# Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan

Department of Environment and Conservation
Our environment, our future

Australian Government

# FOREST BLACK COCKATOO (BAUDIN'S COCKATOO *Calyptorhynchus baudinii* AND FOREST RED-TAILED BLACK COCKATOO *Calyptorhynchus banksii naso*) RECOVERY PLAN

**2008**

# CONTENTS

## FOREWORD

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

Recovery Plans outline the recovery actions that are required to address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

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 is 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.

This Recovery Plan was approved by the Department of Environment and Conservation, Western Australia. 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, as well as the need to address other priorities.

The Recovery Plan was prepared with financial support from the Australian Government to be adopted as a National Recovery Plan under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Information in this Recovery Plan was accurate on 14 May 2008.

### Recovery plan preparation

This Recovery Plan was prepared by Tamra Chapman (Department of Environment and Conservation) for the Forest Black Cockatoo Recovery Team. John Blyth (now retired), Peter Mawson and Ken Atkins (Department of Environment and Conservation) reviewed the recovery plan and Tony Kirkby (Western Australian Museum) provided the cover photographs.

## SUMMARY

**Baudin's Cockatoo *Calyptorhynchus baudinii* Lear 1832**

| | |
|---|---|
| **Family**: | Psittacidae. |
| **DEC Regions**: | Swan, Wheatbelt, South Coast, Warren, South West. |
| **DEC Districts**: | Swan Coastal, Perth Hills, Narrogin, Katanning, Albany, Frankland, Donnelly, Blackwood, Wellington. |
| **Current status of taxon**: | Endangered. |
| **Breeding habitat**: | Nests in the hollows of mature Marri *Corymbia calophylla*, Karri *Eucalyptus diversicolour* and Jarrah *Eucalyptus marginata* in the lower south-west. |
| **Feeding habitat:** | Mainly feeds on the seeds and flowers of Marri in the forested regions of the south-west, the seeds of the Proteaceous *Banksia grandis, B. littoralis, B. ilicifolia, Hakea undulata, H. prostrata, H. trifurcata*, and *Dryandra* spp., as well as *Erodium botrys*, Jarrah and insect larvae. Also feeds on apple and pear seeds in orchards. |

**Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* Gould 1837**

| | |
|---|---|
| **Family:** | Psittacidae. |
| **DEC Regions:** | Swan, Wheatbelt, South Coast, Warren, South West. |
| **DEC Districts:** | Swan Coastal, Perth Hills, Narrogin, Katanning, Albany, Frankland, Donnelly, Blackwood, Wellington. |
| **Current status of taxon:** | Vulnerable. |
| **Breeding habitat:** | Nests in the hollows of mature Marri *Corymbia calophylla*, Jarrah *Eucalyptus marginata* and Karri *E. diversicolour* in south-west forests and may only breed in years when Marri is fruiting in abundance. |
| **Feeding habitat:** | Feeds on Marri and Jarrah in south-west forests and Blackbutt *E. patens*, Albany Blackbutt *E. staeri*, Sheoak *Allocasuarina fraseriana*, Snottygobble *Persoonia longifolia*. Also feeds on the non-indigenous native Spotted Gum *E. maculata* and Cape Lilac *Melia azedarach* on the Swan Coastal Plain. |

**Habitat critical for survival of *Calyptorhynchus baudinii* and *C. banksii naso*:**
The habitat critical to survival and important populations of Forest Black Cockatoos comprises all Marri *Corymbia calophylla*, Karri *Eucalyptus diversicolour* and Jarrah *Eucalyptus marginata* forests, woodlands and remnants in the south-west of Western Australia receiving more than 600 mm of annual average rainfall.

| | |
|---|---|
| **Recovery Plan objective**: | To stop further decline in the breeding populations of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo and to ensure their persistence throughout their range in the south-west of Western Australia. |
| **Recovery Team:** | Forest Black Cockatoo Recovery Team, established in 2005. |

**Criteria for success**

This Recovery Plan will be deemed successful if:

- The extent of occurrence of Forest Black Cockatoos in Western Australia remains stable or increases in the next ten years;
- The number of breeding pairs of Forest Black Cockatoos in Western Australia remains stable or increases in the next ten years;
- The number of Forest Black Cockatoos in each roosting flock remains stable or increases in the next ten years; and
- The proportion of juvenile Forest Black Cockatoos in each roosting flock remains stable or increases in the next ten years.

**Criteria for failure**

This Recovery Plan will be deemed unsuccessful if:

- The extent of occurrence of Forest Black Cockatoos in Western Australia decreases by more than 10 per cent in the next ten years;
- The number of breeding pairs of Forest Black Cockatoos in Western Australia decreases by more than 10 per cent in the next ten years;
- The number of Forest Black Cockatoos in each roosting flock decreases by more than 10 per cent in the next ten years; and
- The proportion of juvenile Forest Black Cockatoos in each roosting flock decreases by more than 10 per cent in the next ten years.

**Recovery Actions:**

14.1 Seek the funding required to implement future recovery actions.
14.2 Determine and promote non-lethal means of mitigating fruit damage by Baudin's Cockatoo in orchards.
14.3 Eliminate illegal shooting.
14.4 Develop and implement strategies to allow for the use of noise emitting devices in orchards.
14.5 Determine and implement ways to remove feral Honeybees from nesting hollows.
14.6 Identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment.
14.7 Determine and implement ways to minimise the effects of mining and urban development on habitat loss.

### 1.1. 14.7 Determine and implement ways to minimise the effects of mining and urban development on habitat loss.

At present, the process of mining of bauxite, alumina, gold and mineral sands in south-west Western Australia involves broad-scale clearance of Jarrah, Marri and Wandoo. Similarly, residential developments are often cleared of vegetation entirely before construction.

In Western Australia, development companies must submit an application to clear native vegetation under the *Environmental Protection Act 1986* administered by the Department of

Environment Western Australia. A fauna survey may then be required as part of the Environmental Impact Assessment (*Environmental Protection Act 1986*) to determine if the area proposed for clearing contains Threatened Fauna listed under the State *Wildlife Conservation Act 1950* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. If Commonwealth-listed threatened fauna inhabit the proposed site, development companies must refer any proposed impacts to the federal Department of the Environment, Water, Heritage and the Arts (DEWHA).

As part of arrangements with the Environmental Protection Authority (EPA), in cases where the EPA is to undertake an environmental impact assessment under the *Environmental Protection Act 1986*, DEWHA will defer the assessment of the impacts to the State of Western Australia, based on the EPA assessment process for the approval or otherwise of the proposed impacts.

As part of the legislative controls over the planning and approval of development activities, DEC will advise the EPA and the proponent on appropriate management and mitigation measures for impacts on Forest Black Cockatoos, should the proposal be approved. Wherever possible, habitats known to be used for feeding, breeding and roosting by Forest Black Cockatoos should be retained. DEC and the Western Australian Museum will also provide advice to development companies on steps that can be taken to protect remaining habitat for the benefit of Forest Black Cockatoos in south-west Western Australia.

**Action:** Determine and implement ways to minimise the effects of mining and urban development on habitat loss
**Responsibility:** DEC, Western Australian Museum
**Completion date:** Ongoing
**Cost:** $5,000 initially, in kind and as part of other actions

Determine and implement ways to manage forests for the conservation of Forest Black Cockatoos.

14.9 Identify and manage important sites and protect from threatening processes.
14.10 Map feeding and breeding habitat critical to survival and important populations, and prepare management guidelines for these habitats.
14.11 Monitor population numbers and distribution.
14.12 Determine the patterns and significance of movement.
14.13 Maintain the Cockatoo Care program and use other opportunities to promote the recovery of Forest Black Cockatoos.

**Cost: $1,810,500 over 10 years.**

## 2. INTRODUCTION

Baudin's Cockatoo *Calyptorhynchus baudinii* and the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* both occur in the humid and sub-humid forests of south-west of Western Australia (Saunders *et al.* 1985; Johnstone and Storr 1998; Higgins 1999). These 'Forest Black Cockatoos' have similar breeding and feeding requirements (Johnstone 1997; Johnstone and Storr 1998) and face similar threats (Garnett and Crowley 2000). Therefore, any recovery actions undertaken to benefit one species is likely to benefit the other and this is why a combined Recovery Plan for Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo has been prepared.

## 3. BAUDIN'S COCKATOO

### 3.1. History and taxonomic relationships

Baudin's Cockatoo *Calyptorhynchus baudinii* is also known as Baudin's Black Cockatoo or the Long-billed Black Cockatoo, but Baudin's Cockatoo is the only accepted name in use in Western Australia. The first specimen of Baudin's Cockatoo was collected during the 1800-1804 expedition to the South Seas on board *Le Geograph* and *Le Naturalist* commanded by Baudin, but the location from which the specimen was collected was not recorded (Higgins 1999). Saunders (1979) suggested that because Baudin mentioned White-tailed Black Cockatoos in his records when the expedition was at Geographe Bay, the type specimen was probably collected there. The type specimen (Specimen No. 619324) is now held in the American Museum of Natural History (Saunders 1979). Baudin's Cockatoo *Calyptorhynchus baudinii* was named in honour of the French commander Captain Thomas Nicolas Baudin (1754-1803) by Lear in 1832 (Ackermann and Lear 1832). Edward Lear 1832 was an ornithological illustrator at the British Museum, who co-published the book *Illustrations of the Family of Psittacidae, or Parrots* in 1832 (Ackermann and Lear 1832).

Baudin's Cockatoo is one of two species of White-tailed Black Cockatoo endemic to south-west Western Australia. It is similar to Carnaby's Cockatoo *Calyptorynchus latirostris* Carnaby 1948 (Saunders 1974a; Adams *et al.* 1984) and many early accounts of White-tailed Black Cockatoos did not distinguish between the two species (see Higgins 1999). Baudin's Cockatoo and Carnaby's Cockatoo show significant morphological divergence of the culmen and skull (Campbell and Saunders 1976). For instance, in Baudin's Cockatoo the tip of the upper mandible is longer and finer than Carnaby's Cockatoo and tapers beyond the lower

mandible when closed (Figure 1, Carnaby 1948). These two species also use different feeding resources and breeding sites (Davies 1966; Saunders 1974a, 1979) and their calls and feeding behaviour differ (Carnaby 1948; Saunders 1974b, 1979; Saunders and Ingram 1995; Johnstone and Storr 1998; Higgins 1999; Cooper 2000). Baudin's Cockatoo was previously known by other names including White-tailed Black Cockatoo and Long-Billed White-tailed Black Cockatoo (Johnstone and Storr 1998).

**Figure 1. Comparison of the heads of Carnaby's Cockatoo (left) and Baudin's Cockatoo (right) showing the longer and finer upper mandible in Baudin's Cockatoo. Image reproduced with permission from the Western Australian Museum.**

### 3.2. Description

Baudin's Cockatoo is a large, mostly dull black cockatoo 52–57 cm in length, 110 cm in wingspan and 660 g in weight (Higgins 1999). Males and females have a large bill, a rounded white patch on the ear coverts and rectangular white panels in the tail (Higgins 1999). The male is distinguished by a pink eye-ring and a dark grey-black bill (Johnstone and Storr 1998). The female has more defined yellowish-white ear coverts, a blue-grey eye-ring and a bone or light grey bill (Johnstone and Storr 1998). The juvenile resembles the adult female, but the bill begins to darken in the second year of life for males (Johnstone and Storr 1998).

Both Baudin's Cockatoo and Carnaby's Cockatoo have a distinctive wailing call which consists of four segments (Higgins 1999). The 'Whi-cha' call of Baudin's Cockatoo lasts about 2.2 seconds in total and is shorter in length than the 'Wee-lah' call of Carnaby's Cockatoo (Higgins 1999). The last segment is shorter in Baudin's Cockatoo than Carnaby's Cockatoo (Saunders 1979). Other calls used by Baudin's Cockatoo include a contact call in flight and a croaking note when perched (Alexander 1916).

### 3.3. Distribution, habitat and movements

Baudin's Cockatoo is endemic to a 2,000 $km^2$ area (Garnett and Crowley 2000) of the humid and sub-humid zones of south-west Western Australia (Johnstone and Storr 1998). The distribution of Baudin's Cockatoo is generally contained within the 750 mm isohyet of average annual rainfall (Figure 2, Saunders 1979). The former distribution of Baudin's Cockatoo is unknown, because early records did not distinguish between the two species of White-tailed Black Cockatoo (Higgins 1999). The current distribution of Baudin's Cockatoo is from Albany extending north to Gidgegannup, east to Mount Helena, Wandering, Quindanning, Kojonup, Frankland and King River and to the eastern margin of the Swan Coastal Plain including West Midland, Byford, North Dandalup, Yarloop, Wokalup and Bunbury (Johnstone 1997; Johnstone and Storr 1998). Baudin's Cockatoo also occurs in the Stirling Range (Sedgwick 1964), Porongurup Range (Abbott 1981) and near Boyup Brook (Davies 1966; Saunders 1974a, 1979; Saunders *et al.* 1985; Johnstone and Storr 1998).

While most commonly known from the forested areas, Baudin's Cockatoo was also found in "the open country" of agricultural areas (Alexander 1916, pp. 32). The species is locally resident, but at the end of the breeding season around January, the birds move away from the breeding area and form flocks that move in response to changing food resources (Saunders 1974b). For example, flocks visit the central and northern Darling Range and the eastern margin of the Swan Coastal Plain in March and September (Johnstone and Storr 1998). The cockatoos move north through the Perth region from March to May and south through the Perth region from August to October (Serventy 1937; Sedgwick 1940; Serventy 1948; Heron 1970; Saunders 1979). A record of movements of Baudin's Cockatoo in Middle Swan in 1970 showed that flocks of five to 200 birds moved northwards from March to May and similar numbers moved southwards from August to October (Heron 1970).

Although the generalised distribution of Baudin's Cockatoo is known, detailed information on the current distribution and habitat critical to survival and important populations is unknown. There are two reasons for this. First, many published accounts did not distinguish between the two species of White-tailed Black Cockatoo in Western Australia. Second, the flocks and nests of Baudin's Cockatoo are very difficult to locate because they occur in dense forest in the canopy of tall trees. Provision has been made in this plan to identify and map feeding and breeding habitat critical to survival and important populations and to monitor population numbers and distribution (Actions 14.10 and 14.11). Important groups of Baudin's Cockatoo will be identified and managed as part of Action 14.9.

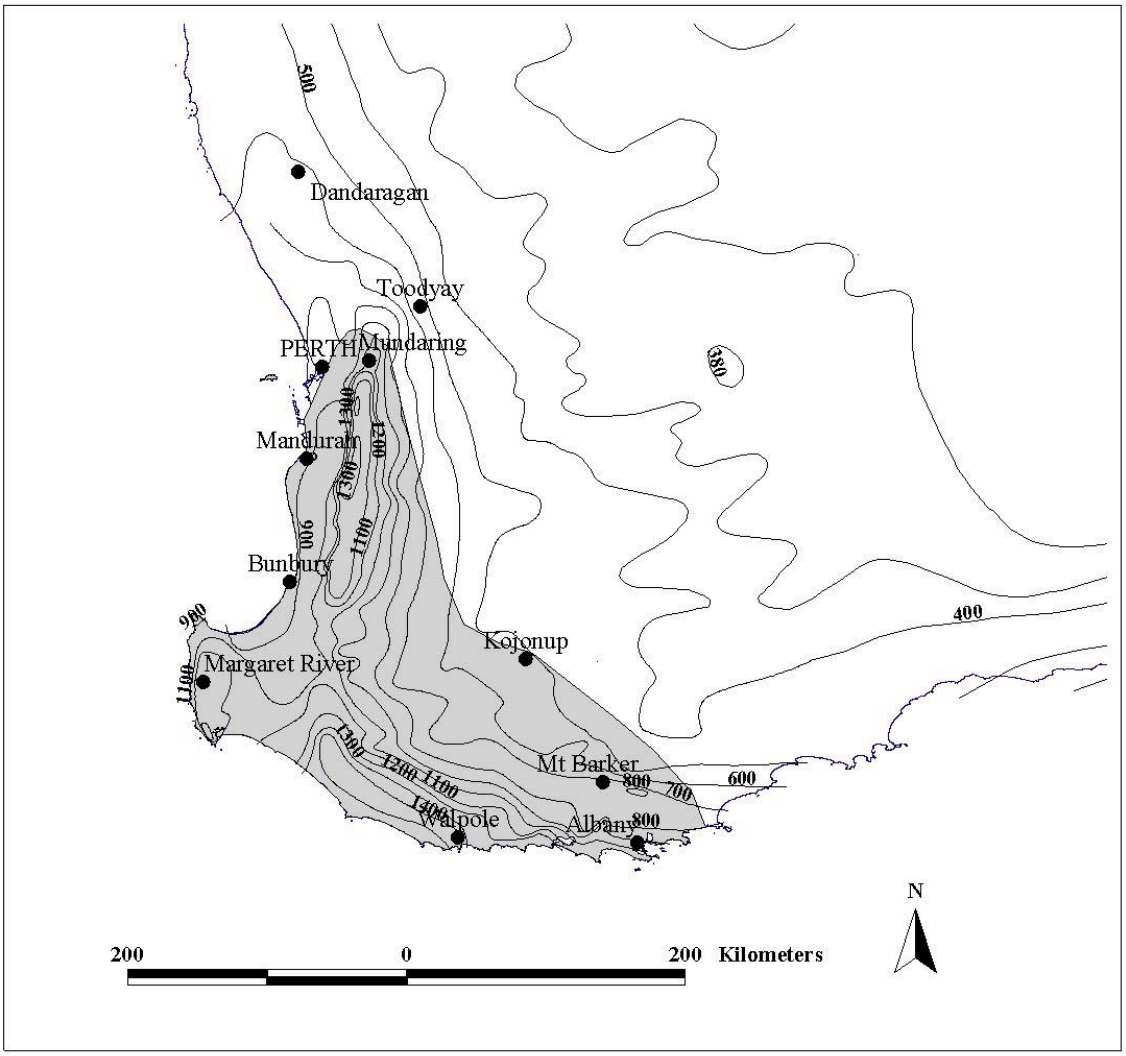


**Figure 2. Distribution of Baudin's Cockatoo in south-west Western Australia shown with isohyets of average annual rainfall (mm). The grey area shows the generalised current distribution of Baudin's Cockatoo (information taken from Johnstone and Storr 1998).**

## 3.4. Biology and ecology

Baudin's Cockatoo roosts in flocks of up to 900 (personal communication R. Johnstone[1]) and the flocks split up into smaller feeding flocks during the day (Robinson 1965). Although flocks of up to 200 have been recorded during the non-breeding season, the cockatoos most commonly move about in small groups of three, consisting of the adult pair and a dependent juvenile (Higgins 1999). Baudin's Cockatoo sometimes associates with Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo when feeding (Higgins 1999).

Baudin's Cockatoo mainly feeds on the seeds of Marri *Corymbia calophylla*, in the forested regions of south-west Western Australia (Ashby and Le Souef 1928; Saunders 1974a, 1974b).

Marri fruits that have been used for feeding by Baudin's Cockatoo can be distinguished from those used by Carnaby's Cockatoo by the damage caused to the rim of the fruits (Saunders 1974a; Cooper 2000). Baudin's Cockatoo extracts seeds from the Marri fruits using its long bill with minimal damage the rim of the fruits whereas Carnaby's Cockatoo damages the rim when extracting the seeds (Saunders 1974a; Cooper 2000). Although Marri seeds take longer to extract than the seeds of other foods, Baudin's Cockatoo feeds primarily on Marri, because the return of energy per unit of foraging time is higher than for the other foods available in its habitat (Cooper *et al.* 2002).

In addition to Marri, Baudin's Cockatoo feeds on the seeds of *Banksia grandis, B. littoralis, B. ilicifolia, Hakea undulata, H. prostrata, H. trifurcata, Erodium botrys* (Saunders 1979; Johnstone and Storr 1998), Jarrah *E. marginata* (Saunders 1974a) and *Dryandra* spp. (Sedgwick 1964). It also feeds on invertebrate larvae (Saunders 1979). The cockatoos harvest larvae from galls (Robinson 1965), strip dead bark from trees in search of beetle larvae (Saunders 1974a; Johnstone and Storr 1998) and Carter (1923, pp. 141) reported that a bird shot at Albany had several caterpillars ("not grubs") in its mouth and crop.

Unlike Carnaby's Cockatoo (Saunders 1974b), Baudin's Cockatoo is not known to feed on the commercial plantations of *Pinus* spp. that are present in its range (Saunders 1974a; Cooper 2000). Baudin's Cockatoo, however, does feed on apple and pear seeds in domestic and commercial orchards (Robinson 1960; Long 1985; Halse 1986). The cockatoos can be very destructive in orchards during the apple season (Serventy 1927; Anon 1943) and they damage a higher proportion of red than green apples (Halse 1986). For example, during a study of fruit damage near Donnybrook in the south-west of Western Australia, Baudin's Cockatoo damaged 16.7% ($n$ = 28,175 fruits) of red apples compared to only 7.0% ($n$ = 39,202 fruits) of green apples (Halse 1986). In total, 9.24% ($n$ = 67,377 fruits) of the fruit crop was damaged by Baudin's Cockatoo during the two month observation period (Halse 1986). Anecdotal observations have shown that Baudin's Cockatoo may be scared from orchards by noises such as those omitted by alarm systems and gas cannons (Long *et al.* 1989).

Baudin's Cockatoo nests in mature trees such as Marri *Corymbia calophylla*, Karri *Eucalyptus diversicolour*, Jarrah *E. marginata* and Wandoo *E. wandoo* (Saunders 1974a) in the lower south-west of Western Australia (Johnstone and Storr 1998). The northern-most breeding record for Baudin's Cockatoo is for Lowden, near Donnybrook (Johnstone and Storr 1998). The cockatoos nest in large tree hollows, 30–40 cm in diameter and more than 30 cm

deep (Saunders 1974a), often formed by the activity of invertebrates and fungi (Williams and Faunt 1997). Individual birds probably begin to breed at four years of age (Shephard 1989). In captivity, both the male and female prepare the nest (Sindel and Lynn 1989), which is lined with woodchips (Higgins 1999). Copulation probably takes place three days prior to laying (Sindel and Lynn 1989), the female lays a clutch of one or two eggs in late winter and spring (Saunders 1974a; Johnstone and Storr 1998) and the female incubates the clutch and broods the nestling. In captivity, the female may lay a replacement egg if the first laid egg fails (Higgins 1999). For example, an additional egg was laid by a female in captivity 40 days after the first egg was broken (Sindel and Lynn 1989).

Little is known about the breeding cycle of Baudin's Cockatoo because the nests are extremely difficult to locate. Ornithologists from the Western Australian Museum located only 12 nests during eight years of research up until 2005 (personal communication R. Johnstone[1]). Fledglings are fed by parent birds (Carter 1923) and flocks of young with one or two adults may form a 'nursery' away from the main flock (Robinson 1965). Adult birds may live for more than 50 years in captivity (Brouwer *et al.* 2000) and may nest in the same hollow in successive years (Carter 1923; Ashby and Le Souef 1928). However, for the 12 nests monitored by the Western Australian Museum, none of the pairs observed have returned to the same hollow in successive years (personal communication R. Johnstone[1]). Each pair raises an average of 0.6 chicks per year (Johnstone and Storr 1998) and this rate of recruitment may be below the annual rate of mortality for adult birds (Garnett 1992).

### 3.5. Conservation status

Baudin's Cockatoo has disappeared from about 25 per cent of its range and has probably declined in density over a further 25 per cent (Garnett and Crowley 2000). Thus, the species has declined over more than 50 per cent of its range (Garnett and Crowley 2000) over the past 50 years. The principal cause of the decline in range was clearing of the eastern margins of the forests for agriculture (Mawson and Johnstone 1997). The primary threat to the population at present is illegal shooting by fruit growers (personal communication P. Mawson[2]) and one or more of the threatening processes continue (Garnett and Crowley 2000). The population appears to be declining because the reporting rate for the *Atlas of Australian Birds* (Birds Australia WA) declined by up to 49 per cent between the 1977–1981 and 1998–2001 surveys (Olsen *et al.* 2003).

Baudin's Cockatoo is currently listed as Endangered in Western Australia. It is listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Baudin's Cockatoo fits the criteria for Endangered because of a projected or suspected decline in the population of 50 per cent or more within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years). In Western Australia, Baudin's Cockatoo has been declared threatened fauna since April 1996 (Mawson and Johnstone 1997) and is listed on Schedule 1 – Fauna that is rare or likely to become extinct pursuant to the Western Australian *Wildlife Conservation Act 1950*.

## 4. FOREST RED-TAILED BLACK COCKATOO

### 4.1. History and taxonomic relationships

The Red-tailed Black Cockatoo was originally named *Psittacus banksii* (Latham 1790) from a specimen collected at Endeavour River in Queensland (Higgins 1999). The south-west subspecies *Calyptorynchus banksii naso* was first recognised by John Gould in 1836 (Gould 1836) and first described by Gould in 1837 (Gould 1865). The subspecific name *naso* means nose in reference to the variation in the size of the bill in comparison with other Red-tailed Black Cockatoos (see Ford 1980 for a discussion). Ford (1980) examined the morphological and ecological divergence and convergence in isolated populations of the Red-tailed Black Cockatoo and supported the recognition of the south-west subspecies of the Forest Red-tailed Black Cockatoo *C. b. naso*.

### 4.2. Description

The Forest Red-tailed Black Cockatoo is 55–60 cm in length, 570–870 g in weight (Higgins 1999) and its wingspan has not yet been published. The bill of the Forest Red-tailed Black Cockatoo is significantly longer and wider than Western Australia's Inland Red-tailed Black Cockatoo *C. b. samuelii* (Ford 1980). Male and female Forest Red-tailed Black Cockatoos are mostly glossy black with a pair of black central tail feathers, a crest, robust bill and bright red, orange or yellow barring in the tail (Higgins 1999). The male is distinguished by broad red tail panels that are often sub-terminal and are only visible when taking off or alighting (Higgins 1999). Males have a dark brown iris, dark grey eye-ring and blackish legs (Johnstone and Storr 1998). The female is distinguished by yellow or whitish spots on the feathers of the head and upper wing coverts (Johnstone and Storr 1998). In females, the tail feathers are bright red and orange, grading to yellow on the inner margins, and the tail

feathers have variable black horizontal barring (Johnstone and Storr 1998). Females have yellow or orange barring on the tips of the feathers of the throat, breast, belly and under-tail coverts and a light grey bill with a dark grey tip (Johnstone and Storr 1998). The juvenile is similar to the adult female but has a white eye-ring (Johnstone and Storr 1998; Higgins 1999). The Forest Red-tailed Black Cockatoo has a loud harsh cry of 'karee' or 'krar-raak' and 'chet' as well as harsh nasal wheezing (Johnstone and Storr 1998).

### 4.3. Distribution, habitat and movements

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and sub-humid zones of Western Australia (Mawson and Johnstone 1997). It inhabits the dense Jarrah *Eucalyptus marginata*, Karri *E. diversicolour* and Marri *Corymbia calophylla* forests receiving more than 600 mm of annual average rainfall (Figure 3, Saunders *et al.* 1985; Saunders and Ingram 1995). Habitats in which the Forest Red-tailed Black Cockatoo occurs at Bungendore Park and Jarrahdale, have an understorey of Bull Banksia *Banksia grandis*, Snottygobble *Persoonia longifolia*, Sheoak *Allocasuarina fraseriana* and *Dryandra* spp., with scattered Blackbutt *E. patens* and Wandoo *E. wandoo* (Johnstone and Kirkby 1999).

The Forest Red-tailed Black Cockatoo once occurred between Albany, Augusta and Perth and north along the Swan Coastal Plain to Dandaragan (Figure 3, Saunders 1977; Johnstone 1997; Johnstone and Storr 1998), but was rare on the Swan Coastal Plain by the early 1900s (Alexander 1921). The current distribution is north of Perth and east to Mount Helena, Christmas Tree Well, North Banister, Mt Saddleback, Rocky Gully and the upper King River (Figure 3, Johnstone 1997). The movements of the Forest Red-tailed Black Cockatoo are irregular (Sedgwick 1949) and they can now be found on the Swan Coastal Plain at any time of year in search of the Cape Lilac *Melia azedarach* (Stranger 1997, pers. comm. R. Johnstone[1]). The cockatoos were also recorded feeding on the seeds of the Mountain Marri *Corymbia haematoxylon* for the first time in 2004 (Johnstone and Cassarchis 2004).

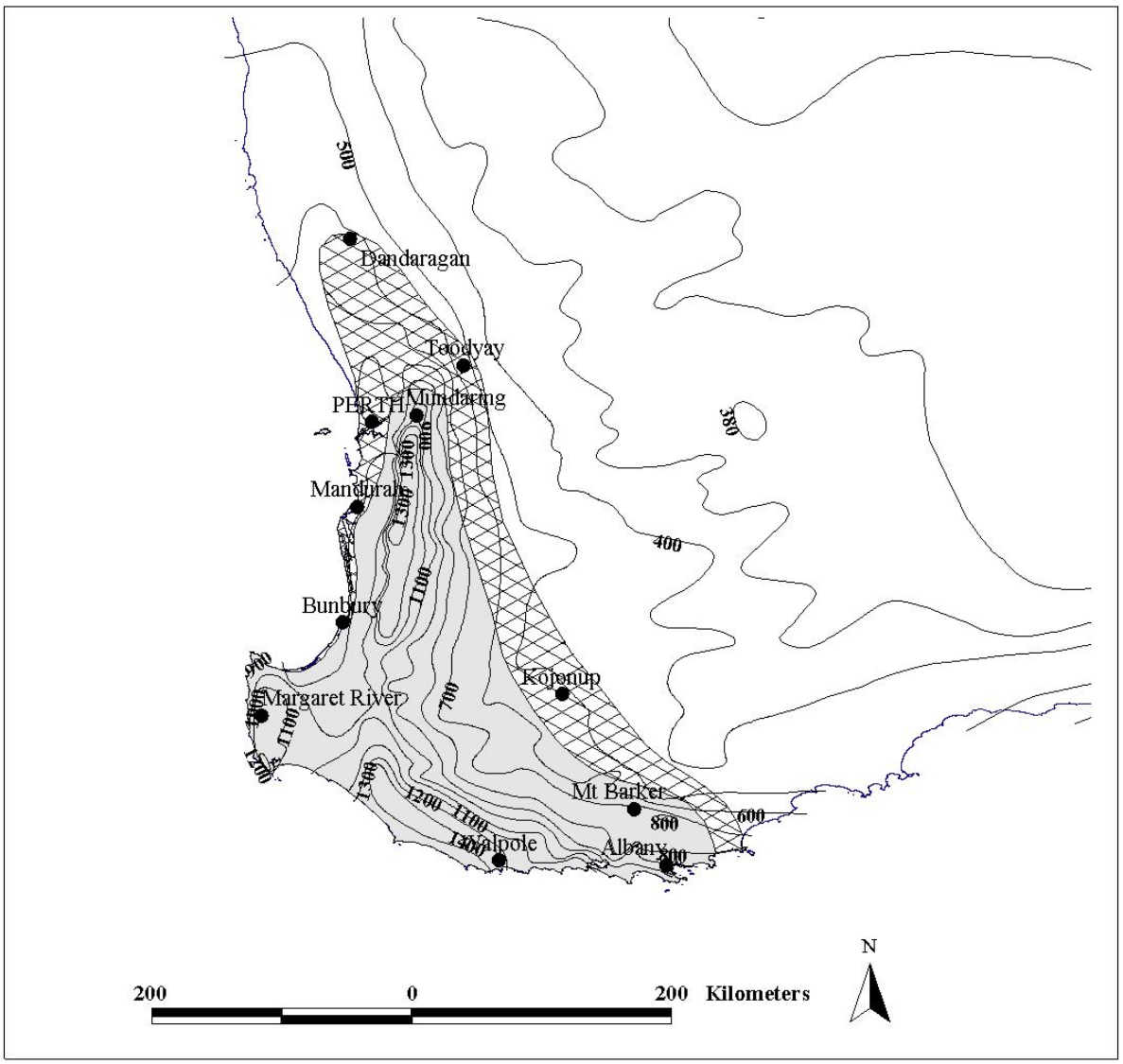


**Figure 3. Distribution of the Forest Red-tailed Black Cockatoo shown with isohyets of average annual rainfall (mm). The grey area shows the generalised current distribution and the hatched area shows the extent of the former distribution (information taken from Johnstone and Storr 1998).**

Although the generalised distribution of the Forest Red-tailed Black Cockatoo is known, detailed information on the current distribution and habitat that is critical to survival and important populations is unknown. The main reason for this is because the forest habitat in which they occur makes it difficult, time consuming and expensive to obtain this information. Provision has been made in this plan to map feeding and breeding habitat critical to survival and important populations and to monitor population numbers and distribution (Actions 14.10 and 14.11). Important flocks will be identified and managed as part of Action 14.9.

### 4.4. Biology and ecology

The Forest Red-tailed Black Cockatoo roosts in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks (Johnstone and Kirkby 1999). Flocks leave the roost at sunrise and feed in small family groups of up to 10 birds, usually within one to 4km of the roost (Johnstone and Kirkby 1999). Forest Red-tailed Black Cockatoos feed in the forest and although they were not known to do so in the 1970s (Masters and Milhinch 1974), they now feed in open agricultural areas (personal communication R. Johnstone[1]). Late in the day, the birds stop feeding and drink at water in tree hollows, creeks, puddles, dams and troughs and they return to the roost at dusk (Johnstone and Kirkby 1999).

While the Forest Red-tailed Black Cockatoo feeds on the seeds of other species, around 90 per cent of its diet is made up of the seeds from Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata* (Johnstone and Kirkby 1999) fruits. The cockatoos feed in Marri trees which carry nuts of greater seed number and total seed weight than trees not used for foraging (Cooper *et al.* 2003). The other species used for feeding include Blackbutt *E. patens,* Albany Blackbutt *E. staeri,* Forest Sheoak *Allocasuarina fraseriana,* Snottygobble *Persoonia longifolia* and the non-indigenous native Spotted Gum *E. maculata* and Cape Lilac *Melia azedarach* (Johnstone and Storr 1998; Johnstone and Kirkby 1999). The cockatoos have also been recorded stripping bark from trees in search of invertebrate larvae (Nicholls 1905), but this behaviour is now rarely observed (personal communication R. Johnstone[1]).

A detailed study of the food and feeding behaviour of the Forest Red-tailed Black Cockatoo was conducted at Bungendore Park and Jarrahdale between 1996 and 1999 (Johnstone and Kirkby 1999). During the study, Forest Red-tailed Black Cockatoos fed on Marri throughout the year but switched to Jarrah and other foods in March and June when Marri fruits were less abundant (Johnstone and Kirkby 1999). The cockatoos also appeared to return to individual trees to feed, on a daily basis, until the supply of fruit was exhausted (Johnstone and Kirkby 1999). The production of Marri takes about 17 months from bud initiation and individual Marri trees may take up to three years to recover from a large flowering effort (Mawson 1995). In most years, only about 20–50 per cent of Marri trees produce a large crop of fruits and a small proportion of the trees produce only male flowers, which do not fruit (Mawson 1995).

The other important source of food for Forest Red-tailed Black Cockatoos, Jarrah, may only flower every four to six years (Abbott *et al.* 1989). Buds are produced in December and

January and flowering takes place between September and December (Abbott *et al.* 1989). The fruits develop in the following September and the seeds are shed from the fruits from December to March (Abbott *et al.* 1989). The cycle of flowering in Jarrah therefore takes 24–27 months from budding to seed shed (Abbott *et al.* 1989). Johnstone and Kirkby (1999) concluded that while the food supply was probably adequate, the profitability of Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata* fruits, or the volume of fruit produced by trees traditionally used for feeding, may limit the number of birds that can breed. In addition, Forest Red-tailed Black Cockatoos may only breed in the north and east of their range on the margins of the forest (Higgins 1999).

Like all Black Cockatoos (Higgins 1999), the Forest Red-tailed Black Cockatoo is monogamous and pairs probably form a lifetime bond (Smith and Saunders 1986). The cockatoos were thought to begin breeding when they are four to six years old (Shephard 1989; Sindel and Lynn 1989). However, birds with partly barred tails, which would be less than four years old, have been recorded breeding by Western Australian Museum staff (personal communication R. Johnstone[1]). Similar to Baudin's Cockatoo, the Forest Red-tailed Black Cockatoo nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8-14 m above ground, the entrance is 12–41 cm in diameter and the depth is 1-5 m (Johnstone and Storr 1998).

The effective clutch size of the Forest Red-tailed Black Cockatoo is one, because although two eggs are sometimes (but rarely) laid, only one chick fledges (Johnstone and Storr 1998). There are few records of breeding in the Forest Red-tailed Black Cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998). In captivity, the female may re-lay if the first egg fails to hatch (Lendon 1973), but this has not been recorded for wild birds (personal communication R. Johnstone[1]). The eggs are laid on woodchips or charcoal and the female incubates the egg (Johnstone and Storr 1998). During the incubation period, the male feeds with the flock and flies back to the nest to feed the female once or twice a day (Johnstone and Kirkby 1999). During the nestling stage the female feeds for herself outside the nest (Johnstone and Kirkby 1999). The incubation period is 29–31 days and the nestling period is 75–85 days (Johnstone 1997). The young are fed by the parents for three to four months after fledging (Lendon 1973; Sindel and Lynn 1989) and juvenile birds may take up to a year to learn how to extract seed from Marri fruits, during which time they are fed by both parents (Johnstone and Kirkby 1999). Adult

Forest Red-tailed Black Cockatoos may live for more than 45years in captivity (Brouwer *et al.* 2000).

### 4.5. Conservation status

The Forest Red-tailed Black Cockatoo was once common in the south-west forests of Western Australia, but began declining as a result of timber harvesting in the early 1900s (Carter 1923). At around the same time, the cockatoos were also shot "to obtain the beautiful tail feathers" (Carter 1923, pp. 141). This cockatoo has declined in range by 25–30 per cent as a result of clearing of the margins of the forests for agriculture in the early 1900s (Mawson and Johnstone 1997). The species has also declined in density over a further 14 per cent of its range that has been partially cleared (Garnett and Crowley 2000).

In Western Australia, the Forest Red-tailed Black Cockatoo is listed on Schedule 1 – Fauna that is rare or likely to become extinct pursuant to the Western Australian *Wildlife Conservation Act 1950*. It is listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The Forest Red-tailed Black Cockatoo fits the IUCN (2001) Red List Categories and Criteria for Vulnerable because of a projected or suspected decline in the population of 30 per cent or more within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

## 5. HABITAT CRITICAL TO SURVIVAL AND IMPORTANT POPULATIONS

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*).

Habitat critical to survival and important populations of Forest Black Cockatoos comprises areas:

- currently occupied by the cockatoos;
- not currently occupied by the cockatoos due to recent fire but capable of supporting cockatoo populations when sufficiently recovered;
- of natural vegetation in which the cockatoos nest, feed and roost;

- of natural vegetation through which the cockatoos can move from one occupied area to another; and
- of suitable vegetation within the recorded range in which undiscovered cockatoo populations may exist.

The habitat critical to survival and important populations of Forest Black Cockatoos comprises all Marri *Corymbia calophylla*, Karri *Eucalyptus diversicolour* and Jarrah *Eucalyptus marginata* forests, woodlands and remnants in the south-west of Western Australia receiving more than 600 mm of annual average rainfall.

## 6. GUIDE FOR DECISION MAKERS

Section 7 provides details of current and possible future threats to Forest Black Cockatoos. Developments, or on-ground works (clearing, firebreaks, road work, burning, drainage etc), in the immediate vicinity of the population or within the habitat that is defined as critical to survival require assessment for potentially significant levels of impact.

## 7. THREATS

The threatening processes for Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo are killing by illegal shooting, feral Honeybees *Apis mellifera*, habitat loss, nest hollow shortage and competition for available nest hollows. Climate change is an additional threat that is likely to exacerbate the threatening processes as a result of changes to biodiversity and ecosystem function (Chambers *et al.* 2005). As Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo occur in single populations, the entire populations are affected by these threats.

### 7.1. Killing by illegal shooting

Baudin's Cockatoo causes damage to pome fruit crops and bonuses for their destruction were paid from 1952 to 1968 (Halse 1986). An open season notice was in place to shoot the birds between the 1950s and 1980s (Mawson and Johnstone 1997), but this was revoked by the Minister on 25 August 1989. Damage licenses are still issued by the Department of Environment and Conservation (DEC) to allow fruit growers to protect commercial fruit crops by shooting to scare (Garnett 1992). Illegal shooting by orchardists continues (Abbott 2001) in the Perth Hills, Donnybrook and Manjimup areas (personal communication P. Mawson[2]). Baudin's Cockatoo is listed as a Declared Pest of Agriculture under the provisions of the *Agriculture and Related Resources Protection Act 1976*, administered by the Western

Australian Department of Agriculture and Food. This declaration allows for the approval and implementation of a management program in the Perth Metropolitan region, the City of Armidale and selected regional Shires.

During the late 1800s and early 1900s, Forest Red-tailed Black Cockatoos were shot for food, for sport and to obtain their tail feathers for ornamental and decorative purposes (Abbott 2001). Records of Forest Red-tailed Black Cockatoos being illegally shot, apparently because they had been snapping the tops off blue gums, were also collected during a 1999–2000 survey (Abbott 2001). These observations show that illegal shooting of Forest Red-tailed Black Cockatoos probably had an impact on the population in the early 1990s and continues to the present day.

### 7.2. Feral Honeybees

The feral Honeybee can form long-term hives in tree hollows and can kill nesting females and chicks in the nest by stinging. For example, feral Honeybees have taken over four of 12 Forest Red-tailed Black Cockatoo nests in Bungendore Park and two of 12 Baudin's Cockatoo nests monitored over the past five years (personal communication R. Johnstone[1]). In addition, feral Honeybees killed a female Baudin's Cockatoo by stinging when she was trapped in the nest (personal communication R. Johnstone[1]). After illegal shooting, feral Honeybees are the most significant current threat to the ability of Forest Black Cockatoos to survive and breed. The threat posed by feral Honeybees is also likely to increase with the southward movement of bees in response to change to a warmer climate in Western Australia.

### 7.3. Habitat loss

Habitat loss for agriculture, timber harvesting, wood chipping and mining appears to be the principal cause of the historical decline of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo (Johnstone 1997; Mawson and Johnstone 1997). The long-term effects of this habitat loss may not yet have been fully realised because of the long life-span (Brouwer *et al.* 2000) of the cockatoos.

In the remaining habitat, selective removal of Marri for timber, mining, wood chipping and agriculture has resulted in further declines (Garnett and Crowley 2000, personal communication P. Mawson[2]). The impacts of previous forest management practices for timber and wood chipping on Forest Black Cockatoo populations have not yet been

quantified. However, forestry practices such as clear felling and 80-year cut rotations may restrict the availability of nest hollows (Saunders and Ingram 1995).

Many forms of development in south-west Western Australia involve clear felling of feeding, breeding and roosting habitat. For example, industrial, urban and residential development is rapidly increasing in many parts of the cockatoos' range. Habitat loss due to clearing for residential development in particular, is an increasing threat in south-west Western Australia at present, particularly on the western Darling Scarp and the southern Swan Coastal Plain.

### 7.4. Nest hollow shortage

The number of nest sites available may be limiting (Garnett and Crowley 2000) because both Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo nest in the hollows of large trees (Johnstone *et al.* 2002). Hollows suitable for use by these two Forest Black Cockatoo species are scarce (personal communication R. Johnstone[1]). Analyses have shown that trees with hollows large enough for use by Forest Black Cockatoos may be between 200 and 500 years of age (see Johnstone *et al.* 2002). Suitable hollows form as a result of the activity of invertebrates and fungi (Williams and Faunt 1997) and generally only form when a branch or the top of the main trunk snaps off or is damaged by fire (personal communication R. Johnstone[1]).

### 7.5. Nest hollow competition

Competition for nest sites with other birds is a significant threatening process for Forest Black Cockatoos. Observations of competition for nest sites between Forest Black Cockatoos and Wood Ducks *Chenonetta jubatta* (Johnstone and Cassarchis 2004), Galahs *Cacatua roseicapilla* and Corellas *Cacatua* spp. are increasing (personal communication R. Johnstone[1]). Competition for hollows with the feral Honeybee *Apis mellifera* is also a significant threatening process for Black Cockatoos (Garnett and Crowley 2000), including Forest Black Cockatoos.

## 8. INTERNATIONAL OBLIGATIONS

All parrots and their allies in the Order Psittaciformes, including *Calyptorhynchus* spp., are listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Australia is a member country to CITES and thus has an

obligation to ensure that international trade in specimens of these species does not threaten their survival (CITES 1973). Appendix II of CITES allows international trade in live wild-caught and captive-bred specimens, if such exports are not detrimental to wild populations (CITES 1973).

## 9. AFFECTED PARTIES

The main parties likely to be affected by this Recovery Plan are: Department of Environment and Conservation (DEC); Department of Agriculture and Food Western Australia (DAFWA); Western Australian Fruit Growers' Association (WAFGA); Water Corporation; Western Australian Museum; Western Australian universities; fruit growers; nature-based tourism operators; mineral exploration and mining companies; Forest Products Commission Western Australia; Conservation Commission of Western Australia; Local Government Authorities; Department of Planning and Infrastructure Western Australia; Real Estate Institute of Western Australia; and private landholders. The means by which these parties will be involved in the implementation of the Recovery Plan will be discussed in Section 14. Actions.

## 10. INDIGENOUS PEOPLE

The Aboriginal (Noongar) name for the Forest Red-tailed Black Cockatoo is *Karrak* and the first syllable is emphasised, the *a* is pronounced as in media and the *rr* is pronounced as in sporran (Abbott 2001). Aboriginal people traditionally hunted Forest Black Cockatoos for food (Abbott 2001) and probably used their feathers for ornamental purposes. Regulation 63 of the *Wildlife Conservation Regulations 1970* now prohibits persons of Aboriginal descent from taking both these species of Forest Black Cockatoo for food, as per Section 23 of the *Wildlife Conservation Act 1950*.

The Department of Environment and Conservation will consult with Indigenous communities in the regions identified in this plan. Implementation of recovery actions under this plan will include consideration of the role and interests of Indigenous communities in the region, and this is discussed in the recovery actions. Input and involvement will be sought from any Indigenous groups that have an active interest in areas that are habitat for Forest Black Cockatoos. The Aboriginal Heritage Sites Register, maintained by the Department of Indigenous Affairs, will be used to identify significant sites in the vicinity of these populations. However, not all significant sites are listed on the Register.

## 11. BENEFITS

The conservation of the feeding and breeding habitat of Forest Black Cockatoos depends on the protection and management of Marri, Jarrah and Karri habitats in the Northern and Southern Jarrah Forest subregions of south-west Western Australia (see May and McKenzie 2003). These ecosystems are under threat from vegetation clearing, fragmentation, loss of remnants, lack of regeneration, exotic weeds, changing fire regimes, altered hydrology, urbanisation and dieback *Phytophthora cinnamomi* (Hearn *et al.* 2003; Williams and Mitchell 2003). The subregions contain rare and priority flora, threatened ecological communities and threatened fauna (Hearn *et al.* 2003; Williams and Mitchell 2003). These fauna carry out essential ecosystem functions such as regulation of insect populations, soil aeration by digging, pollination of flowers and dispersal of seeds and fungal spores (personal communication T. Friend[3]), thereby contributing to the maintenance of biodiversity. Thus, recovery actions carried out to conserve the habitat of Forest Black Cockatoos are likely to improve the status of the Northern and Southern Jarrah Forest subregions as well as rare and priority flora, threatened ecological communities and threatened fauna. This would make a considerable contribution to the maintenance of Western Australia's and Australia's biodiversity.

## 12. SOCIAL AND ECONOMIC IMPACTS

The implementation of this Recovery Plan will benefit the people of Western Australia because Black Cockatoos are very popular birds in the State. For example, great interest has been shown in the activities undertaken as part of the 'Cockatoo Care' program (www.cockatoocare.com), a joint initiative of the Water Corporation and the Western Australian Museum (Johnstone and Cassarchis 2003, see Section 12.4 Existing conservation measures for a discussion). Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo are icons of south-west forests, so their preservation is also likely to be of great benefit for attracting tourism to the region. The development of tourism is particularly important for economic development in regions of the south-west where the logging industry has declined.

If numbers of Baudin's Cockatoo increase, the costs of damage management to landholders and the Departments of Environment and Conservation and Agriculture and Food may also increase. Conversely, if sufficient feeding and breeding resources can be protected for the Forest Black Cockatoos in the south-west forests, Baudin's Cockatoo may be less likely to feed in fruit orchards. Thus, the economic costs of management of damage by Baudin's

Cockatoo in orchardists to fruit growers, the general community, DEC and DAFWA are likely to be reduced.

## 13. RECOVERY OBJECTIVE AND CRITERIA

To stop further decline in the breeding populations of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo and to ensure their persistence throughout their current range in the south-west of Western Australia for the duration of this plan.

### 13.1. Criteria for success

This Recovery Plan will be deemed successful if:

- The extent of occurrence of Forest Black Cockatoos in Western Australia remains stable or increases in the next ten years;
- The number of breeding pairs of Forest Black Cockatoos in Western Australia remains stable or increases in the next ten years;
- The number of Forest Black Cockatoos in each roosting flock remains stable or increases in the next ten years; and
- The proportion of juvenile Forest Black Cockatoos in each roosting flock remains stable or increases in the next ten years.

### 13.2. Criteria for failure

This Recovery Plan will be deemed unsuccessful if:

- The extent of occurrence of Forest Black Cockatoos in Western Australia decreases by more than 10 per cent in the next ten years;
- The number of breeding pairs of Forest Black Cockatoos in Western Australia decreases by more than 10 per cent in the next ten years;
- The number of Forest Black Cockatoos in each roosting flock decreases by more than 10 per cent in the next ten years; and
- The proportion of juvenile Forest Black Cockatoos in each roosting flock decreases by more than 10 per cent in the next ten years.

### 13.3. Evaluation

The Western Australian Department of Environment and Conservation, in consultation with the Forest Black Cockatoo Recovery Team, will evaluate the performance of this Recovery Plan. The plan will be reviewed within five years of its implementation. The recovery actions carried out and any changes to management and recovery actions will be documented accordingly. In accordance with the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) this adopted recovery plan

will remain in force until revoked. The recovery plan must be reviewed at intervals of not longer than 5 years.

### 13.4. Existing conservation measures

The Cockatoo Care program, a joint initiative of the Water Corporation and the Western Australian Museum, was launched on Threatened Species Day, 7 September 2001. The objectives of the program are: research into the distribution and ecology of each of the Forest Black Cockatoos; habitat enhancement; assessment of the effectiveness of feral Honeybee control methods; and community education and involvement. The main outlets for this are through observation cards and frequent sighting forms; school programs; and promotional events (Johnstone and Cassarchis 2003).

The Water Corporation provided funding to the Western Australian Museum to conduct Black Cockatoo research in south-west Western Australia (Johnstone and Cassarchis 2003). The objectives of this research were to document the distribution, status, habitat preferences, breeding season and diet of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo (Johnstone *et al.* 2002). This involved monitoring flock numbers and composition, nests and recording information on nest trees, clutch size, incubation and fledging periods, breeding behaviour and movements of the cockatoos (Johnstone *et al.* 2002). Staff from the Western Australian Museum also repair and maintain natural hollows and remove feral Honeybees from hollows (Johnstone 1997).

The Department of Environment and Conservation has a 'derelict' program for sick, injured or orphaned cockatoos. Birds that are brought to the attention of DEC are treated and rehabilitated whenever possible, or passed on to licensed aviculturists and Perth Zoo if they can not be returned to the wild (Mawson 2002). Injured or 'derelict' cockatoos contribute to the genetic stock of birds held in captivity (Mawson 2002). In addition, captive birds provide a source of cockatoos for display and education purposes, which may reduce the incidence of illegal take from the wild (Mawson 2002).

## 14. ACTIONS

The following recovery actions are presented in order of descending priority but this should not prevent the implementation of 'lower' priority actions where opportunities arise and funding is available. Where sub-populations occur on lands other than those managed by

DEC, permission has been or will be sought from the managers prior to recovery actions being undertaken.

### 14.1. Seek the funding required to implement future recovery actions.

The recovery team will investigate sources of funding and attempt to secure the funding required to implement these actions. This process will be ongoing.

**Action:** Seek the funding required to implement future recovery actions
**Responsibility:** DEC, Water Corporation, WAFGA
**Completion date:** Ongoing
**Cost:** $2,500 in labour to prepare funding applications.

### 14.2. Determine and promote non-lethal means of mitigating fruit damage by Baudin's Cockatoo in orchards.

Of the two Forest Black Cockatoos, only Baudin's Cockatoo is known to damage fruit crops. The Forest Red-tailed Black Cockatoo also damages growth tips of trees in timber plantations (Abbott 2001). Baudin's Cockatoo causes locally severe damage to apples and pears in orchards (Long 1985; Halse 1986). The other White-tailed Black Cockatoo, Carnaby's Cockatoo, causes damage to persimmons and nut crops, but is not known to damage apples (Mawson and Massam 2000).

As with most birds, the most effective means of preventing damage by Baudin's Cockatoo is permanent netting (Bomford and Sinclair 2002). However, many fruit growers are not prepared to invest in netting because of the high cost and limited return in the short-term. Gas guns can be used effectively to scare birds (Bomford and Sinclair 2002), including Baudin's Cockatoo (Halse 1986), from fruit crops. Shooting to kill is no longer permitted for Black Cockatoos in Western Australia, but licences to shoot to scare can be obtained from the Department of Environment and Conservation to prevent damage to fruit crops (personal communication P. Mawson[2]).

Damage control methods are most effective if planned and executed in accordance with best practice guidelines (Bomford and Sinclair 2002). Western Australian fruit growers have expressed the concern that Baudin's Cockatoo is the principal pest of apple and pear (pome fruit) crops; the damage they cause result in significant loss of income; the cost of non-lethal crop protection techniques is excessive; and non-lethal techniques, such as scaring, are not effective or not cost effective (Chapman 2007). Effective non-lethal means of minimising the damage caused by Baudin's Cockatoo to fruit crops must be identified. Information on the

damage caused by the cockatoos, the damage control techniques and their effectiveness will be collected. This information will then be used to provide advice on how to best protect fruit crops without having to kill the cockatoos.

**Action:** Determine and promote non-lethal means of mitigating fruit damage by Baudin's Cockatoo in orchards
**Responsibility:** DEC, WAFGA, DAFWA
**Completion date:** Year three
**Cost:** $309,000 ($103,000 per year for three years)

### 14.3. Eliminate illegal shooting.

Illegal shooting of Baudin's Cockatoo by orchardists continues in the Perth Hills, Donnybrook and Manjimup regions (personal communication P. Mawson[2]). In addition, many orchardists are not aware that there are two species of White-tailed Black Cockatoo in Western Australia and that only one, Baudin's Cockatoo, causes damage to pome fruit crops. Thus, Carnaby's Cockatoo is also vulnerable to illegal shooting. Forest Red-tailed Black Cockatoos are also shot illegally when mistaken for White-tailed Black Cockatoos and when they snap the tops off blue gums in south-west timber plantations (Abbott 2001). Illegal shooting is a significant threatening process for Forest Black Cockatoos, because the number of birds shot probably exceeds the number recruited into the population (Johnstone and Storr 1998; pers. comm. P. Mawson). All reports of illegal shooting will be investigated by DEC Wildlife Officers and offenders will be prosecuted where sufficient evidence can be obtained.

An education program is needed to make primary producers aware that the shooting of Black Cockatoos is illegal in Western Australia and that offenders are liable to prosecution under both the State *Wildlife Conservation Act 1950* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Education materials will be prepared to inform fruit growers that: there are two species of White-tailed Black Cockatoo in south-west Western Australia; shooting of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoos is illegal; only Baudin's Cockatoo attacks pome fruit; and that means other than shooting can be used to protect fruit. Exclusion of Baudin's Cockatoo from orchards has been addressed in a DAFWA 'Farmnote' (Mawson and Massam 2000) and on the Cockatoo Care website. However, both of these could be developed and improved to ensure that fruit growers have a thorough understanding of the status of the cockatoos, their biology, the nature of the damage they cause, and how to plan and manage effective damage mitigation programs (see Action 14.2).

A communication strategy will be prepared to stop illegal shooting of Black Cockatoos in Western Australia. The strategy will include meetings with the Minister for the Environment, public meetings with fruit growers, and press releases to educate the public of the status of the cockatoos and that shooting to kill is not permitted. Fact sheets, newsletter articles and web pages will be prepared to communicate information on the cockatoos and the most effective means of protecting fruit crops from damage.

**Action:** Eliminate illegal shooting of Forest Black Cockatoos
**Responsibility:** DEC, WAFGA, DAFWA
**Completion date:** Ongoing
**Cost:** $200,000 ($20,000 for ten years)

### 14.4. Develop and implement strategies to allow for the use of noise emitting devices in orchards.

Studies of the effectiveness of devices to minimise damage to orchard fruit by parrots have shown that Baudin's Cockatoo may be scared from orchards by noises such as those omitted by alarm systems and gas cannons (Long *et al.* 1989). However, the use of noise emitting devices has been restricted in some regions of Western Australia, where residential developments are located close to orchards, as a result of complaints.

A Black Cockatoo Fruit Protection Technical Advisory Committee will be established to prepare recommendations for the Western Australian Minister for the Environment. The committee will provide advice on tolerance toward the use of gas guns; planning buffer zones; and the need for prospective land owners to be advised (as part of a formal disclosure) of the potential noise issues associated with crop protection in neighbouring commercial fruit orchards. This advice will then be communicated to Local Government Authorities, the Department of Planning and Infrastructure and the Real Estate Institute of Western Australia for implementation.

**Action:** Develop and implement strategies to allow for the use of noise emitting devices in orchards
**Responsibility:** DEC, WAFGA, DAFWA
**Completion date:** Year two
**Cost:** $5,000 ($2,500 for two years)

### 14.5. Determine and implement ways to remove feral Honeybees from nesting hollows.

Feral Honeybees exclude Forest Black Cockatoos from nest hollows by forming long-term hives in key breeding areas (personal communication R. Johnstone[1]). They can also kill nesting females and chicks in the nest by stinging (personal communication R. Johnstone[1]).

A commercial insecticide strip, with the active ingredient Dichlorvos (Vapona), that was used to repel feral Honeybees from the nest hollows of Black Cockatoos, is no longer available on the Australian market (personal communication R. Johnstone[1]). Research is urgently required to develop and test effective means of killing feral Honeybee hives that have established in key breeding areas.

Trials of methods used to kill feral Honeybee hives will be conducted to identify effective methods of removal. The effects of baiting methods or attractants on non-target native species will also be tested. The recovery team will consult with the Western Australian Beekeeper's Association (WABA) and the DEC convened Beekeepers' Consultative Committee to ensure that managed (commercial) Honeybee hives are not affected by control programs on DEC managed land and Crown land.

When the correct dose rates and protocols for the delivery of the insecticide have been established, a program of killing feral Honeybee hives in key breeding areas will be carried out. This program will be monitored and the results will be published in an appropriate journal.

**Action:** Determine, implement and publish methods of removing Honeybees from nesting hollows
**Responsibility:** DEC, Water Corporation
**Completion date:** Year two
**Cost:** $44,000 ($22,000 for two years)

### 14.6. Identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment.

Very little is known about the factors affecting the number of breeding attempts and the breeding success of Forest Black Cockatoos. Pairs may not breed every year (Johnstone and Kirkby 1999) and each pair of Baudin's Cockatoo raises an average of 0.6 chicks per year (Johnstone and Storr 1998). This rate of recruitment appears to be below the annual rate of mortality for adult birds (Garnett 1992).

Study is needed to determine why such a small proportion of the population attempts to breed and why recruitment rates of Forest Black Cockatoos are low. The causes are likely to include lack of nest hollows (although there is no evidence of competition for nests between pairs), competition for nest hollows with feral Honeybees and other birds (e.g. Galah and Corella) or hollow damage. In addition, seasonal and inter-annual variation in the amount of

food produced by food plants may affect the number of birds that can breed (Johnstone and Kirkby 1999).

The Western Australian Museum studies the breeding biology of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo and these studies may help determine the factors affecting the number of breeding attempts, nestling growth rates and breeding success. Experimental studies are also required to: determine the factors that make hollows attractive to other birds and feral Honeybees; and to develop methods to exclude other birds and feral Honeybees from hollows in breeding habitat critical to survival and important populations. Once hollows have been found, the recovery team will manage those hollows to exclude other animals and increase the breeding success rate of Forest Black Cockatoos. Data on the nesting behaviour of the cockatoos will be collected and the results will be published in an appropriate journal.

**Action:** Identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment
**Responsibility:** Western Australian Museum, Western Australian universities, DEC
**Completion date:** Year five
**Cost:** $330,000 ($66,000 per year for five years)

### 14.7. Determine and implement ways to minimise the effects of mining and urban development on habitat loss.

At present, the process of mining of bauxite, alumina, gold and mineral sands in south-west Western Australia involves broad-scale clearance of Jarrah, Marri and Wandoo. Similarly, residential developments are often cleared of vegetation entirely before construction.

In Western Australia, development companies must submit an application to clear native vegetation under the *Environmental Protection Act 1986* administered by the Department of Environment Western Australia. A fauna survey may then be required as part of the Environmental Impact Assessment (*Environmental Protection Act 1986*) to determine if the area proposed for clearing contains Threatened Fauna listed under the State *Wildlife Conservation Act 1950* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. If Commonwealth-listed threatened fauna inhabit the proposed site, development companies must refer any proposed impacts to the federal Department of the Environment, Water, Heritage and the Arts (DEWHA).

As part of arrangements with the Environmental Protection Authority (EPA), in cases where the EPA is to undertake an environmental impact assessment under the *Environmental Protection Act 1986*, DEWHA will defer the assessment of the impacts to the State of

Western Australia, based on the EPA assessment process for the approval or otherwise of the proposed impacts.

As part of the legislative controls over the planning and approval of development activities, DEC will advise the EPA and the proponent on appropriate management and mitigation measures for impacts on Forest Black Cockatoos, should the proposal be approved. Wherever possible, habitats known to be used for feeding, breeding and roosting by Forest Black Cockatoos should be retained. DEC and the Western Australian Museum will also provide advice to development companies on steps that can be taken to protect remaining habitat for the benefit of Forest Black Cockatoos in south-west Western Australia.

**Action:** Determine and implement ways to minimise the effects of mining and urban development on habitat loss
**Responsibility:** DEC, Western Australian Museum
**Completion date:** Ongoing
**Cost:** $5,000 initially, in kind and as part of other actions

### 14.8. Determine and implement ways to manage forests for the conservation of Forest Black Cockatoos.

The Western Australian Conservation Commission produced a forest management plan to manage State forest and timber reserves from 2004-2013 (Conservation Commission 2004). This plan is currently under review and the recovery team will contribute to the review via:

1. Habitat modelling to identify forest habitat that is likely to be important for conservation of Forest Black Cockatoos.

2. Comment on the review of the forest management plan and the related guidelines.

3. Identification and protection of fauna habitat zones – these are designated areas of important habitats of 200 ha that are not logged, but protected with a buffer zone around the habitat.

4. Marking and protection of known nest trees from logging, fire and fire fighting activity (however, the risk of identifying nest trees for poachers will have to be considered).

5. Increasing the amount of forest that is contained in DEC managed reserves.

6. Preparation of maps and *EPBC Act* policy statements to ensure that if private forest habitats are due to be cleared or logged, referral is made to the Minister for the Environment.

7. Mapping of risk areas and provision of other information needed to identify areas of high priority for protection of important forest habitat from *Phytophthora cinnamomi* dieback.

8. Development of logging rotation and density management guidelines to allow for the development of large hollows suitable for nesting by Forest Black Cockatoos.

**Action:** Determine and implement ways to manage forests for the conservation of Forest Black Cockatoos
**Responsibility:** DEC
**Completion date:** Year two
**Cost:** $30,000 ($15,000 per year for two years)

### 14.9. Identify and manage important sites and protect from threatening processes.

Identifying important sites of both taxa of Forest Black Cockatoo will require consultation between DEC, the Western Australian Museum, landholders and community groups. The Western Australian Museum and the Water Corporation will design an electronic frequent sighting form for members of the public to submit records of sightings. These records will be collated and the generalised distributions will be mapped as part of the Cockatoo Care program. To collect detailed information on the locations of roosting, feeding and nesting sites, the Western Australian Museum will prepare a proforma for DEC staff. The proforma will be used by DEC staff to record information on location, number of adult and juvenile birds in the flock, direction of flight and plant species used for feeding and nesting. These sightings will be reported to the Western Australian Museum staff to map the sites and add them to their monitoring program. Once important sub-populations or groups have been identified, DEC and the Western Australian Museum will develop and implement management strategies to protect these groups from threatening processes as part of Action 14.7.

**Action:** Identify and manage important sites and protect from threatening processes
**Responsibility:** DEC, Western Australian Museum
**Completion date:** Year ten
**Cost:** $50,000 ($5,000 per year for ten Years)

### 14.10. Map feeding and breeding habitat critical to survival and important populations, and prepare management guidelines for these habitats.

A general description of the feeding and breeding habitat of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo has been given in this Recovery Plan. However, adequate maps of the feeding and breeding habitat of these two species have not yet been produced. The extent of suitable habitat for Forest Black Cockatoos must be mapped to ensure that the management of those areas is in keeping with the conservation goals for the cockatoos. DEC's Forest Management Branch (FMB) will map feeding, roosting and breeding habitat based on habitat parameters provided by the Western Australian Museum. Parameters such as tree species composition, height, density, patch size and frequency of hollow bearing trees will be used to model known and potential habitat. The maps will then be used to identify 200 ha Fauna Habitat Zones (Conservation Commission 2004) for protection from timber harvesting. Once the feeding and breeding habitat critical to survival and important populations has been identified via mapping, DEC and the Western Australian Museum will liaise with landholders, land managers, timber producers and community groups to develop management strategies to protect these populations from threatening processes as part of Action 14.7.

**Action:** Map feeding and breeding habitat critical to survival and important populations, and prepare management guidelines for these habitats
**Responsibility:** DEC, Western Australian Museum
**Completion date:** Year two
**Cost:** $60,000 ($30,000 for per year for two years)

### 14.11. Monitor population numbers and distribution.

Baudin's Cockatoo occurs in only one population in the south-west of Western Australia (Johnstone and Storr 1998) and this population is estimated to number 12,000 breeding birds (Garnett and Crowley 2000). Similarly, the Forest Red-tailed Black Cockatoo occurs in only one population in the south-west of Western Australia (Johnstone and Storr 1998) that is estimated at about 15,000 individuals (Abbott 1998). Although the number of birds in these populations has been estimated, the total number of birds in each population has not been established via a systematic survey.

One of the challenges of conducting a census of Black Cockatoos in south-west Western Australia is that Baudin's Cockatoo is very difficult to distinguish from Carnaby's Cockatoo, especially in flight when the birds may not be calling. Forest Red-tailed Black Cockatoos may also be mistaken for White-tailed Black Cockatoos when their red tail panels are not

visible. Thus, any attempt to count the number of cockatoos in the population must be carried out by skilled observers as part of a co-ordinated survey.

A survey to determine the number and distribution of these two species will be undertaken as part of this Recovery Plan. Western Australian Museum staff will conduct field studies to locate major roosting flocks. The number of birds in each of these flocks will be recorded and combined to estimate the total number of birds in the population. The number of breeding pairs and immature birds in major flocks will be recorded as an estimate of productivity. Flock numbers and composition will be monitored over time and used to assess the criteria for failure of the recovery plan (Section 13.2).

**Action:** Monitor population numbers and distribution
**Responsibility:** Western Australian Museum, DEC
**Completion date:** Years two and ten
**Cost:** $25,000 ($5,000 per year for five years)

**14.12. Determine the patterns and significance of movement.**

At the end of the breeding season from March to May, flocks of Baudin's Cockatoo move north to the Darling Range and the eastern margin of the Swan Coastal Plain (Johnstone and Storr 1998). The cockatoos then move south through the Perth region from August to October (Serventy 1937; Sedgwick 1940; Serventy 1948; Heron 1970; Saunders 1979). The movements of the Forest Red-tailed Black Cockatoo are thought to be irregular (Sedgwick 1949) and while their movements may be less pronounced than those of Baudin's Cockatoo, the Forest Red-tailed Black Cockatoo does move seasonally in response the changing food availability (personal communication R. Johnstone[1]).

Patterns of movements of Forest Black Cockatoos will be recorded as part of this Recovery Plan and the possible reasons for these movements will be identified. Any study of the movements of the cockatoos should also include a study of the patterns of resource use, which can then be compared to the regional availability of foods to determine if the cockatoos move in response to the availability of particular foods. A study of the movements of Forest Black Cockatoos may be achieved by a number of means, including seasonal analysis of Birds Australia Atlas data, seasonal surveys, observation of marked birds or by satellite transmitter tracking. This information will then be used to manage Forest Black Cockatoos and their habitats throughout their range.

**Action:** Determine the patterns and significance of movement
**Responsibility:** Western Australian Museum, DEC

**Completion date:** Year ten
**Cost:** $50,000 ($5,000 per year for ten years)

### 14.13. Maintain the Cockatoo Care program and use other opportunities to promote the recovery of Forest Black Cockatoos.

The Cockatoo Care program is already a very successful means of encouraging and maintaining community support and involvement in the conservation and management of Black Cockatoos in Western Australia. For example, the Cockatoo Care website receives an average of more than 1,000 hits per day (Johnstone and Cassarchis 2003). The cockatoo observation sheets and cards, forums, school programs and media events conducted as part of Cockatoo Care have been successful in attracting community support for the conservation of Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo (Johnstone and Cassarchis 2003).

The Western Australian Museum's Discovery Centre has a permanent display about Black Cockatoo research and conservation and also distributes information sheets on the biology, ecology and behaviour of the cockatoos (Johnstone 1999b, 1999a). The Department of Environment and Conservation conducted research into the distribution, threats and management of the Forest Red-tailed Black Cockatoo and published a summary of this study on DEC's Naturebase website in 2001 (Abbott 2001).

The Cockatoo Care program and information about Forest Black Cockatoos on the DEC Naturebase website will be maintained and updated as new information is collated. The recovery team will continue to produce educational materials for the general public and as part of the communication strategy to eliminate illegal shooting in Action 14.3.

**Action:** Maintain the Cockatoo Care program and use other opportunities to promote the recovery of Forest Black Cockatoos
**Responsibility:** Water Corporation, Western Australian Museum, DEC
**Completion date:** Ongoing
**Cost:** $700,000 ($70,000 per year for 10 years)

## 15. SUMMARY OF RECOVERY ACTIONS

| Action | Responsibility | Year/Cost ($) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
| 14.1 Seek the funding required to implement future recovery actions. | **DEC, Water Corporation, WAFGA** | 2,500 | | | | | | | | | | 2,500 |
| 14.2 Determine and promote non-lethal means of mitigating fruit damage by Baudin's Cockatoo in orchards. | **DEC, WAFGA, DAFWA** | 103,000 | 103,000 | 103,000 | | | | | | | | 309,000 |
| 14.3 Eliminate illegal shooting. | **DEC, WAFGA, DAFWA** | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 200,000 |
| 14.4 Develop and implement strategies to allow for the use of noise emitting devices in orchards. | **DEC, WAFGA, DAFWA** | 2,500 | 2,500 | | | | | | | | | 5,000 |
| 14.5 Determine and implement ways to remove feral Honeybees from nesting hollows. | **DEC, Water Corporation** | 44,000 | | | | | | | | | | 44,000 |
| 14.6 Identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment. | **Western Australian Museum, Western Australian universities, DEC** | 66,000 | 66,000 | 66,000 | 66,000 | 66,000 | | | | | | 330,000 |
| 14.7 Determine and implement ways to minimise the effects of mining and urban development on habitat loss. | **DEC, Western Australian Museum** | 5,000 | | | | | | | | | | 5,000 |
| 14.8 Determine and implement ways to manage forests for the conservation of Forest Black Cockatoos. | **DEC** | 15,000 | 15,000 | | | | | | | | | 30,000 |
| 14.9 Identify and manage important sites and protect from threatening processes. | **DEC, Western Australian Museum** | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 50,000 |
| 14.10 Map feeding and breeding habitat critical to survival and important populations, and prepare management guidelines for these habitats. | **DEC, Western Australian Museum** | 30,000 | 30,000 | | | | | | | | | 60,000 |
| 14.11 Monitor population numbers and distribution. | **Western Australian Museum, DEC** | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | | | | | | 25,000 |
| 14.12 Determine the patterns and significance of movement. | **Western Australian Museum, DEC** | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 50,000 |
| 14.13 Maintain the Cockatoo Care program and use other opportunities to promote the recovery of Forest Black Cockatoos. | **Water Corporation, Western Australian Museum, DEC** | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 700,000 |
| **Annual Cost** | | 373,000 | 321,500 | 274,000 | 171,000 | 171,000 | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 | **1,810,500** |

**DEC = Department of Environment and Conservation Western Australia, DAFWA = Department of Agriculture and Food Western Australia, WAFGA = Western Australian Fruit Growers' Association.**

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