinoides* and *Banksia leptophylla* 29. 53. 48.7 S, 115. 17. 07.9 E.

Flock of 350 feeding on mulched Banksia seeds (*Banksia hookeriana* and *B. leptophylla*) taken from ground in mulched area. Mulch spread here in January – February 2008.
29. 53. 46.7 S, 115. 18. 07.0 E.

Flock of 350 (same group as previous record. After feeding headed 0.5 km east) socializing and feeding on *Dryandra sessilis* 29. 53. 42.7 S, 115. 18. 18.0 E.

Recent and old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 42.7 S, 115. 18. 15.0 E.

Old evidence of feeding on *Dryandra sessilis* seeds at 29. 53. 42.7 S, 115. 18. 15.0 E.

Recent and old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 42.7 S, 115. 18. 17.0 E.

Old evidence (extensive) of feeding on *Dryandra sessilis* seeds at 29. 53. 42.7 S, 115. 18. 17.0 E.

Old evidence of feeding on *Lambertia ? multiflora* (in 15 – 20 year old revegetation area) at 29. 53. 42.7 S, 115. 18. 17.0 E.

Old evidence of feeding on *Hakea eneabba* seeds at 29. 53. 42.7 S, 115. 18. 17.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 56.8 S, 115. 17. 45.4 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 56.0 S, 115. 17. 45.0 E.

16 June 2008

Old evidence of feeding on *Hakea psilorrhyncha* seeds at 29. 53. 56.0 S, 115. 17. 45.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 57.0 S, 115. 17. 44.0 E (revegetation area established in 1987).

Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 53. 57.0 S, 115. 17. 44.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 58.0 S, 115. 17. 44.0 E.

Old evidence of feeding on *Hakea smilacifolia* at 29. 53. 58.0 S, 115. 17. 44.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 54. 00.0 S, 115. 17. 44.0 E.

Old evidence of feeding on *Banksia menziesii* at 29. 54. 00.0 S, 115. 17. 44.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 54. 01.0 S, 115. 17. 44.0 E.

Old evidence of feeding on *Hakea smilacifolia* at 29. 53. 58.0 S, 115. 17. 44.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 11.0 S, 115. 17. 16.0 E.

Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 11.6 S, 115. 17. 16.2 E.

Recent and old evidence of feeding on *Banksia leptophylla* nectar at 29. 55. 09.6 S, 115. 17. 16.2 E.

1 calling in distance (to west) at 29. 55. 09.6 S, 115. 17. 16.2 E.

Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 55. 04.6 S, 115. 17. 15.2 E.

Old evidence of feeding on *Hakea flabellifolia* at 29. 55. 04.6 S, 115. 17. 16.2 E.

Recorded at 29. 53. 17.6 S, 115. 17. 07.2 E.

16 June 2008	Flock of 350 flying in from south in three large groups and roosted more to the south end of town, at 29. 49. 22.6 S, 115. 16. 23.2 E.
17 June 2008	Flock of 350 flying from roost area (Darling Street) at 0700 and headed roughly south in line with Mineral Sands Road 29. 49. 26.6 S, 115. 16. 26.2 E. Stopped briefly between here and administration building before moving off in same direction. Could not be found until later in the day near the Wandoo ridge area at south mine.
	Old and recent evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 10.6 S, 115. 15. 58.2 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 55. 10.6 S, 115. 15. 58.2 E.
	Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 09.6 S, 115. 15. 58.2 E.
	Extensive recent evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 09.6 S, 115. 15. 58.2 E.
	Recent evidence of feeding on *Banksia hookeriana* nectar (6 – 8 year old revegetation) at 29. 55. 09.6 S, 115. 15. 58.2 E.
	Old evidence of feeding on *Hakea polyanthema* seeds at 29. 54. 49.6 S, 115. 16. 36.2 E.
	Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 54. 49.6 S, 115. 16. 36.2 E.
	Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 54. 50.1 S, 115. 15. 36.2 E.
	Old evidence of feeding on *Hakea spathulata* seeds at 29. 54. 50.1 S, 115. 15. 37.2 E.
	Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 24.1 S, 115. 16. 55.2 E.
	Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 55. 24.1 S, 115. 16. 55.2 E.
	Recent and old evidence of feeding on *Dryandra sessilis* seeds at 29. 55. 24.1 S, 115. 16. 53.0 E.
	Recent evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 24.1 S, 115. 16. 53.0 E.

17 June 2008	Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 55. 29.1 S, 115. 16. 53.0 E.
	Old evidence of feeding on *Dryandra kippistiana* seeds at 29. 55. 25.1 S, 115. 16. 54.0 E.
	Recent evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 47.1 S, 115. 17. 08.0 E.
	Old evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 29.1 S, 115. 16. 53.0 E.
	Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 55. 48.1 S, 115. 17. 08.0 E.
	Old evidence of feeding on *Hakea costata* seeds at 29. 53. 58.1 S, 115. 17. 08.0 E.
	Old evidence of feeding on *Lambertia multiflora* seeds at 29. 56. 23.1 S, 115. 17. 55.0 E.
	Old evidence of feeding on *Banksia hookeriana* nectar at 29. 56. 46.1 S, 115. 16. 45.0 E.
	Old evidence of feeding on *Hakea smilacifolia* seeds at 29. 56. 46.1 S, 115. 16. 45.0 E. (Revegetation area established in 1987).
	Recent and old evidence of feeding on *Banksia hookeriana* nectar at 29. 55. 47.1 S, 115. 16. 44.0 E.
	Old evidence of feeding on *Lambertia multiflora* seeds at 29. 55. 47.1 S, 115. 16. 44.0 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 54. 58.1 S, 115. 17. 12.0 E.
	Old evidence of feeding on *Dryandra sessilis* at 29. 54. 58.1 S, 115. 17. 12.0 E.
	Flock of 350 (at 29. 54. 54.1 S, 115. 17. 46.0 E) left the minesite area and headed 1.5 km NW and perched in tall shrubs. Many immatures calling. Returned at 15:15 and resumed feeding but too far away to see which food. Could be heard calling from 1500 m with wind not in favourable direction. These birds are feeding 10.5 km from Eneabba town roost.
M. Ovans	Pers. comm. Observed a single Carnaby's at west site flying from west to east on 8 July 2008.

Mike Mannion	Pers. comm. 18 July 2008, now only a small flock, 8 – 10 birds around Eneabba in last month. Also observed a flock of 200 at south end of South Mine area earlier in month.
A. Tinker	Pers. comm. On 17 and 18 July 2008 observed huge numbers of *Banksia leptophylla* flowers on ground in the Arrowsmith floodout area and Bee Keepers Reserve.

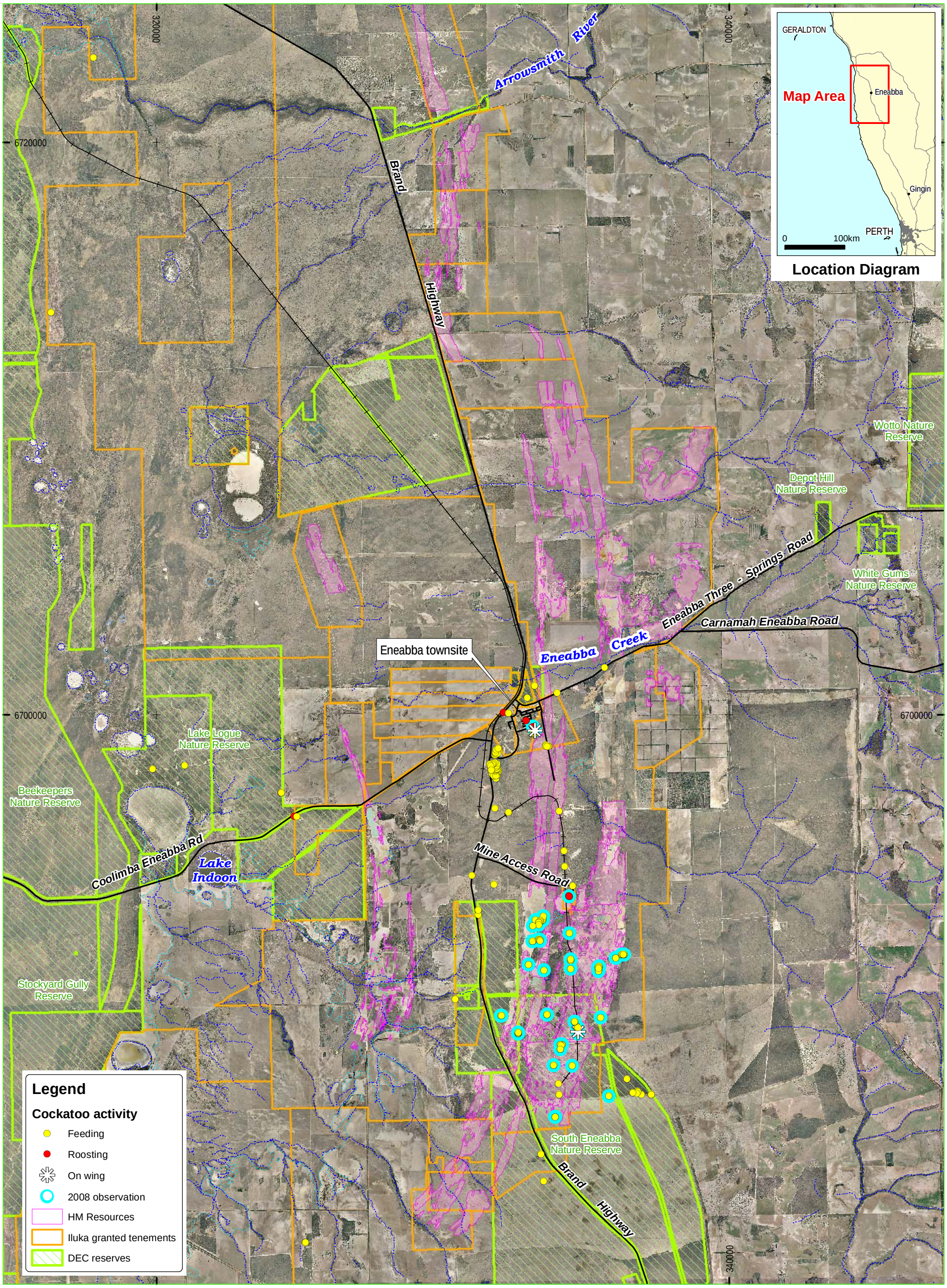
R.E. Johnstone & T. Kirkby

18 July 2008	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 02.0 S, 115. 16. 29.6 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 02.8 S, 115. 16. 29.2 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 03.9 S, 115. 16. 28.9 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 04.7 S, 115. 16. 27.9 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 05.0 S, 115. 16. 27.5 E.
	Old evidence of feeding on *Banksia attenuata* seeds at 29. 53. 05.1 S, 115. 16. 27.3 E.
	Evidence of feeding on *Lambertia multiflora* at 29. 53. 08.0 S, 115. 16. 27.5 E.
	Old evidence of feeding on *Lambertia multiflora* at 29. 53. 08.9 S, 115. 16. 28.3 E.
	Old evidence of feeding on *Banksia attenuata* seeds at 29. 53. 24.0 S, 115. 16. 26.7 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 23.9 S, 115. 16. 27.3 E.
	Old evidence of feeding on *Banksia attenuata* and *Banksia hookeriana* nectar at 29. 53. 25.1 S, 115. 16. 28.5 E.
	Old evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 25.6 S, 115. 16. 28.5 E.
	Old evidence of feeding on *Banksia hookeriana* nectar at 29. 53. 52.6 S, 115. 16. 13.1 E.

18 July 2008	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 03.6 S, 115. 16. 30.1 E.
	Old evidence of feeding on *Banksia leptophylla* nectar (2 trees) at 29. 53. 02.2 S, 115. 16. 32.4 E.
	Old evidence of feeding on *Banksia leptophylla* nectar (2 trees) at 29. 53. 00.1 S, 115. 16. 32.9 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 53. 59.4 S, 115. 16. 33.1 E.
	Old evidence of feeding on *Banksia leptophylla* nectar at 29. 52. 58.0 S, 115. 16. 33.4 E.
	Old evidence of feeding on *Banksia hookeriana* at 29. 53. 26.0 S, 115. 16. 19.3 E.
	Old evidence of feeding on *Banksia hookeriana at* 29. 53. 26.0 S, 115. 16. 20.4 E.
	Old evidence of feeding on *Dryandra sessilis* at 29. 53. 26.2 S, 115. 16. 18.8 E.
	Flock of 20 feeding in small burnt area of *Banksia* in Eneabba township.

RECOMMENDATIONS FOR FURTHER RESEARCH

- Further studies of food resource use by Carnaby's Cockatoos in Eneabba region.
- Targeted surveys for breeding sites in the Eneabba region (i.e. in Wandoo Reserve east of township and in Arrowsmith floodout area).
- Further work in the region to determine the significance of cockatoo migration and movements.
- Continue surveys in the area over the life of the mine to provide details on the continuing size and health of this population.



Photography flown: 2006

N

0 2.5 5 km

MGA Coordinates, GDA94

ENEABBA

CARNABY'S COCKATOO SURVEY, 2007 - 2008

ILUKA

ORIG: M.Mannion DRAWN: D.G.S. SCALE: 1:125,000 (A3) DATE: 15 Aug. 2008 DWG No: 187090 ver.00

FIGURE: **1**

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

R.E. & C. JOHNSTONE and T. KIRKBY

SPECIES BACKGROUND INFORMATION

Carnaby's Cockatoo *Calyptorhynchus latirostris*

Listed as Schedule 1 (Endangered) under the Western Australian *Wildlife Conservation Act 1950* and as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

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).

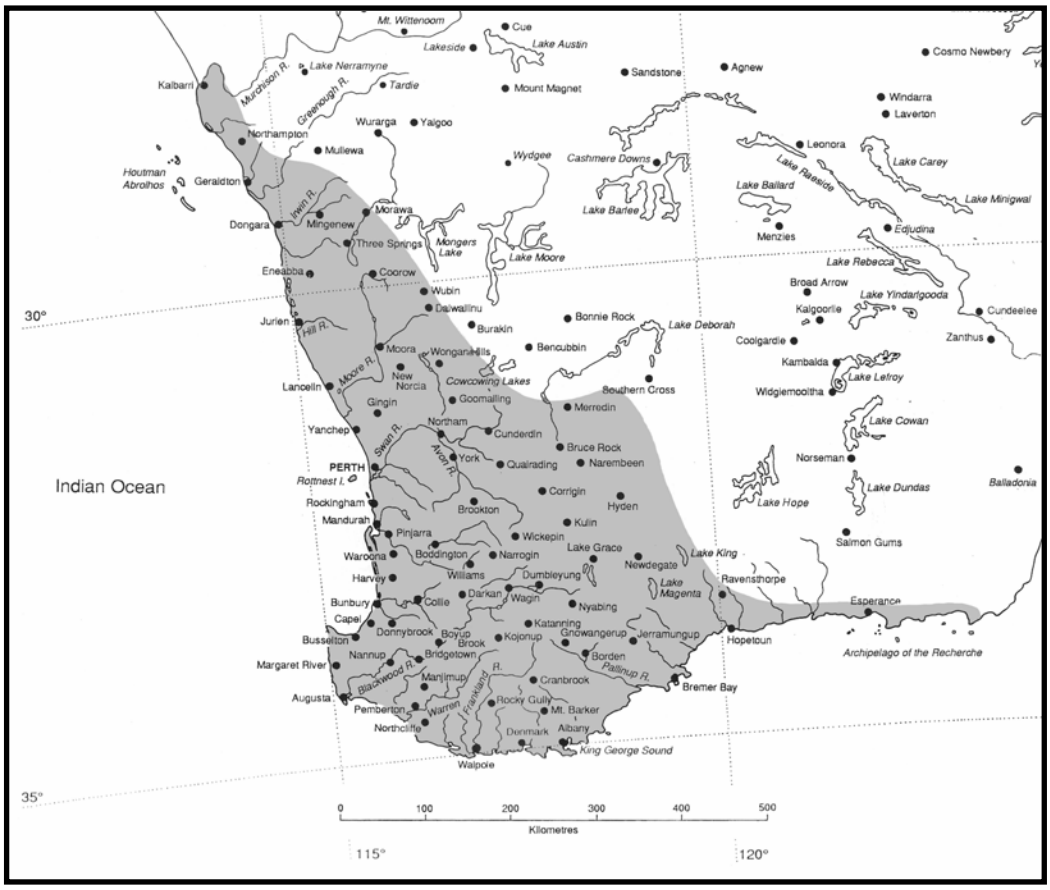


Figure 1. Distribution map of Carnaby's Cockatoo.

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 – 30 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 1930's. 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.

Roost sites include stands of River Gums and Flat-topped Yates.

Breeding

Breeding is recorded from early July to mid-December. Mainly in semiarid and subhumid interior from the 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, and Badgingarra 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 2 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.

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 and at Wanneroo and 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.

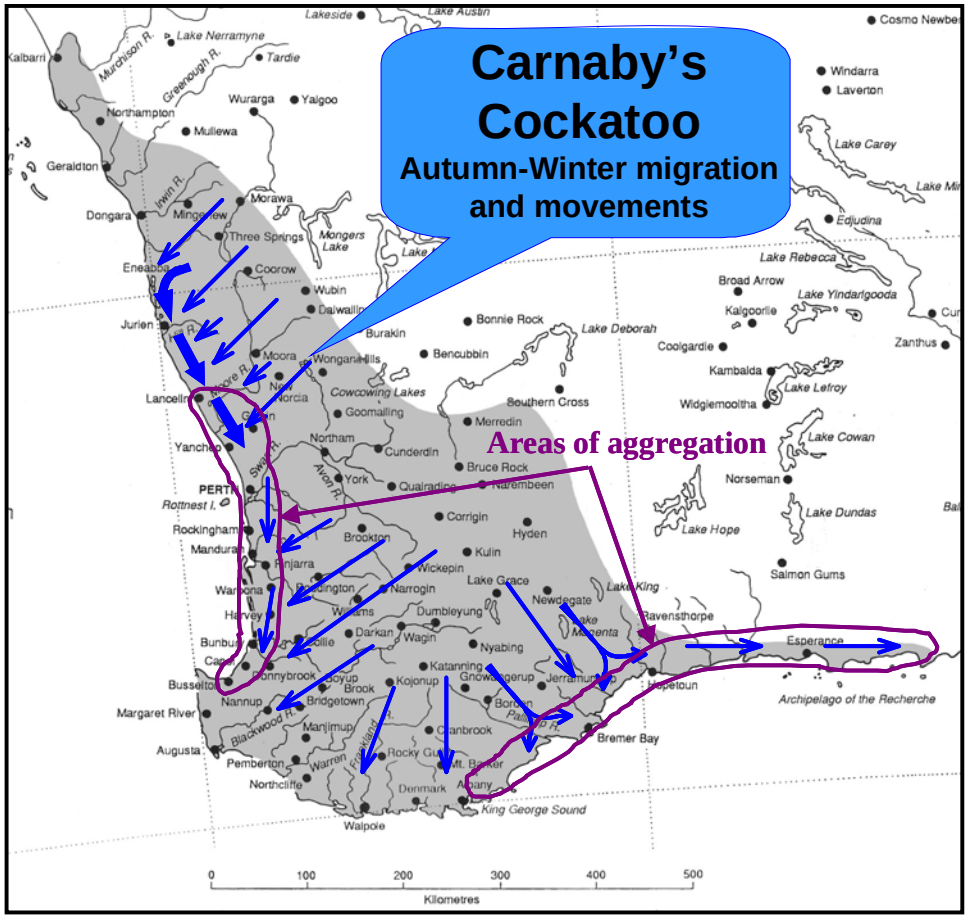


Figure 2. Migration and movements of Carnaby's Cockatoo.

Significance of the Eneabba Region

No evidence of Carnaby's Cockatoos breeding or any suitable breeding habitat for this cockatoo has been found in the Project area or in the vicinity of Eneabba. The Carnaby's Cockatoos 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. 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 back to their breeding sites. The exception to this movement is the large flock of about 300 that remain in the Eneabba region throughout the entire autumn - winter period.

The obvious question to answer here was what food resource or resources were used by this flock to enable them to remain in the Eneabba region during the late summer and autumn – winter period. The Eneabba flock roost in the township in tall river gums and leave the roost

at dawn each day to forage in patches of native vegetation including in parts of the Project area (remnant vegetation and rehabilitation areas) and in adjacent farmlands.

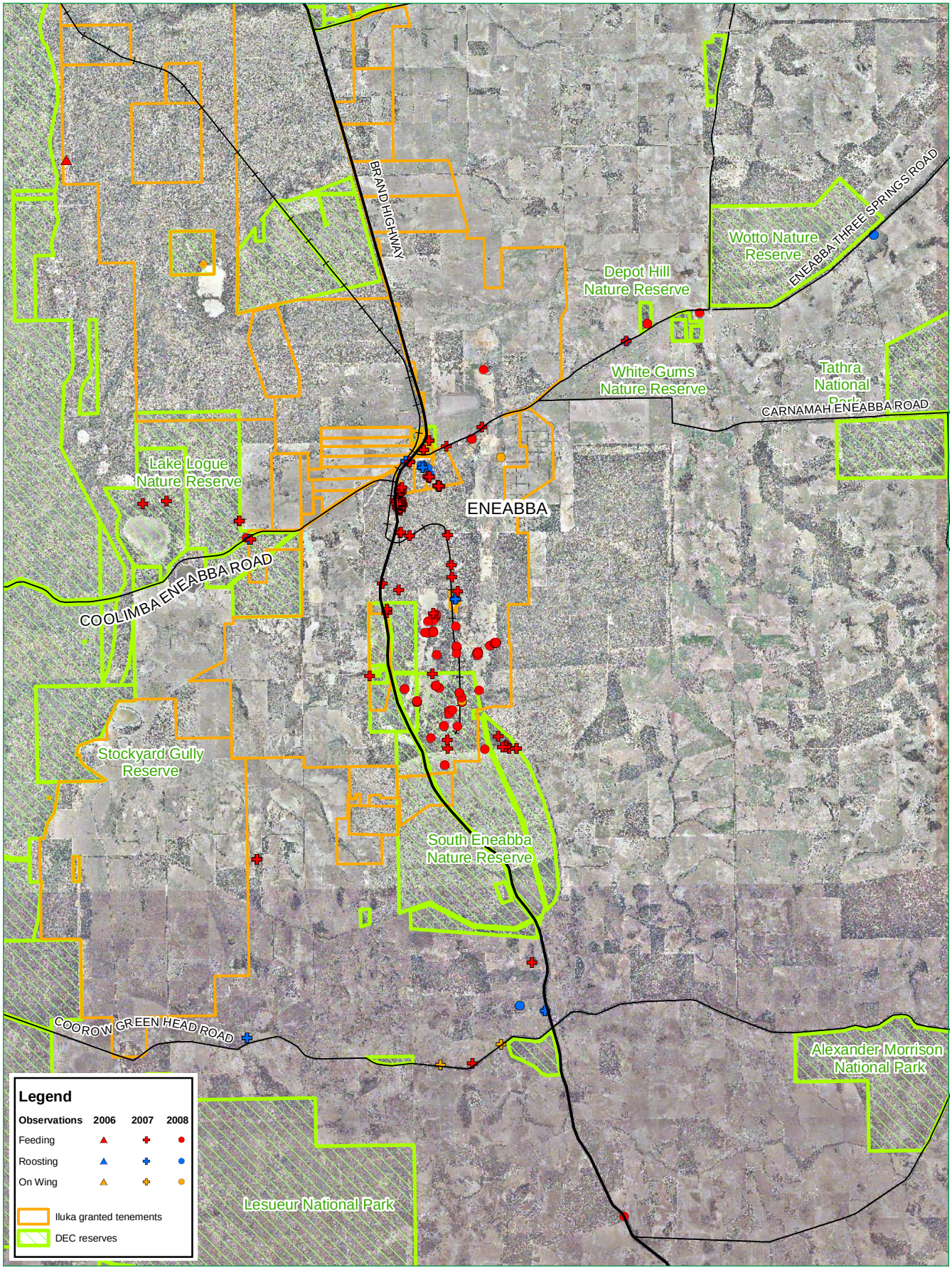
In 2006 – 2007 the flock was observed foraging mainly in patches of remnant bushland on Eneabba Creek just north of Eneabba township, areas west of IPL North, areas around Lake Indoon and cleared farmlands to the east and west of the township. One of the main foods during this time were the seeds of the Pie Melon *Citrullus lanatus* a summer growing annual native to Africa that is widespread in paddocks and along roadsides in the Eneabba area. The Pie 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. The Pie Melon 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.

In 2008 important roosting sites included the main Eneabba town roost in exotic River Gums, the roost in tall exotic River Gums at the Iluka Administration buildings in the project area and a satellite roost area on Woodada Road also in exotic River Gums. In 2008 important foraging sites were mainly in rehabilitated native vegetation areas throughout the mining area, in a small patch of burnt remnant woodland in the Eneabba township and *Banksia* woodlands west of Eneabba. Also noteworthy on a regional basis were reports of large numbers feeding in *Banksia* woodland in the Arrowsmith floodout 20km north of Eneabba and the Lake Logue and Beekeepers Nature Reserve areas in July 2008.

Field observations between 2006 and 2008 are provided in **Figure 3**.

Important foods in the Eneabba region

Major food in the Eneabba region include *Banksia* spp. (especially *B. attenuata, B. hookeriana, B. leptophylla, B. kippistiana* and *B. sessilis) Hakea* spp. (especially *H. Eneabba, H. spathalata, H. smilacifolia, H. polyanthema, H. psilorrhyncha, H. flabellifolia* and *H. costata)* and *Lambertia multiflora.* A number of the floristic community types identified by Woodman Environmental Consultants contain significant foraging species for Carnaby's Cockatoo e.g. FCT 1a and FCT 1b. Extensive evidence of foraging was recorded across the Project area in the northern section of IPL North and around South Tails.



N

0 3 6 km

Aerial Photography flown 2006

ENEABBA CARNABY'S COCKATOO OBSERVATIONS MAP 2006 - 2008

ILUKA

ORIG: J.Hesford DRAWN: LPC SCALE: 1:250,000 (A4) DATE: Feb 09 DWG No: 193641ver.00

FIGURE: 3

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 on the northern Swan Coastal Plain on major roads.
- Predation by feral predators

Possible mitigation measures include the following:

- Workforce education on the significance of the Carnaby's Cocakatoo and their reliance on the Eneabba region and mine site for roosting and foraging habitat.
- Maintain a mosaic of vegetation age classes especially those with *Banksia* (including *Dryandra*), *Hakea* and *Grevillea* spp. to increase foraging habitat.
- Enhance any degraded areas eg edges of roadways and unused tracks, administration buildings, rubbish tip and other small patches of bare ground with foraging species.
- Retain vegetation corridors especially those too and from roost sites.
- Retain artificial watering sites.
- Surveys of possible offset sites within the region, especially to identify breeding habitat of the Eneabba flock.
- Culling of competitive superabundant bird species at nesting sites.
- Control of feral predators.

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 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. Assuming that the management of the Project area continues to include the revegetation of expansion areas (that are currently rich in food plants), then the impetus for this flock to continue to visit the area and survive through time would be high.

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 two 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.

RECOMMENDATIONS FOR FURTHER RESEARCH

- Further studies of food resource use by Carnaby's Cockatoos in Eneabba region. Some of the FCT's have significant and important foraging species for Carnaby's Cockatoos. Based on findings from 2007 and 2008 surveys, foraging behaviour changes slightly from year to year and should be investigated further to ascertain which FCTs are preferred by Carnaby's as foraging habitat.

- Targeted surveys for breeding sites in the Eneabba region (i.e. in Wandoo Reserve east of township and in Arrowsmith floodout area). On a regional basis areas should be studied north to Arrowsmith and Yandanooka and south to Hill River and east to Watheroo.

- Further work in the region to determine the significance of Cockatoo migration and movements e.g. banding and tail marking of chicks at breeding sites within the region in order to gain information on the movements, demography, behaviour, morphology and site fidelity.

- Continue surveys in the area over the life of the mine to provide details on the continuing size and health of this population.