

Carnaby's Black-Cockatoo (*CALYPTORHYNCHUS LATIROSTRIS*) Recovery Plan

By Belinda Cale for the Carnaby's Black-Cockatoo Recovery Team



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DEPARTMENT OF
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CARNABY'S BLACK-COCKATOO
(CALYPTORHYNCHUS LATIROSTRIS)
RECOVERY PLAN

2002-2012

by

Belinda Cale

for the Carnaby's Black-Cockatoo Recovery Team

2003

Department of Conservation and Land Management
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Drawing of Carnaby's Black-Cockatoo
by

Judy Blyth

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FOREWORD

Recovery Plans are developed within the framework laid down in Department of Conservation and Land Management (the Department) Policy Statements Nos 44 and 50.

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of threatened species and ecological communities. The attainment of objectives and the provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views or the official position of individuals or organisations represented on the Recovery Team.

The Acting Executive Director, Department of Conservation and Land Management, the Conservation Commission of Western Australia and the Minister for the Environment have approved this Recovery Plan.. Approved Recovery Plans are subject to modification as dictated by new findings, changes in status of the taxon or ecological community and the completion of recovery actions. The provision of funds identified in this Recovery Plan is dependent on budgetary and other constraints affecting the Department and the need to address other priorities.

Information in this Recovery Plan was accurate at April 2003.

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SUMMARY

Carnaby's (or Short-billed) Black-Cockatoo *Calyptorhynchus latirostris* Carnaby 1948

Family: Psittacidae

Regions:

Midwest, Wheatbelt, South Coast, Swan, South West

Districts:

Shark Bay, Moora, Geraldton, Narrogin, Merredin, Katanning, Albany, Esperance, Swan Coastal, Perth Hills, Blackwood, Wellington.

Recovery Team:

Carnaby's Black-Cockatoo Recovery Team

Current status of taxon:

Endangered (EN)

Habitat requirements:

Breeding habitat: Uncleared or remnant areas of eucalypt woodland in the wheatbelt with large live or dead hollows and nearby areas of scrub and heath with numerous Proteaceous trees and shrubs.

Non-breeding habitat: After breeding Carnaby's Black-Cockatoo moves to higher-rainfall coastal areas with *Banksia* woodland and/or *Pinus* plantations and accessible water. Carnaby's Black-Cockatoo feeds on seeds and insect larvae from a variety of native species, including *Dryandra*, *Grevillea*, *Eucalyptus*, *Hakea*, *Lambertia* and *Callistemon* spp.

Recovery criteria:

This Recovery Plan will be deemed successful if:

- The species' extent of occurrence does not fall below 18 000 km²; and
- The number of breeding pairs at priority areas remains stable or increases.

This Recovery Plan will be deemed a failure if:

- The rate of population decline has not slowed down within 10 years; or
- population numbers have not increased within its present range and expanded into its former range

Recovery Actions:

Given the fact that much existing breeding habitat occurs on private property and that community interest in this species is very high, an underlying strategy is to attain a high level of public support and involvement.

1. Habitat management within priority areas.
2. Management of feeding habitat within priority areas.
3. Monitoring of populations.
4. Community involvement.
5. Captive-breeding programs.

Cost: \$2,253,100 over the first 5 years

Biodiversity benefits: The conservation of Carnaby's Black-Cockatoo depends the protection and management of remnant woodlands and heathlands in the wheatbelt of Western Australia, ecosystems are that under considerable threat from increasing salinity and other forms of land degradation.

1. INTRODUCTION

1.1 Description of species

Carnaby's (or Short-billed) Black-Cockatoo *Calyptorhynchus latirostris* Carnaby 1948 is one of five cockatoos of the genus *Calyptorhynchus* endemic to Australia. It is a large, black cockatoo with a white patch on its cheek, white bands on its tail and a strong curved bill. In males the bill is black and the eye-ring red. Females differ from males in having a light grey bill, grey eye-ring and a more distinctive cheek patch. Adults range from 53-58 cm in length (Johnstone & Storr 1998) and 540-790 g in weight (Saunders 1974a). Carnaby's Black-Cockatoo is closely related to Baudin's (or Long-billed) Black-Cockatoo *Calyptorhynchus baudinii* (Saunders 1974a, Adams *et al.* 1984). Although Carnaby's Black-Cockatoo differs from Baudin's Black-Cockatoo in having a shorter upper mandible, it is often difficult to distinguish between the two species unless familiar with their different calls and/or feeding habits (Saunders 1974a, Saunders 1979a, Saunders & Ingram 1995, Johnstone & Storr 1998).

1.2 Distribution

Carnaby's Black-Cockatoo is endemic to the south-west of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (Saunders 1974a, Saunders & Ingram 1995, Johnstone & Storr 1998). Most breeding occurs in areas receiving between 300 and 750 mm of annual average rainfall (Saunders 1974a). After breeding the species moves to higher-rainfall coastal areas, forming large flocks that wander in search of food (Saunders 1974a). It is during this time that Carnaby's Black-Cockatoos move into the range of Baudin's Black-Cockatoos, particularly in areas around pine plantations (Saunders 1974b). In addition, Baudin's Black-Cockatoos may move north in the period between March and September to the central and northern parts of the Darling Range (Johnstone & Storr 1998). Casual sightings of Carnaby's Black-Cockatoo were recorded on Rottnest Island during the summer of 1988 (Winnett 1989, D. Saunders¹ personal communication).

Carnaby's Black-Cockatoo is scarce and patchily distributed in the driest parts of its range and in the extreme south-west. It has shown a reduction in its range, particularly in the northern and eastern areas of the wheatbelt, largely because of the clearing for agriculture. This has resulted in a shift in its distribution further westwards and southwards since the middle of the century (Saunders 1990, Johnstone & Storr 1998).

1.3 Habitat

Carnaby's Black-Cockatoo occurs in uncleared or remnant areas of eucalypt woodland, principally Salmon Gum *Eucalyptus salmonophloia* or Wandoo *E. wandoo*, and shrubland or kwongan heath dominated by

¹ Dr Denis Saunders, Research Fellow, CSIRO Sustainable Ecosystems, GPO Box 284, Canberra ACT 2601

Hakea, *Dryandra* and *Banksia* species. A close association between feeding areas and the woodland nesting habitat is important to the breeding success of the cockatoo (Saunders 1977, 1986; Saunders & Ingram 1987). After the breeding season Carnaby's Black-Cockatoo moves to higher-rainfall coastal areas that feature areas of feeding habitat, such as heath, *Banksia* woodland and/or *Pinus* plantations, accessible water and trees around watercourses that provide shade in summer (Saunders 1980). Since the 1930s, pine plantations in coastal regions have become important feeding areas during the non-breeding season (Perry 1948, Saunders 1980). Carnaby's Black-Cockatoo occurs less frequently in Marri *Corymbia calophylla*, Jarrah *Eucalyptus marginata* and Karri *E. diversicolor* forests (Saunders 1980).

1.3.1 Hollow requirements

Carnaby's Black-Cockatoo nests in the hollows of live or dead eucalypts, primarily the smooth-barked Salmon Gum and Wandoo (Saunders 1982). Some breeding has been reported in Red Morrell *E. longicornis*, York Gum *E. loxophleba*, Tuart *E. gomphocephala*, Flooded Gum *E. rudis*, Gimlet *E. salubris*, Swamp Yate *E. occidentalis* and Marri *Corymbia calophylla* (Saunders 1982, Storr 1991, Johnstone & Storr 1998, K. Miller², personal communication; A. Doley³, personal communication). Carnaby's Black-Cockatoo is found nesting on private property, road and railway reserves, crown land and conservation estate. There are significant breeding areas located outside conservation estate, particularly along rail and road reserves (P. Mawson⁴, K. Miller personal communication) and on agricultural land (Saunders & Ingram 1998).

Carnaby's Black-Cockatoo nests in hollows situated from 2 to over 10 m above ground, averaging 6.3 m in height (Saunders 1979b). The depth of the hollow, from the lowest point of the entrance to the floor, ranges from 25 to over 250 cm, averaging 110 cm (Saunders 1979b). At Coomallo Creek one third of nesting attempts were made in the same hollow that was used the previous season (Saunders 1982). The birds rarely use the same hollow if the breeding attempt the previous season was unsuccessful.

Carnaby's Black-Cockatoos may compete for the use of hollows with Australian Shelducks *Tadorna tadornoides*, Australian Wood Ducks *Chenonetta jubata*, Grey Teal *Anas gracilis*, Pacific Black Ducks *Anas superciliosa*, Barn Owls *Tyto alba*, Southern Boobooks *Ninox novaeseelandiae*, Western Corellas *Cacatua pastinator butleri*, Galahs *Cacatua roseicapilla*, Australian Ringnecks *Barnardius zonarius*, Brushtail Possums *Trichosurus vulpecula* and feral bees *Apis mellifera* (Saunders 1979b, 1982; K. Miller personal communication). Tree hollows may be lost as a result of tree-fall, clearing, fire, collapse of the nest chamber floor or damage to the hollow by humans (Saunders 1979b).

² Mr Kingsley Miller, Department of Conservation and Land Management, PO Box 65, Broome WA 6725

³ Ms Alison Doley, Koobabbie, PO Box 1, Coorow WA 6515

⁴ Dr Peter Mawson, Department of Conservation and Land Management, Hayman Road, Kensington WA 6151

1.4 Life history and ecology

1.4.1 Movements

Carnaby's Black-Cockatoos are gregarious birds, occurring in pairs or small flocks during the breeding season. After fledging, the young move with their parents to their non-breeding feeding areas where other family groups join them. The cockatoos aggregate in large flocks that wander in search of food. In the Coomallo Creek area, cockatoos forage locally in heathland within 50 km of their breeding area (Saunders 1980). Populations further to the south move towards the coast and exploit areas where food is concentrated, such as heathlands, *Banksia* woodland and/or *Pinus* plantations (Orton & Sandland 1913; Perry 1948; Davies 1966; Sedgwick 1968, 1973; Saunders 1980). For example, birds of the central wheatbelt at Manmanning were observed at Yanchep Swamp on the coastal plain in mid-January (Saunders 1980). Around the Perth metropolitan area the cockatoos are present in pine plantations from January to June (Saunders 1974b). During the 1940s, Perry (1948) observed flocks of 5 000 to 6 000 birds in pine plantations, whereas Saunders (1974b) reported flocks of up to 1 500 to 2 000 in the early 1970s. In recent years flocks of over 5 000 birds have been reported in pine plantations north of Perth (N. Kolichis and R. Johnstone, personal communication⁵). Prior to the breeding season flocks of Carnaby's Black-Cockatoos break up into smaller units and return to their breeding areas (Saunders 1974a).

1.4.2 Diet and foraging ecology

Carnaby's Black-Cockatoos feed on the seeds of a variety of native and introduced plant species, nectar and insect larvae. The species is arboreal, but often comes to the ground to feed. It is known to consume seeds from species of *Banksia*, *Dryandra*, *Hakea*, *Grevillea*, *Allocasuarina* and *Eucalyptus* (Saunders 1974a, 1974b, 1980). Carnaby's Black-Cockatoo characteristically breaks the rim of Marri fruit open with its short bill, unlike Baudin's Black-Cockatoo which can extract the seeds directly with its long upper mandible (Saunders 1974a). The seeds of introduced plant species are consumed, particularly pines *Pinus* spp., Storksbill *Erodium* sp. and Wild Radish *Raphanus raphanistrum* (Saunders 1980, A. Doley, personal communication). Other seeds taken include Double Gees *Emex australis*, lupins, fruiting almonds (Saunders 1974a, 1980) and pecan nuts (R. Johnstone, personal communication). Carnaby's Black-Cockatoo has become a regular visitor to plantations of both *Pinus pinaster* and *P. radiata* in the south-west of Western Australia (Perry 1948, Saunders 1974b). For example, from 1967 to 1970 there was a significant increase in the consumption of pine cones in Gngangara Plantation between May and June each year (Saunders 1974b). In these areas the birds also fed on *Banksia attenuata* seed in the woodland surrounding the plantation (Saunders 1974b).

Carnaby's Black-Cockatoo has been observed taking the nectar from the flowers of *Dryandra* species (De Rebeira & De Rebeira 1977, Storr 1991, Johnstone & Storr 1998), *Lambertia inermis* (Storr 1991),

Callistemon viminalis (Mawson 1995), *Banksia grandis* and *Eucalyptus* spp. (Johnstone & Storr 1998). The cockatoos are known to feed on insects hidden in the flowers or fruits of *Banksia* species, such as the larvae of a wood-boring moth *Arthropora* sp. (Tortricidae) found in *Banksia tricuspis* (van Leeuwen & Lamont 1996) and the weevil *Alphitopis nivea* from *Banksia attenuata* fruits (Scott & Black 1981). They also are known to feed on the larvae of moths from the family Pyralidae found in flowers of *Dryandra* aff. *circioides* (Saunders 1980).

1.4.3 Reproduction

An intensive study of the breeding biology of Carnaby's Black-Cockatoo was conducted at Coomallo Creek and Manmanning from 1970 to 1976 inclusive (Saunders 1982), and less intensive studies at Moornaming, Tarwonga, Nereeno Hill and Three Springs (Saunders 1986). This research forms the basis of the following section.

Carnaby's Black-Cockatoos display strong pair bonds throughout their adult life. From July to September birds move back to their breeding area and begin searching for suitable nesting hollows. At Coomallo Creek and Manmanning eggs were laid between July and November. Clutch size varied from one to two eggs, with an average of 1.7. Eggs were laid asynchronously with an average of eight days between the laying of the first and second egg. The female incubated the eggs over a period of 28-29 days. Hatching success was higher for two-egg rather than one-egg clutches. In 95% of two-egg clutches the second nestling died within 48 h after hatching and it was extremely rare for both nestlings to fledge successfully. Initially the female alone broods and feeds the young. After two to three weeks both parents return at mid-morning and dusk to feed the young.

Fledgling success at Coomallo Creek was 63% compared to only 34% at Manmanning. Saunders (1982) suggested that lower levels of fledgling success at Manmanning than at Coomallo Creek were due to differences in food availability. Woodland and heathland at Coomallo Creek were continuous while the feeding heathland habitat at Manmanning was highly fragmented. Consequently, birds from Manmanning travelled further from their nests to forage; females at Manmanning foraged while brooding eggs, whereas at Coomallo Creek the females were dependent on the males for food; birds at Manmanning often did not return to the nest between dawn and dusk, while birds at Coomallo Creek invariably did; and the growth rate of nestlings was lower at Manmanning than at Coomallo Creek.

Further studies were consistent with the hypothesis that the breeding success of Carnaby's Black-Cockatoo was dependent on sufficient areas of heathland adjacent to the nest sites to provide the necessary food for the population. In a comparison of the breeding success of Carnaby's Black-Cockatoo at five sites, it was found that sites with extensive areas of native vegetation had greater breeding success than sites where little native

⁵ Nick Kolichis and Ron Johnstone, Western Australian Museum, Francis Street, Perth WA 6000

vegetation remained after clearing for agriculture (Saunders 1986, Saunders & Ingram 1987). Although there may be a surplus of trees with hollows of sufficient size at some sites, clearing of native vegetation has left little heathland adjacent to the remaining woodlands.

The breeding population of Carnaby's Black-Cockatoos at Coomallo Creek was monitored from 1971 to 1996 (Saunders and Ingram 1998). At this study site the area of native vegetation cover was reduced from 90% in 1959 to 25% in 1996. This loss of habitat has been implicated in a decline in the number of breeding attempts in the area from 80 attempts in 1975 to less than 40 by 1996. By 1977 Carnaby's Black-Cockatoos were no longer found breeding at Manmanning (Saunders & Ingram 1987).

On leaving the nest the young are dependent on their parents for several months. After fledging the juvenile remains with its parents, disperses with them to the non-breeding areas and returns to the breeding area the following breeding season (Saunders 1982). The young may remain in the vicinity of the nest hollow for a short period, prior to breeding, and then disperse away from its parents (Saunders 1982). Little is known about the association of juveniles with other birds between their second and fourth years (Saunders 1982). However, Saunders (1982) did observe that a two-year-old-male remained associated with his father for several years. Adult females were found to breed for the first time at four to five years of age.

1.4.4 Survival

The annual survival of tagged adults was 61-69% compared to only 15% for juveniles reaching 12 months of age after fledging (Saunders 1982). Wedge-tailed Eagles *Aquila audax* accounted for 74% of known deaths. It was suggested that the tagging of birds with wing-tags may increase the predation of birds, particularly by Wedge-tailed Eagles (Saunders 1982, 1988). Other factors known to cause mortality include road deaths, drowning, part of the body being caught in a tree hollow and shooting (Saunders 1982).

Carnaby's Black-Cockatoos are long-lived. In 28 years of monitoring the oldest female was at least 19 years old (Saunders & Ingram 1998). The average age of reproductively active individuals, or generation time, is estimated to be 15 years (D. Saunders, personal communication).

1.5 Reasons for listing

Carnaby's Black-Cockatoo is listed as 'rare or likely to become extinct' pursuant to the Western Australian *Wildlife Conservation Act 1950*. It has been ranked as Endangered by the Western Australian Threatened Species Scientific Committee using IUCN (1994) Red List Categories and Criteria, meeting Criterion A1ac. The Western Australian Minister of the Environment has endorsed this ranking. Carnaby's Black-Cockatoo meets Criterion A for Endangered as it has suffered a population decline of at least 50% over the past three generations or 45 years (generation time—the average age of breeding adults in the population—is estimated

to be 15 years). This trend is based on direct observation and a decline in area of occupancy and quality of habitat. Carnaby's Black-Cockatoo is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The Action Plan for Australian Birds 2000 listed Carnaby's Black-Cockatoo as Endangered EN A1abc+2abc (Garnett & Crowley 2000).

Carnaby's Black-Cockatoo is endangered because:

- much of its habitat in the wheatbelt region of Western Australia has been cleared or fragmented,
- clearing of heathland surrounding breeding sites has reduced the availability of food (seeds and insect larvae of native vegetation) for breeding birds and young,
- in many woodland remnants, the lack of eucalypt regeneration and the deterioration of hollows has reduced the availability of suitable nest hollows,
- on the Swan Coastal Plain its original food resources have been largely replaced by introduced pine plantations which are to be reduced significantly in area in the future, and
- it is a highly prized cage bird and is taken illegally from the wild. Often trees are cut down or the hollow severely damaged when young and eggs are taken, making them unsuitable for future breeding attempts.

As a result of these habitat changes and illegal activities, Carnaby's Black-Cockatoo has undergone a major decline in range, particularly in the drier areas of its range and the central wheatbelt (Saunders 1990). Regional extinctions are likely to continue for some decades since the birds are long-lived. Based on the distribution of birds during the breeding season, the total population of Carnaby's Black-Cockatoo is estimated to range from 11 000 to 60 000 birds (Saunders *et al.* 1985).

1.6 Existing conservation measures

Carnaby's Black-Cockatoos are held in captivity under two programs. One program, the captive-breeding program, involved the taking of eggs and chicks from the wild (Department of Conservation and Land Management 1999a), while the 'derelict' program involves injured cockatoos that are brought to the attention of the Department of Conservation and Land Management (the Department). Both of these programs involve licensed aviculturists, the Department and Perth Zoo, and aim to broaden the genetic base of the species in aviculture, lessen the value of birds, minimise the illegal taking of young from the wild, and thereby limit damage to nest trees and nesting hollows. A stud book of Carnaby's Black-Cockatoos of known provenance is maintained by Perth Zoo, and this information assists in determining whether birds held by licensed aviculturists are legally obtained. Over the last 10 years there has been a noticeable

decrease in the level of illegal poaching and the price of the cockatoos (K. Miller, personal communication). Injured or 'derelict' cockatoos contribute to the genetic stock of birds held in captivity. In addition, captive Carnaby's Black-Cockatoos provide a source of cockatoos for display and education purposes.

The captive-breeding program involves known-age birds. From 1996 to 1998, cockatoos were raised from eggs and nestlings collected in the wild under a joint partnership between the avicultural industry and the Department (Department of Conservation and Land Management 1999a). In captivity, the survival of birds to weaning age was found to be greater for chicks than for eggs and, therefore, only recently hatched chicks were collected in 1997 and 1998 (Department of Conservation and Land Management 1999a). A total of 148 eggs and chicks were collected during the three year period, of which 124 (84%) chicks had survived to 31 January 1999 (Department of Conservation and Land Management 1999a). All captive-raised birds were fitted with microchips to aid in identification and blood samples were collected to determine the sex of each bird. Blood samples were stored for future use in DNA studies. Monitoring of the nests from which eggs or a chick were collected indicated that 81 of 150 (54%) nests successfully fledged a chick to the wild (Department of Conservation and Land Management 1999a). In some cases the pair successfully re-nested. This fledgling success was slightly lower than an estimate based on data gathered by Saunders (1982). Environmental factors were implicated in the very low percentage of chicks fledged from nests monitored in 1997 (Department of Conservation and Land Management 1999a).

From February to May, Carnaby's Black-Cockatoos of 6 to 18 months of age are frequently brought to the attention of staff of the Department. Often these birds are weak, dehydrated or have been hit by a vehicle. Surviving birds may be kept by aviculturists as part of a 'derelict' breeding program, but remain the property of the Crown.

Over the last 10 years damaged hollows used by Carnaby's Black-Cockatoos have been repaired by staff of the Department (K. Miller personal communication).

Several primary schools in metropolitan and country areas have been involved in collecting seed and/or replanting native vegetation to provide more feeding areas for Carnaby's Black-Cockatoo (Jupp 1996).

Perth Zoo has established a public awareness program for school students and the general public that explains the threats to the continued survival of the species and what can and is being done to protect them.

Information sheets concerning Carnaby's Black-Cockatoo are available from the Western Australian Museum's Discovery Centre and the species is mentioned in the school education kit 'Threatened Species'.

1.7 Strategy for recovery

This Recovery Plan will run for a term of 10 years from 2002 to 2012. Given the fact that much existing breeding habitat occurs on private property and that community interest in this species is very high, an underlying strategy is to attain a high level of public support and involvement. The five primary strategies of this plan are outlined below.

i) Habitat management of priority areas

Identify priority areas

Carnaby's Black-Cockatoo has a widespread distribution in the south-west of Western Australia. Much of its breeding and feeding habitat has been destroyed by land clearance and much of the remaining habitat is degrading due to a lack of regeneration, weed invasion, increasing salinity and grazing pressures. Consequently, full restoration of Carnaby's Black-Cockatoo original habitat is not possible. Therefore, efforts in this recovery plan will be directed toward priority areas. The population growth of the Carnaby's Black-Cockatoo is primarily limited by factors associated with breeding, and consequently priority areas will focus on breeding sites. The selection of priority areas will involve:

- determining known breeding sites throughout Carnaby's Black-Cockatoo's current distribution,
- assessing the size and health of specific breeding populations,
- assessing the relative proportions of breeding and feeding habitat surrounding specific breeding sites,
- assessing the current and future availability of nesting hollows,
- determining a set of criteria, from the above information, to select a number of priority areas, and
- formulating a specific management plan for each priority area based on the recovery actions outlined in this plan.

These priority areas should provide a benchmark and inspiration for similar activities to be conducted elsewhere. Selection of priority areas will require consultation by the Recovery Team with the Department's staff, landholders and community groups. Determination of known breeding sites will involve the survey of areas in the southern wheatbelt, the gathering of known information from relevant Departmental Districts, the distribution of reply-paid postcards seeking information from landholders on breeding areas, and liaison with Birds Australia to share information gathered during the current Atlas project.

Feeding habitat in priority areas

During the breeding season Carnaby's Black-Cockatoo feeds primarily on the seeds of, and larvae within, native proteaceous plants found in heaths and shrublands. With the spread of agriculture in the Western Australian wheatbelt, the extent and connectivity of Carnaby's Black-Cockatoo feeding habitat has declined. In particular, the loss of feeding habitat surrounding breeding sites has reduced the availability of food for breeding birds and young (Saunders 1986, Saunders & Ingram 1987). Feeding habitat needs to be within 20 km of the breeding hollow for successful breeding to occur (D. Saunders pers. comm.). In extensively cleared areas, a mosaic of vegetation remnants that are not visually

isolated from their neighbours will increase the likelihood of the area being used by Carnaby's Black-Cockatoo (Saunders & Ingram 1987). At each priority area an appropriate strategic plan will be developed to:

- promote the retention of existing feeding habitat, and
- increase the availability of feeding habitat adjacent to the breeding area.

This will involve identifying existing remnants, determining which remnants are to be expanded or connected (based on factors such as size, soil type, proximity to breeding habitat), collecting seed and propagating appropriate species, negotiating with relevant land managers, devising planting layouts, and the planting and maintenance of revegetated areas.

Breeding habitat in priority areas

Woodland areas in the wheatbelt of Western Australia have been extensively cleared and there is little regeneration of woodland, particularly Salmon Gum (Yates *et al.* 1995). In addition, cockatoo species that feed on cereal crops, such as the Galah and Long-billed Corella, have increased their pre-settlement ranges (Saunders *et al.* 1985), and these species may compete with Carnaby's Black-Cockatoos for nest hollows. It is unclear whether nest hollow availability is currently limiting for Carnaby's Black-Cockatoo. However, deterioration of existing woodland and the lack of regeneration is likely to pose problems in the future (Saunders & Ingram 1987). Additionally, invasive species, mainly the Galah and the Western Long-billed Corella (northern subspecies) are extending their range in the wheatbelt and are competing with and excluding Carnaby's Black-Cockatoos from traditional nest hollows. At each priority area an assessment will be made of the number of breeding pairs found at the breeding site and the number of pairs nesting in hollows, as well as the occurrence of invasive galahs and corellas. This will provide a baseline for monitoring any temporal changes in hollow availability and use. In addition, at each priority area strategies will be developed and implemented to

- retain and protect existing nesting trees,
- limit hollow competition from other hollow-nesting species,
- increase hollow availability (by protecting young trees, tree planting, creating new hollows from logs, installing nest boxes and repairing substandard hollows), and
- promoting eucalypt regeneration within existing stands.

ii) Habitat management of non-breeding areas

In the non-breeding season, a large proportion of the Carnaby's Black-Cockatoo population moves to coastal regions to feed. Significant areas of native feeding habitat are currently located in land managed by the Department (e.g. National Parks and Reserves between Dongara and Perth). In southern areas of the wheatbelt, the location of Carnaby's Black-Cockatoo feeding habitats is poorly documented. For example, several breeding populations east of Katanning do not migrate to coastal areas (M. Graham⁶, personal communication). Throughout the Western Australian wheatbelt, strategies will be undertaken to maintain the health of existing reserves in which Carnaby's Black-Cockatoos feed. Sightings of Carnaby's Black-Cockatoo in reserves will be documented in existing Fauna Files and collated at a central database at Como.

⁶ Mr Mal Graham, formerly of Department of Conservation and Land Management, PO Box 811, Katanning WA 6317

Areas of feeding habitat also exist on lands other than conservation estate, such as those managed by private landholders. The Recovery Team, in liaison with groups such as Land Conservation District Committees, Bushcare, Land for Wildlife and the Urban Bushland Council, will encourage and promote practices to retain and increase areas of native vegetation that provide Carnaby's Black-Cockatoos with food.

Pine plantations near Perth and elsewhere in the south-west are regularly used by cockatoos in the non-breeding season. On the Swan Coastal Plain Carnaby's Black-Cockatoo's native food resources have been largely replaced by introduced pines, particularly those north of Perth. Most of these plantations fall within the proposed Gngangara Park, where there are plans to gradually remove most of the pines and replace them with native vegetation (Department of Conservation and Land Management 1999b). Studies of the use of pine plantations by Carnaby's Black-Cockatoos were conducted in the early 1970s (Saunders 1974b). Current knowledge of Carnaby's Black-Cockatoo use of the pine plantations within the proposed Gngangara Park is limited. It is unclear how many birds use these pine plantations, how dependent they are on them, and the extent to which pine plantations and adjacent banksia woodland are used. A study will be conducted to determine Carnaby's Black-Cockatoo use of the vegetation in Gngangara Park. Study results will be presented to the Recovery Team, and the team will make recommendations to the Gngangara Park Technical Working Group, with a view to developing guidelines for maximizing feeding habitat for Carnaby's Black Cockatoo. Re-vegetation is a major task and partnerships with other major stakeholders in relation to the Gngangara Mound and its waters will be negotiated.

The planting of Maritime Pine (*Pinus pinaster*) is being promoted in the Wheatbelt of Western Australia in rainfall zones greater than 400 mm to reduce the effects of rising saline water tables and at the same time produce a cash crop for land owners. It is not known whether Carnaby's Black-Cockatoo will utilise these plantations for feeding. Future use of Maritime Pines by Carnaby's Black-Cockatoos will be documented.

iii) Monitoring of the Carnaby's Black-Cockatoo population

Regular monitoring of Carnaby's Black-Cockatoo populations at each of the priority areas will provide information on the size of the breeding population and breeding success of the cockatoos in these areas. Monitoring of the number of breeding pairs and use of hollows in each priority area will be conducted each breeding season. Saunders (1986) described an easy method for determining whether breeding populations were obtaining sufficient food to raise their young. This method involved weighing nestlings and measuring the length of their folded left wing. Nestling weights were then plotted against the appropriate chick age, based on the wing length, and compared to data collected from Coomallo Creek. Nestling weights lower than the curve established at Coomallo Creek suggest that food is limiting. In addition, a food shortage may be indicated by the lack of feeding habitat surrounding the breeding. This method can be used to monitor the status of breeding populations in priority areas.

A long-term study of Carnaby's Black-Cockatoo at Coomallo Creek over the last 28 years has provided a significant amount of information on the biology of this species (Saunders & Ingram 1998). Additional monitoring and research at Coomallo Creek could provide information on the age structure, survival and longevity of Carnaby's Black-Cockatoo, and this knowledge would assist in determining the viability of populations in priority areas.

iv) Community involvement

Since Carnaby's Black-Cockatoo occurs over a range of land tenures, including private property, community involvement, requiring coordinated public information and participation program is an essential strategy for this Recovery Plan. This program will aim to facilitate public awareness and community involvement in projects concerning Carnaby's Black-Cockatoo.

In priority areas, good communication between the Recovery Team and individual landholders will be vital in the rehabilitation of land and monitoring of Carnaby's Black-Cockatoo populations. This communication will be through staff of the Department, Birds Australia and other interested community groups and individuals. On private property, permission for access and notification for all research and management actions carried out will be essential. Often revegetation of farmland will provide additional benefits to landholders, especially if tied in with the State Salinity Strategy or Land for Wildlife projects.

v) Captive-breeding programs

Sufficient stocks of Carnaby's Black-Cockatoo have now been collected from the wild. A stud book for Carnaby's Black-Cockatoos held in captivity under the captive-breeding program is maintained by the Perth Zoo. Staff at The Department's Wildlife Branch are responsible for the delivery of Carnaby's Black-Cockatoos to licensed aviculturists.

1.8 Recovery team

A Carnaby's Black-Cockatoo Recovery Team was appointed in 1999 to coordinate the recovery of Carnaby's Black-Cockatoo and the development and implementation of the Recovery Plan. At December 2001, the team comprised representatives from the Department (Nature Conservation Division, Midwest Region and Swan Region), CSIRO Sustainable Ecosystems, the Western Australian Museum, Perth Zoo, Birds Australia and a private landowner. Other organisations or individuals that become involved with the recovery plan may be invited to join the Recovery Team.

The Recovery Team will report annually on the implementation of this plan to The Department's Corporate Executive and funding agencies.

2. RECOVERY OBJECTIVE AND CRITERIA

Since Carnaby's Black-Cockatoo is long-lived, with an average generation time of 15 years, and individuals do not breed until four to five years of age it will not be possible to achieve down-listing from endangered to vulnerable within the 10 year time frame of this Recovery Plan. Therefore, the objective of this Recovery Plan is to slow the rate of population decline of Carnaby's Black-Cockatoo within 10 years by:

- (1) ensuring the species persists within its present range; and
- (2) increasing population numbers within its present range and by expansion into its former range.

The criteria for successfully achieving this objective are that:

- (1) The extent of occurrence does not fall below 18 000 km² (it is not possible at present to provide a figure for a desirable area of occupancy).
- (2) The number of breeding pairs at priority areas remains stable or increases. A base figure for each priority area will be established by Year 3.

3. CRITICAL HABITAT

Critical habitat is habitat identified as being critical to the survival of a listed threatened species or community. Habitat means the biophysical medium or media: (a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or (b) once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)).

Critical habitat is difficult to designate accurately for Carnaby's Black-Cockatoo, mainly because the species moves over long distances and now depends partly on altered landscapes. Work proposed under this recovery plan will refine our knowledge of critical habitat.

For Carnaby's Black-Cockatoo, the following should be considered to be critical habitat:

- remaining woodland breeding sites in the south west of Western Australia, and feeding and watering areas used during the breeding period;
- woodland sites known to have supported breeding in the past and which could be used in the future if new food resources are established; and
- coastal kwongan (heath) and other areas where the cockatoos feed when not breeding;

4. GUIDE FOR DECISION-MAKERS

Possible future actions that may constitute 'significant impact' on Carnaby's Black-Cockatoo or its habitat include:

- any action, including changes in land use within catchments, that leads to the clearing or degradation of woodland areas used now or potentially used for breeding;
- any action that prevents natural regeneration of woodland areas used for breeding;
- any action that leads to the loss of areas of native vegetation used for feeding;
- the elimination of extensive areas of pine plantations on the Swan Coastal Plain on which major flocks now depend for food;
- any action that increases the distribution or promotes the abundance of hollow competitors, especially feral bees; and
- illegal taking from the wild for the cage bird trade.

5. RECOVERY ACTIONS

Recovery actions for the Carnaby's Black-Cockatoo are presented below. Costings have been calculated in 2001 dollars. Cost estimates are provided for the first three years of the plan's implementation. Costs in the first three years of the plan's implementation will be directed toward identifying priority areas, managing feeding habitat used in the non-breeding season, increasing community awareness of Carnaby's Black-Cockatoo and this Recovery Plan, and maintaining the captive-breeding program. Once priority areas are selected in Year 3, habitat management of these areas will commence.

5.1 Habitat management within priority areas

5.1.1 Identify priority areas

Selection of priority areas will require consultation by the Recovery Team with staff of the Department, landholders and community groups. Determination of known breeding sites will involve the survey of areas in the southern wheatbelt, the gathering of known information from relevant Departmental Districts, the distribution of reply-paid postcards seeking information from landholders on breeding areas, and liaison with Birds Australia to share information gathered during the current Atlas project. Initial Priority Areas are Koobabbie (near Coorow) and Minyolo (a nature reserve near Cataby). Potential priority areas include Coomallo Creek/Lesueur National Park/Cantabilling, Moora/Piawanning district, Lake Magenta/Dragon Rocks reserves, Tarwonga, Moornaming, and Manmanning.

Action: Determine known breeding sites
Responsibility: Birds Australia, Recovery Team
Completion: Year 3
Cost: \$27 500 in Year 1, review at end of 2002

Action: Assess the size and health of specific breeding populations
Responsibility: The Department
Completion: Year 3
Cost: \$1 000 in year 1 for three populations, \$2 000 in succeeding years.

Action: Assess the relative proportions of breeding and feeding habitat for specific breeding populations
Responsibility: The Department
Completion: Year 3
Cost: \$500 in year 1, \$1 000 thereafter.

Action: Select priority areas and formulate specific plans for each area
Responsibility: Recovery Team/Departmental Regions
Completion: Year 3
Cost: \$1000.

5.1.2 Management of breeding habitat within priority areas

a) *Maintain nesting hollows*

At each priority area, nesting hollows will be monitored and efforts made to maintain these nesting hollows by:

- repairing damaged or unused tree hollows,
- minimising the impact of hollow competitors,
- minimising the illegal poaching of birds and subsequent damage to hollows,
- fencing off woodland remnants, where necessary,
- preventing fire in woodlands, and
- controlling nest competitors.

It is likely that these activities will involve considerable liaison with landholders, Local Government Authorities, Main Roads Western Australia, Westrail and groups such as the Roadside Conservation Committee, Land Conservation District Committees, Land for Wildlife and Birds Australia. For example in the Moora district, extensive areas of road and rail reserves are used by Carnaby's Black-Cockatoos for breeding. Alternative vesting or a management protocol (e.g. management of fires, chemical use, access) may need to be negotiated with Main Roads Western Australia and Westrail.

Action: Monitor and maintain nesting hollows, fire prevention
Responsibility: relevant Departmental Districts, landholders
Completion: Ongoing
Cost: \$10 000 per year

Action: Minimise illegal poaching throughout breeding distribution
Responsibility: The Department's Wildlife Branch
Completion: Ongoing
Cost: \$25 000 per year

Action: Fence woodland remnants
Responsibility: Departmental Districts, Recovery Team, landholders
Completion: Ongoing
Cost: \$8 000 in year 1, variable thereafter; NHT funding to be sought

Action: Control nest competitors
Responsibility: Landholders with assistance from Wildlife Branch of the Department
Completion: Ongoing
Cost: Year 1: Koobabbie \$2700, Minyolo \$700, will increase as additional Priority Areas are established.

b) Increase hollow availability

At priority areas, nest boxes and/or modified tree stumps will be used to increase the availability of hollows. The planting of trees with the potential to develop hollows (e.g. Salmon Gum and Wandoo) will be promoted in tree planting programs in liaison with landholders, Land Conservation District Committees and community groups. Guidelines will be developed for planting to be associated with existing woodland remnants and/or feeding habitat. Monitoring is essential, as Carnaby's Black-Cockatoo is reluctant to use artificial hollows in captivity.

Action: Design, construct and erect nest boxes and logs
Responsibility: Relevant Departmental Districts with landholders, Land Conservation District Committees (LCDCs), community groups

Completion: Ongoing
Cost: no cost in Year 1, to be reviewed in later years.

Action: Develop and publish planting guidelines in consultation with stakeholders
Responsibility: Relevant Departmental Districts, Recovery Team
Completion: Ongoing
Cost: see 3.4

c) Regeneration of woodland

In Salmon Gum and Wandoo remnants strategies will be developed and implemented to promote regeneration of woodland. In addition to the exclusion of livestock and weed management, techniques may be required to reduce soil compaction and restore the infiltration of water into the soil. Trees can be planted in open areas within a remnant and/or on the edge of the remnant. These activities will involve liaison with landholders, Land Conservation District Committees, Greening Australia and community groups. This is a long-term strategy—in Salmon Gum, one of the main species used by Carnaby’s Black-Cockatoo, hollows take about 130 years to develop.

Action: Develop management guidelines for woodland regeneration
Responsibility: relevant Departmental Districts/LCDCs/Recovery Team
Completion: Ongoing
Cost: see 3.4

5.1.3 Management of feeding habitat within priority areas

a) Retention of feeding habitat

Much feeding habitat already exists in publicly-owned land managed by the Department. Ongoing management strategies in these areas should maintain the health of these habitats through hygiene, to prevent the introduction and spread of *Phytophthora*, and appropriate fire management to maintain natural processes of heathlands. In other areas the retention of feeding habitat will involve the Recovery Team liaising, through appropriate channels, with landholders and other organisations in which the land is vested.

Action: Manage existing heath/shrubland reserves
Responsibility: relevant Departmental Districts/Recovery Team
Completion: Ongoing
Cost: \$200 000 per year (note: this is a nominal figure, management costs of the relevant publicly-owned land are likely to be much higher)

b) Planting of feeding habitat

In priority areas, the planting of heath/shrubland species or feeding habitat will focus on connecting the breeding site with potential feeding sites and/or expanding the size of existing feeding habitat. Planting of heath/shrubland around woodland remnants may improve the health of the remnant by providing a buffer against weed invasion. Revegetation of feeding habitat could be worked into actions under the State Salinity Strategy, and will involve liaison with landholders, Land Conservation District Committees and Greening Australia.

Action:	Prepare and implement revegetation strategies for each priority area, taking into consideration the range of planning and operational requirements needed for a successful revegetation program.
Responsibility:	Relevant Departmental districts/LCDCs/Landholders
Completion:	Ongoing
Cost:	no cost in year 1, to be reviewed in later years

5.2 Management of feeding habitat in non-breeding areas

5.2.1 Native feeding habitat

In the non-breeding season, significant areas of feeding habitat in native bushland are located in publicly-owned lands managed by the Department. Ongoing management strategies in these areas should maintain the health of these habitats through fire management and hygiene to prevent the introduction and spread of *Phytophthora*.

Action:	Manage heath/shrubland in land managed by the Department
Responsibility:	Relevant Departmental Districts
Completion:	Ongoing
Cost:	\$200 000 per year (note: this is a nominal figure, management costs of the relevant publicly-owned land are likely to be much higher)

Areas of feeding habitat also exist on land managed by private landholders, Main Roads Western Australia and Westrail. In liaison with groups such as Land Conservation District Committees, Bushcare, Land for Wildlife and the Urban Bushland Council, the Recovery Team will encourage and promote practices that will retain and increase areas of native vegetation that provide Carnaby's Black-Cockatoo with feeding habitat.

Action:	Develop guidelines for management of feeding habitat
Responsibility:	Recovery Team/relevant Departmental districts
Completion:	Ongoing
Cost:	see 3.4

5.2.2 Non-native feeding habitat

a) Gnangara Park

A study of the use by Carnaby's Black-Cockatoos of the vegetation in Gnangara Park will determine their needs and whether the birds will be significantly affected by planned changes to the vegetation. Guidelines for native bush management and regeneration within Gnangara Park will be developed, and implemented in partnership with other stakeholders, to maximise Carnaby's Black-Cockatoo feeding habitat.

Action:	Surveys of Carnaby's Black-Cockatoos' use of Gnangara Park
Responsibility:	Consultant scientist
Completion:	Year 3
Cost:	\$15 000 in year 2 (6 months half-time salary plus overheads)

b) Maritime Pine program

The planting of Maritime Pine (*Pinus pinaster*) is being promoted in the Wheatbelt of Western Australia in rainfall zones greater than 400 mm to reduce the effects of rising saline water tables and at the same time produce a cash crop. It is not known to what extent Carnaby's Black-Cockatoos will utilise these plantations for feeding. The Recovery Team and staff of the Department will liaise with staff of the Forest Products Commission involved in the Maritime Pine program to maintain records of the use of plantations by Carnaby's Black-Cockatoo and to encourage landholders to keep records of cockatoo usage of their plantations.

Action: Develop a log book, and/or use current District Fauna Files
Responsibility: Recovery Team, WATSCU, District staff, Forest Products Commission
Completion: Year 2
Cost: \$200 in year 1

5.3 Monitoring of population

Regular monitoring of Carnaby's Black-Cockatoo populations at each of the priority areas will provide information on the population densities and breeding success of the cockatoos in these areas, by determining the number of breeding pairs and use of hollows. A Pilot Project will be carried out at Koobabbie in Year 1 to develop methods. Nestling health may be assessed using the method described in Saunders (1986). Nestling health will be monitored at least every three years in all Priority Areas.

Action: Develop monitoring procedures for landholders, print log books
Responsibility: Private landholders with help from the Department
Completion: Ongoing
Cost: \$500 in Year 1, costs for additional years to be developed after pilot project

Action: Monitoring of nestling health
Responsibility: The Department's Wildlife Branch, relevant Departmental districts
Completion: Ongoing
Cost: \$1 800 per year (\$9 000 over five years)

5.4 Community involvement

A source of information, 'The Carnaby's Black-Cockatoo Recovery Kit', will be used to increase community awareness of Carnaby's Black-Cockatoo and the Recovery Plan. This information will be aimed towards Landcare groups, school groups, landholders, councils and the metropolitan public. Agencies and programs such as Bushcare, Land for Wildlife and the Urban Bushland Council, through their extension networks, could play a role in engaging relevant landholders in a given area and encouraging and/or promoting practices that will assist in conserving Carnaby's Black-Cockatoo habitat. The local press and other media are additional means by which information will be provided to the general public.

A number of leaflets concerning Carnaby's Black-Cockatoos have already been produced by Perth Zoo, the WA Museum and the Department (eg CALM Wildlife Note no. 16/99). These leaflets or information contained within them could be incorporated into the Recovery Kit.

Actions: Design and production of 'Recovery Kit'
Responsibility: The Department/Perth Zoo Education/WA Museum
Completion: Year 2
Cost: \$3 000

5.5 Captive-breeding programs

Sufficient stocks of Carnaby's Black-Cockatoo have now been collected from the wild for the captive-breeding program. The 'derelict' breeding program is on-going. The Department's Wildlife Branch is responsible for the delivery of Carnaby's Black-Cockatoos from both the captive-breeding and 'derelict' programs to licensed aviculturists.

Action: Maintain captive-breeding program
Responsibility: The Department's Wildlife Branch/Perth Zoo
Completion: Ongoing
Cost: \$1500 per annum

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IMPLEMENTATION TABLE – CARNABY’S BLACK-COCKATOO RECOVERY PLAN

Action No.	Recovery actions	Cost first 5 years	Responsibility
1	Habitat management within priority areas		
	Identify priority areas	\$31,500	The Department, Birds Australia, Recovery Team
	Management of breeding habitat within priority areas		
	Maintain nesting hollows	\$186,400	The Department, Recovery Team, Landholders
	Increase hollow availability	To be reviewed in later years	The Department, Recovery Team, Landholders, LCDCs, community groups
	Regeneration of woodland	To be reviewed in later years	The Department, Recovery Team, LCDCs
2	Management of feeding habitat within priority areas		
	<i>a) Retention of feeding habitat</i>	\$1,000,000	The Department, Recovery Team
	<i>b) Planting of feeding habitat</i>	To be review in later years	The Department, LCDCs, Landholders
	Management of feeding habitat in non-breeding areas		
	Native feeding habitat	\$1,000,000	The Department, Recovery Team
	Non-native feeding habitat		
	<i>a) Gnangara Park</i>	\$15,000	Consultant
	<i>b) Maritime Pine program</i>	\$200	The Department, Forest Products Commission
3	Monitoring of population	\$9,500	The Department, Landholders
4	Community involvement	\$3,000	The Department, Perth Zoo, WA Museum
5	Captive-breeding programs	\$7,500	The Department, Perth Zoo
Total Cost first Five years		\$2,253,100	