

# Husbandry Guidelines for



Image Courtesy of Lisa Harris

## Red-tailed Black Cockatoo

*Calyptorhynchus banksii*

Aves:Cacatuidae

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## **Disclaimer**

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## Occupational Health And Safety Considerations

The Red-tailed Black Cockatoo is classified as an innocuous species, which means it is relatively harmless, however there are some Occupational Health and Safety risks that could occur when working with them.

### Physical

Red-tailed Black Cockatoos have a large and powerful bill, which could cause deep lacerations and possibly remove a finger. Whilst Red-tailed Black Cockatoos usually have a docile temperament there are circumstances which could lead to biting such as being frightened or threatened. Territorial aggression is also a factor. It is important to document any bites and the circumstances surrounding them so that all staff have knowledge of the incident and how to avoid it.

The toe-nails of Red-tailed Black Cockatoos can also become quite sharp which can lead to scratches if they are being handled. It is important to properly treat scratches with proper first aid as scratches can become infected.

Red-tailed Black Cockatoos can also be extremely loud and extended exposure to their screams could lead to permanent hearing damage, so it is well advised to wear ear plugs around them when they are being noisy.

### Chemical

When working with any chemicals in the workplace it is necessary that you consult the Material Safety Data Sheet prior to using a chemical. Certain chemicals can be extremely hazardous to your health and the health of the animals in your care if used inappropriately or other than directed.

### Biological

Red-tailed Black Cockatoos are generally robust birds however there is one disease that they can pass onto humans, Psittacosis (Chlamydia). Psittacosis in humans is usually only mild. However, it can be more serious for people who are already sick as well as the elderly as if left untreated it can result in death.

Psittacosis can be transferred to humans by the infected bird by the inhaling of aerosols from droppings, feather dust or respiratory tract excretions such as sneezing.

The symptoms for Psittacosis in humans are headaches, fever, irritant and non productive cough, chills, loss of appetite. It is important to consult a Doctor if you have some or all of these symptoms as the sooner it is treated the better.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

### Ergonomical

Aviary layout and aesthetics are important in OH and S because if they are poorly designed one can sustain serious injury. Perches should be set to an appropriate height so one will not hit their head, doors to the aviary should also be at an appropriate height as excess bending down can strain the neck and back as well as posing a risk of hitting your head on the upper door frame. With a larger door entry it is advised to add an air lock to the aviary so if birds accidentally fly out of their aviary they will be trapped in the air lock.

All aviary wire should be tied up neatly with no sharp protrusions as these can cause scratches to the skin as well as cause injuries to your birds.

### Radiation

There is a risk of exposure to Ultra Violet light when working in outdoor aviaries. Ultra Violet light can cause sunburn which if continually exposed to can cause skin cancer. It is recommended before working in outdoor aviaries to wear sunglasses and a hat as well as applying sunscreen.

### Psychological

When working with sociable animals daily one can become attached quite easily, Red-tailed Black Cockatoos are beautiful creatures but even though they are long lived they are not immune to death. Death of an animal in your care can be very upsetting and depressing. In the event of depression it is worth consulting a doctor who can help you through the grieving process.

# 1 Introduction

The Red-tailed Black Cockatoo ( *Calyptorhynchus banksii*) is one of the most beautiful members of the Cockatoo family ( Cacatuidae). It was first described in a pencil sketch by Sydney Parkinson in 1770 who sailed on the *Endeavour* as a draughtsman to Sir Joseph Banks. This is the earliest known illustration of a bird from the east coast of Australia and the 1<sup>st</sup> of an Australian parrot. (Forshaw 2003)

*C.banksii* is a member of the Cockatoo family and as such is a large stocky parrot that has an erectile backswept crest, large robust bill, reinforced skull and well developed feather downs. (Cameron 2007)

There are 5 different subspecies of *C.banksii* which make up 8 populations throughout Australia. These 8 populations inhabit varying habitats such as *Eucalyptus* forest, woodland dominated by *Acacia* and *Allocasuarina* trees, monsoon or subtropical rainforests, recently burned proteaceous shrublands, sparsely timbered grasslands and trees scattered through cultivated farmlands.

The first partial breeding success of *C.banksii* occurred in England 1939 in the Marquis of Tavistocks (Duke of Bedfords) aviaries .(Sindel and Lynn 1989). Since this time there has been great success in breeding this species with both private institutions and aviculturalists readily breeding this species in captivity.

Many zoos around Australia hold *C.banksii* in their collection as they adapt well to captivity. Due to a ban on the export of birds from Australia *C.banksii* is relatively uncommon in other countries with it being held in low numbers in the USA and Europe.

*C.banksii* is currently as a whole listed as Appendix II on Cites which means it could become threatened in the future, however *C.b.graptogyne* a subspecies found in Victoria and South-East South Australia is currently endangered in the wild. There has been a strong interest in maintaining the subspecific identity of *C.banksii* in captive populations, which should be considered best practice for institutions.



### **1.1 ASMP Category**

No regional program; Management Level 3

Referenced from Australasian Species Management Plan 2007

### **1.2 IUCN Category**

The IUCN category for *Calyptrorhynchus banksii* is LC, which stands for Least Concern.

The IUCNs justification for this category is as follows:

“This species has a large range, with an estimated global extent of occurrence of 1,000,000-10,000,000km<sup>2</sup>. The global population has not been quantified, but the species is not believed to approach the thresholds for the population size criterion of the IUCN Red List (ie., less than 10,000 mature individuals in conjunction with appropriate decline rates and subpopulation qualifiers). Global population trends have not been quantified; there is evidence of a population decline (del Hoyo *et al.* 1997), but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (ie., declining more than 30% in 10 years or 3 generations). For these reasons, the species is evaluated as Least Concern.”

Referenced from Birdlife International 2004. *Calyptrorhynchus banksii*. In: IUCN 2007. 2007 IUCN Redlist of Threatened Species. [www.iucnredlist.org](http://www.iucnredlist.org). Downloaded on 08 March 2008

### **1.3 EA Category**

Currently the Department of the Environment, Water, Heritage and the Arts has a 5 year recovery plan in place for *Calyptrorhynchus banksii graptogyne* as this subspecies is listed as endangered under the *Environment Protection and Biodiversity Act 1999*.

There is also a Draft Recovery Plan in development for *Calyptrorhynchus banksii naso* which is threatened under the *Environment Protection and Biodiversity Act 1999*.

### **1.4 NZ and PNG Categories and Legislation**

NA

### **1.5 Wild Population Management**

There is currently a National Recovery Plan in place for *Calyptrorhynchus banksii graptogyne* found in Victoria and South-East South Australia. *C.b.graptogyne* is currently endangered in the wild with a population of 1000+ left. The program aims at identify issues affecting survival and trying to implement strategies to counteract these issues.

There is also a Draft Recovery in development for *Calyptrorhynchus banksii naso*, which is found in the southern parts of Western Australia.

Referenced from

**1.6 *Species Coordinator***

NA

**1.7 *Studbook Holder***

Mike Curzon

## 2 Taxonomy

### 2.1 Nomenclature

**Class:** Aves

**Order:** Psittaciformes

**Family:** Cacatuidae

**Subfamily:** Cacatuinae

**Tribe:** Calyptorhynchini

**Genus:** *Calyptorhynchus*

**Subgenus:** *Calyptorhynchus* (Calypto is Greek for covered and rhynchus is Greek for bill)

**Species:** *banksii* (Species named in honor of Joseph Banks)

### 2.2 Subspecies

*C.b banksii* (Nominate species)

*C.b graptogyne* (Commonly known as South-eastern Red-tailed Black Cockatoo)

*C.b samueli* (Commonly known as Inland Red-tailed Black Cockatoo)

*C.b naso* (Commonly known as Forest Red-tailed Black Cockatoo)

*C.b macrorhynchus* (Commonly known as the Northern or Great-billed Red-tailed Black Cockatoo)

### 2.3 Recent Synonyms

*Calyptorhynchus magnificus*

*Psittacus banksii*

*Psittacus magnificus*

### 2.4 Other Common Names

#### 2.4.1 Other English Names

Black Cockatoo

Red-tailed Cockatoo

Banksian Cockatoo

Banksian Red Tailed Cockatoo

Banks Black Cockatoo

Great-billed Cockatoo

Referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)

### **2.4.2 Other Aboriginal Names**

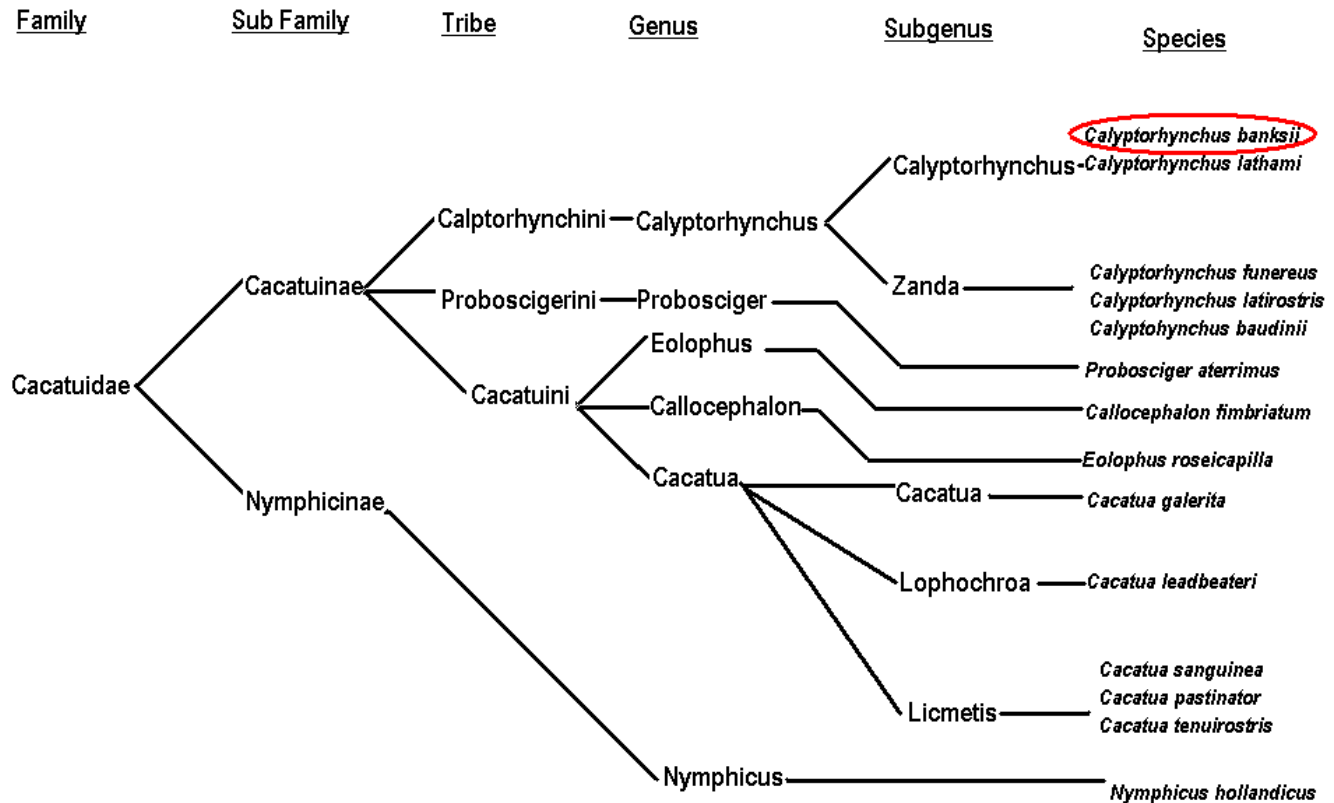
Awarak, Biddiarra, Bigar, Bildera, Bra Bia Bolam, Carrar, Darabiya, Darabiyangara, Diyara, Ga:ran, Gunggidala, Irallu, Iranda, Kadarabiya, Kappatch, Kar-rak, Keer-jan-dee, Kern, Korrark, Kor-rar-ra, Korridge-e-cup, Laralta, Leradoma, Lipa, Liraduma, Nangari, Ngurraar, Ngeitali, Njatili, Nokodarabiya, Tjirarnti, Treen, Urrarnda, Walapanda, Wilann, Wirann, Wuya, Yaralta, Yirrarnti, Yurrineta.

Referenced from *Handbook of Australia, New Zealand and Antarctic Birds. . Volume 4: Parrots to Dollarbird.* (Higgins 1999)

### 3 Natural History

The Red-tailed Black Cockatoo ( *Calyptorhynchus banksii*) is one of the most beautiful members of the Cockatoo family ( *Cacatuidae*). The scientific name can be broken down into 3 parts, *Calypto* which is Greek for covered, *rhynchus* which is Greek for bill and *banksii* after, Joseph Banks . Below is a family tree of Australian Cockatoos.

**Figure 1**



The species belongs to the Genus *Calyptorhynchus* which comprises of all Australian Black Cockatoos, with the exception of the Palm Cockatoo (*Probosciger aterrimus*). All of the 5 species in the genus have unique colored tail banding and are predominantly black.

There are 5 different subspecies which can be found in various areas throughout Australia. Of the 5 subspecies only 3 are well represented in zoos and private aviculture, *C.b macrorhynchus*, *C.b samueli* and *C.b banksii* being the nominate subspecies that are best represented. *C.b naso* is held in low numbers and *C.b.graptogyne* is quite rare in collections and is also endangered in the wild.

Referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)

### **3.1 Morphometrics**

#### **3.1.1 Mass And Basic Body Measurements**

##### **Males**

Wing length: 390-449 (427.5) mm  
Tail Length: 272-301 (289.5) mm  
Exposed Culmen: 48-55 (50.6) mm  
Tarsus: 32-37 (35.0) mm  
Beak: 45.4-53.6 (49.7) mm  
Weight: 670-920grams

##### **Females**

Wing Length: 402-454 (422.8) mm  
Tail Length: 277-321 (295.7) mm  
Exposed Culmen: 47-54 (49.4) mm  
Tarsus: 33-38 (35.1) mm  
Beak: 46.8-51.8 (49.1) mm  
Weight: 615-868grams.

Referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)  
and

*Handbook of Australia, New Zealand and Antarctic Birds. . Volume 4: Parrots to Dollarbird.* (Higgins 1999)

#### **3.1.2 Sexual Dimorphism**

Males are a glossy black brown in colour with a panel of bright red on the tail feathers. The feathers on top of the forehead and crown are extended to form a prominent crest. The beak is dark grey in color as is the periophthalmic ring with the iris being dark brown. Males generally weigh between 670-920grams.

Females: are a duller brown black in colour with yellow speckling on the on head, crest, neck and forewing feathers. There is also light yellow to orange on the breast and abdominal feather edges, producing a barring effect. The tail feathers are not like the males, they are a yellow orange to red in color with irregular black barring. The beak is an off white to light grey in color. Females generally weigh between 615-868grams.

Juveniles: are similar in appearance to females but have a whitish periophthalmic ring with incomplete barring on feathers around head, neck, collar and abdomen.

Referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)  
and

*Handbook of Australia, New Zealand and Antarctic Birds. . Volume 4: Parrots to Dollarbird.* (Higgins 1999)

### 3.1.3 Distinguishing Features

Red-tailed Black Cockatoos are of similar appearance to Glossy Black Cockatoos (*Calyptorhynchus lathami*) and both commonly inhabit the same areas on the eastern coast of Australia, both are of the same sub-genus *Calyptorhynchus*.

Red-tailed can be distinguished from Glossy Black Cockatoos in several ways.

- Red-tailed Black Cockatoos are larger than Glossy black Cockatoos; the average length of a Red-Tailed Black Cockatoo is 60-65cms and weight being between 615-920grams compared to Glossy Black Cockatoos being 48-50cms in length and 420-500grams in weight.
- Red-tailed Black Cockatoo hens generally have yellow speckling on the on head, crest, neck and forewing feathers while Glossy Black Cockatoo hens have some yellow speckling but a greater amount of yellow as patched areas around the neck.
- Red-tailed Black Cockatoos are a darker black in colour compared to Glossy Black Cockatoos that are a duller black brown in colour.
- Red-tailed Black Cockatoo males have a more prominent crest compared to Glossy Black Cockatoo males that have a smaller and more subtle crest.

Referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)

and

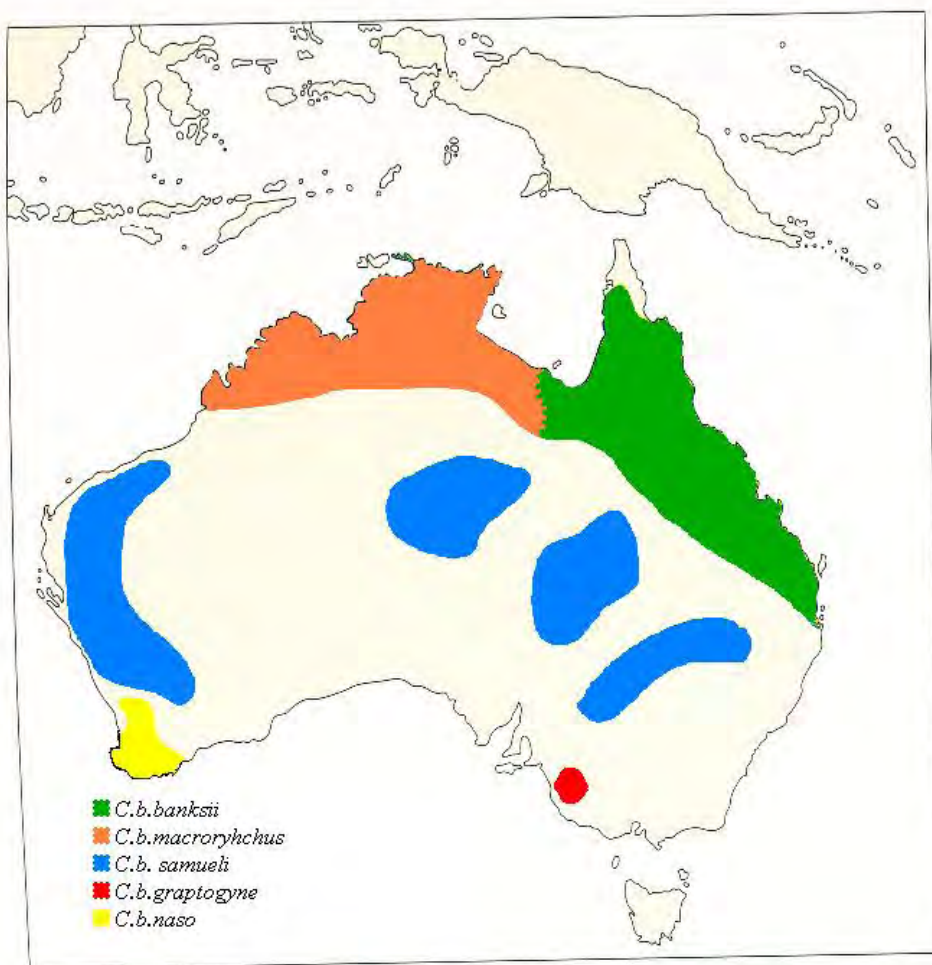
*Handbook of Australia, New Zealand and Antarctic Birds. . Volume 4: Parrots to Dollarbird.* (Higgins 1999)

### 3.2 Distribution and Habitat

The Red-tailed Black Cockatoo is an endemic species to Australia and has 5 sub-species; the 5 subspecies make up 8 populations throughout the country.

Widespread through northern and north-eastern Australia, but occurring in isolated populations across central and southern regions. This species does not occur in eastern Victoria, records from that area being attributable to misidentification of *Calyptorhynchus lathami* (Forshaw 2002). There have also been early reports of Red-tailed Black Cockatoos around Sydney on maiden voyages to Australia around the 1770's however this is also being believed as the misidentification of the Glossy Black Cockatoo (*Calyptorhynchus lathami*).

**Figure 2**



Range on map referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)

The map above represents all five subspecies of the Red-tailed Black Cockatoo whilst also highlighting the 8 separate populations found throughout the country. The 8 different populations can be found in various habitats. There are partial subspecies population



overlaps between *C.b.banksii* and *C.b.macrorhynchus* which means there could be the odd occurrence of breeding between subspecies and the production of an intergrade Red-tailed Black Cockatoo in the wild.

The Red-tailed Black Cockatoo inhabits various habitats throughout Australia, this showcases the species adaptability to Australia's various and often harsh landscapes.

Red-tailed Black Cockatoos favour *Eucalyptus* woodland and trees bordering watercourses, but are found in a wide variety of habitats, including dense *Eucalyptus* forests, woodland dominated by *Acacia* or *Allocasurina* trees, monsoon or sub-tropical rainforests, recently-burnt proteaceous scrublands, sparsely timbered grasslands, and trees scattered through cultivated farmlands.( Forshaw 2002)

Referenced from *Australian Parrots: Third Revised Edition* (Forshaw 2002)

### **3.3 Conservation Status**

*C.banksii* is currently as a whole listed as Appendix II on Cites which means it could become threatened in the future, however *C.b.graptogyne* found in Victoria and South-East South Australia is currently endangered in the wild. *C.b.graptogyne* is currently endangered due to habitat loss resulting in a lack of suitable nesting sites and it is estimated that there are only 1000 left in the wild. Habitat has been lost due to widespread clearing for agriculture and grazing. Bush regeneration has been staggered and unsuccessful in parts largely due to the grazing affects of sheep and rabbits.

Currently there are conservation programs in place for this subspecies, one such program is run by <http://redtail.com.au/> who are made up of representatives from Birds Australia, South Australian Farmer's Federation, Department of Sustainability and Environment, Department of Environment and Heritage (Federal), Department for Environment and Heritage (South Australia), Glenelg Hopkins and Wimmera Catchment Management Authorities, Trust for Nature, Threatened Species Network, South East Natural Resource Consultative Committee, Local Government, Adelaide University and Forestry SA.  
( Referenced from <http://redtail.com.au/recovery.html> )

Institutions and private aviculturalists are recommended to breed nothing but pure subspecies to ensure pure bloodlines and the preservation of all subspecies and the species as a whole. To successfully do this institutions and aviculturalist must positively identify the subspecies which they wish to breed.

In 2006 the mascot for the 2006 Melbourne Commonwealth Games was *C.b.graptogyne*, this was done to aid conservation efforts for the subspecies, as well as provide the public with a better education on its current status and how they can help.

Whilst currently *C.b.banksii* is in abundant numbers, their numbers could decline in the future due to the fact that the Queensland Department of Environment and Heritage issue permits to farmers allowing them to shoot pest species that damage crops. Some farmers do plant sacrificial crops for *C.b.banksii* , and this has been successful in reducing

damages to crops. The shooting and trapping is an unjust and outdated method of damage prevention, and I feel that other avenues should be explored by farmers and The Queensland Department of Environment and Heritage as this could cause a decline in the future.

(Referenced from *A Guide To Black Cockatoos: As Pet and Aviary Birds* 2005)

It is also commonly believed that the Red-tailed Black Cockatoo is illegally caught for aviculture therefore institutions should only buy from reputable breeders or from other zoos.

### **3.4 Diet in the Wild**

In the wild Red-tailed Black Cockatoos feed on a variety of different foods depending on what is available. The foods can include:

- The seeds of a many different species of Eucalypts such as, Brown Stringy Bark (*Eucalyptus baxteri*), Bloodwoods (*Eucalyptus polycarpa* and *Eucalyptus intermedia*), *Eucalyptus miniata* and *Eucalyptus ptychocarpa*.
- The seeds and nuts from *Acacia*, *Allocasurina*, *Hakea* and *Banksia*.
- Fruits, blossoms, berries, nectar, insects and larvae.
- In Western Australia the seeds of the introduced Double Gee (*Emex australis*)
- In Queensland and Red-tails Black Cockatoos have been known to eat the peanuts at peanut farms, this poses as a problem to farmers.

### **3.5 Longevity**

#### **3.5.1 In the Wild**

I would estimate the wild life expectancy of Red-tailed Black Cockatoos to be between 10-25 years based on the fact that in captivity birds can be reproductively viable for over 20 years (see 10.7).

From my research I was unable to find any actual data on wild life expectancy for Red-tailed Black Cockatoos which could be an area needing research in terms of conservation of the species and subspecies in the years to come.

#### **3.5.2 In Captivity**

The oldest recorded age in captivity is a female at London Zoo who is a minimum of 45 years old. The bird is documented as a minimum age as its origin is unknown.

Referenced from *Longevity records for Psittaciformes in captivity* (Brouwer, Jones, King and Schifter 2000)

#### **3.5.3 Techniques Used to Determine Age in Adults**

From my research I was unable to find any techniques used to determine age in adults.

## 4 Housing Requirements

### 4.1 Exhibit/Enclosure Design

One of the most important things when designing an enclosure for Red-tailed Black Cockatoos is to take into account their locomotive lifestyle. Red-tailed Black Cockatoos have the ability to sustain flight, they are acrobatic climbers and are agile manipulators, they also have powerful beaks. With this in mind the enclosure can now be designed. The enclosure should have the following:

- Inch by Inch mesh. (25mmX25mm) with a thickness of 2.5-3mm
- Reasonable distance to allow flying. 5m+
- A clear flight path.
- Branches of varying sizes to perch on and climb in.
- An airlock to prevent escapes
- Height to allow the birds to feel safe up high.
- Easy to clean substrate, concrete being the easiest to clean and the most hygienic.
- 30% shelter of the exhibit.
- Suitable nesting or roosting sites.
- Suitable public viewing area.
- The exhibit should ideally be north facing to provide maximum sunlight.
- Protection from the elements.
- A tap to provide water and used in cleaning.
- The enclosure should be pest proof, with concrete or corrugated iron at least 2 feet high at the base before the aviary mesh starts.
- A pest control system should be put in place.
- There should be browse holders installed around the exhibit so that enrichment can be rotated throughout the exhibit.
- A feed station should be installed so that a keeper, not a Cockatoo, can only remove the food bowl. Feed bowls should be off the ground and under shelter to provide protection from rodents and the elements.
- Species Identification should be made part of the exhibit to comply with EAPA regulations.
- Aviaries should never be built facing south and must always be totally protected on the southern side.
- Water bowls should never be positioned underneath a perch as they become subject to faecal contamination.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)  
And *(Australian Cockatoos* Sindel and Lynn 1989).

## **4.2 Holding Area Design**

Holding area should be a minimum of 2m X 2m X 4 m to allow flight and sufficient space to move about. There should be suitable perching of various sizes in the enclosure. There should also be a covered end of the enclosure to provide protection from the elements. Provisions for food and water should also be accounted for.

## **4.3 Spatial Requirements**

The Red-tailed Black Cockatoo is a large species of Cockatoo that enjoys flight, and in order to stay fit it needs to exercise wing muscles and have space to be active, therefore an aviary of reasonable size is best recommended.

“They will breed in an aviary with minimum dimensions of approximately 4 metres long x 2 metres wide x 2 metres high, although a small aviary of this size is more suitable for juveniles until they attain breeding age.” (Connors 2005 p121)

“The aviary which housed my breeding pair is aligned due north-south, and has an overall length of 8m, with 2m being enclosed within the rear shelter, while the width is 1.8m and the height is 3.1m.” (Forshaw 2002 p103)

In Sindel and Lynn (1989) Robert Lynn housed his first pair of Red-tailed Black Cockatoos in a north facing aviary approximately 9m long, 2m wide and 2.4m high; it had a fully enclosed shelter at the southern end and was totally protected on the western side and roofed from 3m over both ends.

Referenced from (*Australian Cockatoos* Sindel and Lynn 1989).

### **Clause 18 of The EAPA Act**

1. “The size and shape of the enclosures must provide freedom of movement, both horizontally and vertically.”
2. “An enclosure must be of sufficient size, and the animals in the enclosure must be so managed, as to:
  - a) “Avoid undue domination of a herd or group by an individual or individuals; and”
  - b) “avoid the risk of persistent and unresolved conflict between herd or group members or different species in the enclosures containing different species; and”
  - c) “make it possible for an animal to avoid, or withdraw from, contact with other animals or with people; and
  - d) “ensure that the carrying capacity of the enclosure is not exceeded; and”
  - e) “prevent an uncontrolled accumulation of parasites and other pathogens; and”
  - f) “encourage and permit exercise and behavioral enrichment.”
3. “Each animal must be provided with sufficient space in all directions to enable it:”
  - a) “to exercise; and”
  - b) “to be protected from undue dominance and conflict; and”
  - c) “to be provided with its social, breeding and husbandry needs.”

4. “With the approval of the Director-General, a bird rendered flightless may be kept in an enclosure smaller than that which would be required if it could fly.”

Referenced from *General Standards for Exhibiting Animals in New South Wales: Exhibited Animals Protection Act* (Department of Primary Industries 1986)

#### **4.4 Position of Enclosures**

“Aviaries in the southern hemisphere should ideally face north or at least in the case of large broad cockatoo aviaries have one side facing north so as to provide maximum sunlight.” (Sindel and Lynn 1989 p23)

#### **4.5 Weather Protection**

An aviary housing Red-tailed Black Cockatoos should be at least 30% covered allowing birds to move about between cooler and warmer areas as they wish, it also provides protection from the elements and an added feel of security. Food, water and nest boxes should all be undercover for protection. Nest boxes can add extra protection from the weather and elements. Red-tailed Black Cockatoos love to bath in the rain so the enclosure should not be fully sheltered.

“Full protection from all prevailing winds is advisable as well as fully enclosed weatherproof shelters, open only at the front and situated on the southern end of aviaries facing north. One aviaries facing east or west there should be fully enclosed shelters at both ends.” (Sindel and Lynn 1989 p23)

“Sufficient shelter must be provided to allow protection from the wind, rain and extremes in temperature and allow sufficient access to shade during the hot periods of the day” Referenced from *General Standards for Exhibiting Animals in New South Wales: Exhibited Animals Protection Act* (Department of Primary Industries 1986) Clause 13

#### **4.6 Temperature Requirements**

The enclosure in which Red-tailed Black Cockatoos are housed should allow the birds to move freely between covered and uncovered areas, covered areas should provided protection and relief in extreme temperature conditions. On extremely hot days aviary sprinklers can help cool the enclosure and promotes bathing which also cools the birds down. In colder climates heat lamps can be provided in undercover areas of aviaries to keep the birds warm if they are cold.

Ideally temperature should be a consistent level, only changing in between seasons and not fluctuate between hot and cold frequently.

“At high temperatures, cockatoos adopt postures that expose blood-rich and poorly insulated parts of their body, such as the underwing, to the air in order to maximize heat loss. At very high temperatures, birds pant to enhance cooling by evaporating water from the respiratory tract, Cockatoos sitting quietly in the shade, wings drooped and panting heavily, are a common midday sight in summer throughout inland Australia.” (Cameron 2007 p72)

“The breakdown, or metabolism, of ingested food in a cockatoo’s cells produces heat. Low metabolic rates means birds have less heat to get rid of when temperatures rise. Studies in Western Australia have shown that Inland Red-tailed (Black) Cockatoos (*C.b.samueli*) have a lower metabolic rate than the Forest Red-tailed (Black) Cockatoos (*C.b.naso*), the former subspecies occupying a more arid environment. Lower metabolic rates also mean that birds can sustain themselves on less energy than birds with higher rates, and as a result can spend less time foraging and more time resting in the shade.” (Cameron 2007 p72)

#### **4.7 Substrate**

“Concrete floors, which probably have the least pleasing aesthetic appearance, are without a doubt the most functional aviary flooring. They can be reasonably attractive and are easy to clean if kept covered with a sprinkling of sand. Concrete floors help to eliminate vermin and worm infestation as well as facilitating cleaning with a broom and shovel and/or the use of a high pressure water hose.” (Sindel and Lynn 1989 p22)

#### **4.8 Nest boxes and/or Bedding Material**

Nest boxes can be of varying shapes and sizes. Hollowed out logs from fallen trees are recommended. Trees should never be cut down for the purpose of collecting nest logs, as wild animals lose their homes in this process and suitable hollows take many years to form, with this in mind there are other options. Commercial made nest boxes have been on the market for many years and designed for Cockatoos size and are, old wine barrels and it is possible to repair old nest logs with timber.

A suitable nest log should measure approximately 90-100cm deep with an internal diameter of 30cm. The log should be open at the top and have a hole for nest inspections. Ideally the log should be hung vertically in a location which allows the first morning sunlight and just a little rain to enter the nest.

Nest box substrate can consist of hardwood chips or coarse sawdust mixed with clean sand or soil. The nest box will also get added woodchips from chewing inside the log added to it.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

“Again Bob Lynn favours vertical logs standing on the ground under shelter which measure approximately 1.5m (5 ft) long and 30 to 40cm (12-16in.) internal diameter with a natural entrance spout. They are filled to within 60cm (2 ft) of the top with rotten wood, dirt or soft termite nest.” (Sindel and Lynn 1989 p122)

#### **4.9 Enclosure Furnishings**

Enclosure furnishings for Red-tailed Black Cockatoos need not be fancy but must have certain aesthetic qualities and functionality that will provide a stimulating, safe and comfortable environment

One of the most important pieces of enclosure furniture is perches. Perches should be made of natural branches of various shapes and sizes as this prevents problems with feet such as Repetitive Strain Injury (RSI) and Bumble Foot by providing them with exercise as well as trimming toenails. Perches will have to be changed from time to time as they wear and tear and the destructive nature of Red-tailed Black Cockatoos will take its toll. It is recommended that perches be monitored for damage so that they can be replaced before birds can injure themselves. By having a collection of pre-cut to size perches ready, changing perches can be a quick and easy process.

Browse holders are a very useful addition to an aviary as they allow browse to be safely and strategically placed throughout the aviary. Browse holders are generally placed throughout the aviary on walls near perches as they allow birds to forage through the loose branches whilst having reasonable balance. Browse is an important part of enrichment with Red-tailed Black Cockatoos as it promotes foraging for food.

Vertical perches can also be added to an aviary provided that they are stable when installed. Vertical perches are great for chewing and Red-tailed Black Cockatoos will find much amusement in chewing the perch to pieces.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## **5 General Husbandry**

### **5.1 Hygiene and Cleaning**

#### **Daily**

- Old food removed.
- Faeces washed away from aviary floor either by hose or scrubbing.
- Clean food and water bowls, replace with clean water and fresh food.

#### **Weekly**

- Clean perches to remove faeces.
- Remove old browse. Replace with new.
- Scrub aviary floor with an aviary disinfectant such as Aviclenz™
- Assess enclosure for any repair needed and repair.

#### **Monthly**

- Assess perch damage, if needed replace with new perches.
- Assess enclosure for any major damage that may need repair and repair it.
- Check if nest box needs new nesting material.

#### **Bi-annual**

- Scrub down entire enclosure with an aviary disinfectant such as Aviclenz™.
- Assess nest box for damage from breeding season and either repair or replace with new.

### **5.2 Record Keeping**

Record keeping is a vital part of captive animal management and should be kept as accurate and up to date as possible. Record keeping can assist in identifying behavioral problems, health problems and breeding triggers. By documenting the animals' general condition and any other interesting or notable things in a daily diary you can improve your knowledge on the species in captivity, their husbandry and their general wellbeing.

“Exhibitors are encouraged to maintain records that include the following information for each individual or group:”

- “Species (common and scientific name).
- Given name of the animal and its sex.
- Date of birth.
- Name of breeder, place of birth, sire and dam (if known)
- Previous ownerships-names and dates.
- Breeding history – mating dates, mating partners, number and sex of any offspring, and the fate of those offspring.
- Medical history (including diagnoses of diseases, medical treatments, surgical procedures, vaccinations). Dates are essential.
- Any noteworthy incidents involving this animal.



- Identification – eg. Leg band, eartag, microchip, tattoo number, distinguishing marks or appropriate photograph.
- Dietary preferences.”

Referenced from Clause 31 *General Standards for Exhibiting Animals in New South Wales: Exhibited Animals Protection Act* (Department of Primary Industries 1986)

### **5.3 Methods of Identification**

Common methods of identification that are used on *C.banksii* in captivity are:

- Leg banding: Leg banding is used to identify birds by attaching a small ring that has a unique number attached to it. If there are multiple birds in the aviary it is advised that the rings are of different colors and on different legs EG green right, green left, blue right... By doing this you will be able to identify specific birds in a group.
- Micro-chipping: Micro-chipping is now becoming a common way to identify birds in captivity as in the event of the bird escaping or being stolen it is a way to positively prove ownership of the bird.
- Distinguishing characteristics: In an aviary with multiple birds it is possible to positively identify a bird by their appearance. Features like beak size, body size, feather coloration or pattern, behavior, beak color can all help in identify a certain bird in an aviary. These distinguishing characteristics can also include sexual dimorphisms.
- It is also well advised that the door to each aviary have a door ID sign which tells you how many birds are in the aviary, their sex and their ARKS number (Animal Record Keeping System) these will help in positive identification.

“Unless distinguishing marks or features, documented in the animals records, can easily identify and individual animal, a permanent method of identification is required to identify an individual, if requested by the Director-General or an authorized inspector.”  
(Department of Primary Industries 1986) Clause 33

“Preferably two methods of identification should be used in case one method fails. The attributes of effective identification techniques may include:

- Being permanent.
- Positively identifying the animal as an individual.
- Being easy to apply.
- Not unreasonably damaging the individual.
- Having a relatively painless application.
- Not interfering with the animals’ mobility.
- Being adaptable to modern data retrieval systems.
- Being clearly visible.
- Being unalterable.”

(Department of Primary Industries 1986) Clause 33

## **5.4 Routine Data Collection**

The Red-tailed Black Cockatoos at Taronga Zoos Free Flight Bird Show are all weighed daily whilst this is not essential for most institutions it is best practice as it allows keepers to monitor weights more closely. It is vital for birds being hand raised to be weighed before and after every feed to carefully monitor and control their growth and development.

See 11.11 for data collection on eggs and chicks.

## 6 Feeding Requirements

### 6.1 Wild Diet

In the wild Red-tailed Black Cockatoos feed on a variety of different foods depending on what is available. The foods can include:

- The seeds of a many different species of Eucalypts such as, Brown Stringy Bark (*Eucalyptus baxteri*), Bloodwoods (*Eucalyptus polycarpa* and *Eucalyptus intermedia*), *Eucalyptus miniata* and *Eucalyptus ptychocarpa*.
- The seeds and nuts from *Acacia*, *Allocasurina*, *Hakea* and *Banksia*.
- Fruits, blossoms, berries, nectar, insects and larvae.
- In Western Australia the seeds of the introduced Double Gee (*Emex australis*)
- In Queensland and Red-tails Black Cockatoos have been known to eat the peanuts at peanut farms, this poses as a problem to farmers.

Referenced from Higgins 1999, Forshaw 2002 and Connors 2005

### 6.2 Captive Diet

“Being primarily seedeaters, Red-tailed Black Cockatoos normally accept a basic seed diet with little difficulty, but this should be varied as much as possible and supplemented with almonds, peanuts, corn-on the-cob and any other natural foods available.” (Forshaw 2002).

“If given a variety of foods when being weaned, Red-tailed Black Cockatoos can be quite versatile eaters. However, if birds are offered mostly sunflower seeds during the weaning process, they will be quite content to exist on a diet consisting entirely of this seed” (Connors 2005).

The following is a diet found in Sindel and Lynns *Australian Cockatoos*(1989). The diet is made for the entire Calyptorhynchus Genus.

- A basic seed diet of sunflower seed together with some safflower seed.
- Supplemented daily with raw peanuts, sprouted sunflower seed, sprouted maize, green peas, apple and silverbeet to which should be added any other of the supplementary foods that may be accepted, on an irregular basis.
- Native seed bearing cones and pods should be supplied on a daily basis, not only for their nutritional value but for the therapy provided by the chewing. Red-tails prefer Casuarina cones and as few as six per day will satisfy their needs
- Other supplementary food items: Raw peanuts, various other nuts such as walnuts, almonds, brazil nuts etc., sprouted seeds such as sunflower, corn, millets, sorghum, etc., sweet corn, wholemeal bread, dog kibble (soaked and dry); fruits such as apple, pear, orange, banana; vegetables such as silverbeet, broccoli, cauliflower, green peas, beans, carrots, fresh pumpkin and melon seeds; table scrap bones such as chop bones, chicken bones, lamb, pork or beef bones etc.,

retaining as much meat on them as possible; native and introduced seed pods and cones, fruits, berries and various seeding grasses.

Referenced from, *Australian Cockatoos* (Sindel and Lynn 1989)

The following diet is used at Taronga Zoos Free Flight Birdshow for their 5 Red-tailed Black Cockatoos.

- 30 grams Kaytee™ large parrot pellets.
- 180 grams Sunflower seed.
- 30 grams Soaked seed. (See mix below)
- Half a bowl of mixed fruit and vegetables; silverbeet, sweet potato, apple, pear, banana, grapes, corn on cob, green peas.
- 2 hands full of crushed mixed nuts; walnuts, peanuts, brazil nuts and almonds.

This diet was fed to the group daily prior to their starting of training.

The soaked seed is comprised of 12 different seeds at varying ratios and is made as a mix for all parrots at The Free Flight Birdshow.

- 14% Popcorn
- 14% Wheat
- 10% Mungbean
- 7% Sorghum
- 7% Feed Oats
- 7% Hulled Oats
- 7% Barley
- 7% Green Lentils
- 7% Black Eyed Peas
- 7% White French Millet
- 7% Plain Canary Seed
- 6% Safflower

At the Free Flight Birdshow the Red-tailed Black Cockatoos are fed once in the morning and once in the afternoon, with the diet above split into 4 different bowls.

### **6.3 Supplements**

The addition of a calcium supplement is an important additive for Black Cockatoos (Connors 2005).

“Calcium is the most important mineral as it is a major component of the skeletal structure of the bird and the shell of eggs. The intake of dietary calcium should be considered in relation to that of phosphorus as the metabolism of these 2 minerals is linked. The ideal ration of calcium to phosphorus in the diet is 1.5:1. For an egg laying female, this ratio becomes even higher. The ratio of calcium to phosphorous in most commercially available seeds, however, varies between 1:6 to 1:10. For this reason,

calcium deficiency is one of the most common imbalances seen in aviary birds fed a basic seed only diet.” (Shephard 1989)

Whilst Red-tailed Black Cockatoos are more tolerant of higher fat content diet it is important to offer a wide variety of foods as plain sunflower seed diets do not supply sufficient amounts of Calcium. With plain seed diets with that lack Calcium it is common that Calcium deficiency occurs, this can lead to poor egg production and egg binding in adult birds and nutritional secondary hyperparathyroidism in chicks, which can be accredited to its parents calcium deficiency.

By providing a varied and complete diet as well as offering a calcium supplement such as Calcivet™ calcium deficiency can be prevented.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)  
And *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## **6.4 Presentation of Food**

Food should be presented at elevated level above the ground and away from under perches to prevent contamination from faeces. The food bowls used should be secure so that they do not tip over. This can be done by either presenting the food in a ceramic bowl or heavy plastic bowl, or by feeding in stainless steel bowls that are secured in specially designed feed bowl holders.

Feeding can occur twice during the day to encourage birds to eat the less favorite foods in the morning followed by the more desirable foods in the afternoon. By doing this you can be sure that the birds are eating a wider variety of foods and that their dietary needs are served better.

By supplying fresh browse to Red-tailed Black Cockatoos several times a week one can promote natural behaviors such as foraging as well as provide foods that are part of a their natural wild diet. Browse can be placed either in PVC piping that is attached to aviary walls or by chaining it to the aviary walls.

Species that are a normal part of a wild red-tailed Black Cockatoos diet and that are suitable for browse are:

- *Chionachne barbata*
- *Oryza sativa*
- *Bauhinia sp.*
- *Casuarina sp.*
- *Eucalyptus sp.*
- *Banksia sp.*
- *Grevillea sp.*
- *Hakea sp.*

Referenced from *The food of Australian birds. I, Non-Passerines* (Barker 1940)

At Taronga Zoos Free Flight Birdshow fresh browse is offered 1-2 times a week depending on availability. Browse species offered can vary from various species of Eucalyptus, Casuarina, Hakea, Banksia and species of Ficus. Browse is provided as enrichment.

## **7 Handling and Transport**

### **7.1 Timing of Capture and Handling**

The capturing of Red-tailed Black Cockatoos should generally be done in the early morning or late afternoon as these are cooler times of day and the risk of a the bird being captured getting heat stress is dramatically reduced. However there may be instances where birds have to be caught during the hotter parts of the day which cannot be avoid so it is important to be quick and efficient to minimize stress as much as possible when this is the case.

Birds can also be caught up after sun down once they have retreated to their nest boxes. Catching a bird in it nest box is a much easier and quicker way to catch birds as opposed to swinging a net in their aviary.

### **7.2 Catching Bags**

Bag nets are an important tool when catching Red-tailed Black Cockatoos, as they allow you to catch birds in a safer and more efficient manner. It is important when catching a bird to be as quick and efficient as possible to reduce stress.

A suitable sized catch bag net for Red-tailed Black Cockatoos would be one that is around 50cm in diameter. The handle of the bag net should be strong but not to heavy so you can swing it more easily. By using a bag net successfully you can bring the Red-tailed Black Cockatoo to the ground where it can now be safely physically restrained.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

### **7.3 Capture and Restraint Techniques**

Red-tailed Black Cockatoos have very strong beaks so it is important when physically restraining the bird that you are wary of their beak.

Using a bag net you can capture Red-tailed Black Cockatoos rather easily depending on the size of the aviary

After capturing a Red-tailed Black Cockatoo in a bag net and bringing the bag down to the ground it can now be physically restrained. By putting the bag on the ground this generally encourages the bird stand upright, once the bird is upright you can now restrain it. To restrain the bird use one hand to secure the back of the head through the bag while the other hand encircles the wings as well as secure the feet. The grip is in a way a modified pigeon grip however you use your second hand to secure the birds head to prevent getting bitten on the hand.

A towel may also be used to restrain the bird if the handler is inexperienced as it allows a little more maneuverability, and the towel can even be used to cover the birds eyes to reduce stress.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## **7.4 Weighing and Examination**

Weighing and examinations are necessary before transport as they are important in assessing the birds condition to travel. If a bird is in poor condition prior to travelling there is a risk that the added stress of traveling could kill the bird.

It is important to weigh the bird prior to travel so that you can a) compare its weight with its previous weights and look to see if there is a difference and b) to give the receiving institute a current weight of the bird that they will be receiving.

Red-tailed Black Cockatoos can be trained to weigh on a scale, birds that are untrained however can be placed on a scale inside a calico bag after they have been caught. The bag should be weighed prior to capturing the bird so that it can be deducted from the weight the received once the bird is inside the bag. This will give an accurate weight of the bird.

## **7.5 Release**

Birds should be released into their box as soon as the physical examination is complete to allow them to settle. The bird should be placed on the box floor with its head facing away from the door, doing this will prevent the bird either attempting to escape or try to bite you.

Alternatively Red-tailed Black Cockatoos can be box trained, which makes traveling much less stressful as the bird has had experienced being inside its box previously and has a good association of being inside the box.

## **7.6 Transport Requirements**

“Except as indicated in other standards prescribed under the Exhibited Animals Protection Regulations or as the Director General otherwise determines, transportation of animals within Australia by NSW exhibitors must comply with current International Air Transport Association (IATA) regulations.”

Referenced from *General Standards for Exhibiting Animals in New South Wales: Exhibited Animals Protection Act* (Department of Primary Industries 1986) Clause 45

### **7.6.1 Box Design**

The transport box should be constructed out of tough materials as Red-tailed Black Cockatoos do have a strong beak, which could easily damage a box made of poor materials. Materials such as mesh and strong plastic are often used for transport boxes as they are readily available on the market and can be bought rather cheap.

“For general transport purposes, birds will be carried only in closed containers. The container must be well constructed and be able to withstand other freight damaging it or causing the structure to buckle or collapse. It must be constructed of non-toxic materials. Chemically impregnated wood may be poisonous and must not be used.”



“It is recommended that the material for the sides, frame, roof and floor be standardized as follows:

Sides – 0.6cm (1/4 in) plywood (Minimum for Cockatoos)

Frame – 2x4cm (3/4 x 1 1/4 in) solid wood

Roof floor – 1.2cm (1/2 in) plywood”

“The interior must have no projections, which the bird can get hold of.”

“The container must be suitable to keep the bird inside at all times and protect the bird from unauthorized access. The door must be constructed so that accidental opening cannot occur, either from the inside or the outside.”

“The container must be clean and leak-proof. If it is being reused, it must be thoroughly disinfected or sterilized.”

“The container must be adequately ventilated on at least three sides, with the majority of the ventilation being provided on the upper part of the container.”

Referenced from *International Air Transport Association: Live Animal Regulations*

### **7.6.2 Furnishings**

“Wooden perches must be provided per container. There must be sufficient perch space for the bird inside the container and enough height for the bird to perch with its head upright and its tail clear of the floor. The diameter of the perch must be large enough to permit the bird to maintain a firm, comfortable grip with its claws. The perch must be placed so that the droppings do not fall into the food or water troughs.”

Referenced from *International Air Transport Association: Live Animal Regulations*

### **7.6.3 Water and Food**

“Separate food and water troughs must be provided, either fixed inside the container or attached to it so that they are accessible for replenishment purposes. They must have rounded edges and be made of non-toxic materials suitable for the species.”

Water containers must have flanged sides and be sufficiently narrow access that the bird cannot wet themselves because they must be filled at the time of shipment. Stainless steel is ideal bowl material as it is clean, safe for Red-tailed Black Cockatoos and is ultra-durable. Precautions must be taken to reduce the risk of drowning by adding a sponge or other suitable material on the surface of the water in the trough.

“The shippers instructions for watering and feeding must be given in writing at the time of acceptance. Feeding and watering instructions must be affixed to the container and a copy of the instruction must accompany the shipping documents. And feed or water given must be recorded on the container instructions with the time and date of supply.”

Referenced from *International Air Transport Association: Live Animal Regulations*

#### **7.6.4 Animals per Box**

Only one bird should be housed per box. There is an extremely high risk of death with multiple birds in the same box together as they can inflict serious injury or cause death to one another if put in the same box.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

#### **7.6.5 Timing of Transportation**

Transport should occur in the early morning or late afternoon, generally shortly after the bird has been captured and loaded into its transport container. In the event of extremely hot days birds should either be transport in air-conditioned modes of transport or the transport be aborted until a cooler day.

#### **7.6.6 Release from Box**

Birds should be released as soon as possible to allow them to settle into their new environment sooner. The box should be placed on the ground of the new aviary with the door open, allowing the bird to exit on its own terms. The aviary should be quiet with no disturbances so the bird settles in with minimal stress.

## 8 Health Requirements

### 8.1 Daily Health Checks

From a distant examination a normal healthy bird should display the following:

- Bright and alert behavior.
- Both eyes wide open and clear with no swelling or discharges.
- Both nostrils open and clear of any discharge.
- No darkening or stains on feathers surrounding the nostrils.
- Responsive to your approach and watches what you are doing.
- Perched at the normal spots in its aviary.
- Standing erect with weight evenly spread on both feet.
- Wings folded against the body in the usual position.
- Feathers are in general good condition, asides from usual wear and tear damage.
- Actively moving around the aviary.
- Making normal vocalizations and socializing as normal.
- Breathing is barely detectable.
- Does not appear overweight or very thin.
- No abnormal swellings anywhere on the body.
- No ragged or untidy feathers.

Signs of illness can include any of the following:

- Weight loss
- Reduction in appetite, or complete cessation of appetite
- Inability to swallow food or manipulate food in the mouth
- Head under one wing
- Sitting low down on the perch
- Vomiting
- Fluffed feathers
- Wet feathers around the eyes and nostrils
- Low activity
- Droopy wings
- Reduced preening activity and maintenance of feathers
- Broken or untidy feathers
- Cessation of vocalization
- Unresponsive to your presence
- Visible lumps or masses on the body.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

## **8.2 Detailed Physical Examination**

### **8.2.1 Chemical Restraint**

- “Examine the head, eyes, ears, nostrils and cere. Pay particular attention to the feathers immediately adjacent to the nostrils as even a mild discharge will make dust adhere to them and give them a stained appearance. This is the equivalent of a runny nose. The head should be symmetrical. Examine the head on top, from the front and back each side, looking for any asymmetry. Examine the beak for any damage or malformation. Bruising of the beak may be associated with liver disease or trauma”. (Cannon 1996)
- “Open the mouth and examine the tongue, choana (the slit in the roof of the mouth) and the throat. Note any sour or abnormal odors. Is there excessive mucous or cheesy plaque present? Examine the fringe lining the choana. In chronic respiratory disease or vitamin A deficiency, the fringe will be damaged or missing.” (Cannon 1996)
- “ Pull out each wing individually. Feel the bones from the shoulder to the wing tip. Examine each joint for full range of motion or any swelling. Hold each wing up to the bright light to transilluminate the feathers. Spray methylated spirits on the skin if closer inspection is required. This may reveal bruising of a swollen area.” (Cannon 1996)
- Examine each leg individually. Run your fingers from the hip to the end of each claw, paying particular attention to the joints.” (Cannon 1996)
- “Assess the lengths of the claws. Over grown claws may be associated with liver disease, nutritional disorders or poor perches.” (Cannon 1996)
- Inspect the bottom of each foot. The surface should be rough, not smooth. A smooth surface at the base of the foot may be the first sign of incorrect perching material or the beginning of bumble foot.” (Cannon 1996)

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

### **8.2.2 Physical Examination**

- “Examine the head, eyes, ears, nostrils and cere. Pay particular attention to the feathers immediately adjacent to the nostrils as even a mild discharge will make dust adhere to them and give them a stained appearance. This is the equivalent of a runny nose. The head should be symmetrical. Examine the head on top, from the front and back each side, looking for any asymmetry. Examine the beak for any damage or malformation. Bruising of the beak may be associated with liver disease or trauma”. (Cannon 1996)
- “The breast muscles should be convex and the keel bone should not be prominent, however this does not apply to young birds that are not flying yet as they haven’t properly developed breast muscles”. (Cannon 1996)

- “The abdomen should be concave (slightly sunken) not convex. If the abdomen is enlarged, examination must be extremely gentle. The bird should not demonstrate pain with a normal, gentle abdominal examination.” (Cannon 1996)
- “Examine the vent for swellings, encrustations or soiling, indicative of loose droppings. If the tail is gently flexed towards the back, the vent will open and allow inspection of the cloaca.” (Cannon 1996)
- “Examine the feathers. Look for any missing or chewed feathers are there any mites or lice?. Are any of the feathers damaged or malformed- particularly the primary flight and tail feathers? Does the bird have a powder covering on all the feathers and beak? Lack of powder and a shiny beak can be early symptoms of Psittacine Beak and Feather Disease.” (Cannon 1996)
- “Pull out each wing individually. Feel the bones from the shoulder to the wing tip. Examine each joint for full range of motion or any swelling.” (Cannon 1996)

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

### **8.3 Routine Treatments**

“Cockatoos housed in suspended wire aviaries should never need to be wormed, whereas those housed on earth floors should preferably be wormed every 3 month, and those housed on all other surfaces every 6 months. It must be considered good practice to regularly worm all species, regardless of their susceptibility.” (Sindel and Lynn 1989)

“The only practical and effective way of worming Cockatoos is to catch up each individual and administer the worming agent direct to the crop, using a metal crop needle attached to a syringe. Worming via drinking water is totally ineffective, as Cockatoos are able to drink little or no water for a number of days if the water is deemed unpalatable.” (Sindel and Lynn 1989)

Worming Red-tailed Black Cockatoos can be done by giving a course of praziquantel (Droncit™, Avitrol™, Wormout™ tablets and gel, Prazivet™) or oxfendazole (Benzelmin™, Synanthic™, Systamex™). The varying products have different amounts of the active constitute therefore dosage would be different for each product.

### **8.4 Known Health Problems**

#### **Candidiasis ([Non Infectious](#))**

##### **Specific Signs**

- Vomiting and regurgitation
- White plaques in mouth
- Crop may feel thickened
- Slow crop emptying in nestlings and hand reared birds
- Diarrhoea with a sweet odour
- Incessant begging
- Difficulty weaning

### **Cause**

Candidiasis is caused by an infection of the fungal yeast organism *Candida albicans* which can infect the mouth and crop. *Candida albicans* is found in small numbers in the natural flora systems of most living things, including humans, which in the desirable environment can thrive. Candidiasis is most common in chicks that are coming up to the weaning age but can also occur in chicks and adults that are on a course of antibiotics.

Candidiasis is usually caused by secondary problem arising from some other initial cause, such as underfeeding, slow crop or stress. Stress can be caused whilst the young chick is being weaned as the stress combined with weight loss weakens the chick leaving it more susceptible to infection.

Whilst Candidiasis does occur more frequently in chicks that are being weaned it does occur in younger chicks through to adults that are currently on antibiotics. Whilst antibiotics kill bacteria that are causing an infection at that time, they also kill a lot of friendly bacteria in the system, reducing the bird's immunity. It is recommended to use an anti-fungal treatment in conjunction with the antibiotic and for a week after the treatment has finished to prevent Candidiasis.

### **Treatment**

When treating Candidiasis a yeast-killing antibiotic must be used. Nystatin™ is commonly used and can be given at 0.25-0.5ml three times daily for a period of 10 days. In some cases Nystatin™ may not be effective as the yeast proves to be resistant so other drugs like ketoconazole are needed. Treatment should continue to 3 days after all signs have cleared. It is recommended to add products like Aviclen™ in the birds drinking water daily as they have a yeast inhibitory action which will help prevent further infections.

### **Prevention**

Hygiene is an important preventative measure against Candidiasis. Foods should be stored properly and brooders and feeding instruments should be regularly disinfected. Hands must also be thoroughly washed before and after handling chicks.

As Candidiasis is usually a secondary problem that can be caused by under feeding, slow crop and stress it is important to try to prevent these things. As stress is commonly caused by weight loss during the weaning process it is important to try and make the environment stress free so that the chick can smoothly transition into independent feeding with out the risk of Candidiasis.

Anti-fungal treatments such as Aviclen™ can also be added to drinking water daily as they are reasonably cheap to buy and can help prevent Candidiasis.

Referenced from from *A Guide to Basic Health and Disease in Birds* (Cannon 1996), *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005) and *A Guide to Incubation and Handraising Parrots*. (Digney 1998)

## Nutritional Secondary Hyperparathyroidism ([Non Infectious](#))

### **Specific Signs**

- Common in neonatal and juvenile Black Cockatoos.
- Chicks learning to fly fall out of nest and break bones.
- Beak easily bent
- Soft bones

### **Cause**

The cause of Nutritional Secondary Hyperparathyroidism is if there is a calcium deficiency in the diet which comes from the parents who are receiving a poor diet EG all seed. This condition is common in neonatal and juvenile chicks. The condition occurs when calcium is drawn out of the bones to supply the needs of the muscle. If calcium is not being put back into the bones then over time they will become thin and fragile. They then start to break and bend under the pressure of the chicks' weight. Because of the weakness of the chicks bones they are often found on the floor of the aviary with broken wings and legs after attempting their first flight.

### **Treatment**

Because of the weakness in the calcium deficient bones of the chick repair is extremely hard. Sadly the chick will often die or have to be euthanased due to the difficulty of repairing the soft and weak bones.

### **Prevention**

Preventing Nutritional Secondary Hyperparathyroidism is not extremely difficult. By providing the chicks parents with a healthy well balanced diet you can be assured that the parents are giving the chicks a good diet. It is also possible to add a calcium supplement to the parents food such as Calcivet™ or provide cuttlefish in the aviary.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## Feather Plucking ([Non Infectious](#))

### **Specific Signs**

- Excessive chewing on feathers or skin (Over preening)
- Normal feathers on head and neck (Unreachable parts on the body)
- Damaged feathers that are on reachable sections of the bird.

### **Cause**

There are multiple causes of Feather plucking in Red-tailed Black Cockatoos. Before diagnosing behaviour problems in which feather plucking is commonly associated with, it is important to rule out medical problems by consulting a veterinarian who can conduct a blood and feather test. Medical problems that can lead to feather plucking are Beak and Feather Disease, poor diet, skin infection or allergies. Many birds have also been known to pluck feathers during breeding season. This can be caused by abdominal discomfort when the internal reproductive organs have become enlarged. Once they are ruled out then any psychological problems can be addressed EG fear, boredom, separation anxiety and insecurity. It is also important to check that birds are not feather plucking each other as this is a common problem.

### **Treatment**

Depending on the cause of the feather plucking, treatment is different. If a bird has been plucking feathers because of a skin infection then the infection should be treated and this should stop and heal the infection and stop the plucking. If the bird has been plucking feathers out of boredom then they should be given things occupy time. In the wild, birds spend a large portion of their time foraging for and eating food, this is significantly reduced when in captivity and the bird will now have more free time. By hiding a favourite food around the aviary and in toys and providing challenges like branches with gumnuts and pine cones in which the bird has to work to get the food as well as providing leafy branches and other environmentally enriching things like toys, more time is taken up in the day. However these things do not always result in a cure. Depending on how long feather plucking had been a habit it may be an ongoing problem throughout the birds life and the things just mentioned may only reduce the amount of plucking.

### **Prevention**

Prevention is better than a cure so in order to prevent Feather Plucking it is important to provide environmental enrichment. By providing things like fresh branches with gumnuts or pine cones you are helping to simulate foraging and other natural behaviours. Diet is also important, by providing a healthy diet many other conditions that can result in Feather Plucking will be reduced.

Referenced from from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)  
And *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

### Psittacosis (Chlamydophilosis) ( [Highly Infectious can infect humans](#) )

#### **Signs**

- Ruffled feathers / huddled position
- Appearance of poor health
- Weight loss
- Conjunctivitis
- Watery eyes
- Excess Urine (often green)
- Diarrhoea
- Feather loss around one or both eyes
- Soled vent
- Runny nose
- Depression
- Not eating
- Sneezing
- Blinking or eyes partially closed
- Sudden death

Many of the listed signs can be caused due to secondary infection so it is therefore important to consult a veterinarian for a proper diagnoses.

#### **Cause**

Psittacosis is caused by the intracellular organism *Chlamydophila psittaci*. *Chlamydophila psittaci* can be passed onto other birds who come into contact with the



infected birds droppings or respiratory tract secretions. It is possible for birds infected by *Chlamydophila psittaci* to appear healthy throughout their life and only show signs of illness when they become stressed which can be triggered by moulting, overcrowded aviaries, contraction of another disease or illness, being newly introduced to a new environment EG a new home or pet shop. Psittacosis is a dangerous disease as it can not only infect an entire aviary it can also infect humans. The most common way for people to be infected is by inhaling aerosols from droppings, feather dust or respiratory tract excretions EG sneezing.

### **Treatment**

Treatment for individual birds diagnosed with Psittacosis is by an intramuscular injection or crop needle delivery of an antibiotic. Doxycycline is commonly used and is found in the medication Psittavet™. Some birds will unfortunately have a relapse even though the proper dosage was administered. Relapses occur due to the *Chlamydophila psittaci* organism surviving deep in the bone marrow cells and the medication not being able to penetrate well enough into this area. Intravenous injection is a viable alternative in extreme cases.

The most practical method of delivering medication to a large number of birds is by medicating the drinking water. There are problems with this however as it requires that birds drink sufficient quantities of the medicated water at regular intervals if this does not occur there will not be enough medication in the birds body to fight the disease. Psittavet™ or Vibravet™ can be used as the medication as they contain Doxycycline.

During the treatment period it is important to:

- Minimize stress
- Cease breeding
- Improve diet
- Provide a secure aviary
- Provide protection from the elements
- Remove “Bully” birds and don’t introduce new ones
- Clean and disinfect aviary every two weeks during treatment. Wear a face mask when cleaning. Dilute all disinfect to manufacturers directions.

It is very important to wear a face mask as this will help prevent you from getting infected as well.

### **Prevention**

Preventing Psittacosis can be difficult as it can go undiagnosed for a long time. By providing a hygienic environment and disinfecting aviaries routinely the risk of infection should decrease. It is also important to provide a non stressful environment as stress can often be a trigger to birds that have this disease in their system. Having birds in the collection vet checked can help to put ones mind at rest.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)  
And *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

Psittacine Beak and Feather Disease (Circovirus) (Highly Infectious)

### **Specific Signs**

- More common in birds under 1 year of age.
- Shiny Beaks ( In Cockatoos)
- Overgrown Beaks
- Bald patches on random spots of the body
- Dirty plumage
- Loss of powder down on feathers
- Abnormal feather growth, largely on primary flight and crest feathers
- Secondary infections EG conjunctivitis, sneezing and diarrhoea

### **Cause**

The cause of Psittacine Beak and Feather Disease (PBFD) is by a relatively simple virus which infects and kills the cells of the feather and beak. The virus also kills the cells of the immune system. Consequently many diseased birds succumb to bacterial and other infections. Infection can occur from wild carrier birds.

### **Treatment**

At current times there is no proper treatment for PBFD as it is a virus, however there is a vaccine that is currently in development. Infected birds should be isolated so that they cannot pass the virus onto any other birds. If the bird is suffering from secondary infections euthanasia should be considered.

### **Prevention**

PBFD is difficult to quarantine. Carrier birds may appear clinically normal but produce diseased young. Therefore it is necessary to breed birds in quarantine. Blood and feather tests are necessary when birds are in quarantine as this helps to detect the virus. It is also necessary that proper hygiene practices are used on a daily basis in all collections.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)  
And *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## **Tapeworms (Infectious Internal Parasitic)**

### **Signs**

- Sleeping more than normal.
- Stained or dirty vent
- Sharp protruding keel ( not always visible until examination)
- Vomiting

### **Cause**

The cause of tapeworms is if a bird ingested an insect that contained the eggs of the tape worm, this can then be passed to other birds by faeces coming into contact with food or by having eaten regurgitated food by the infected bird. Tapes cause problems in birds as they interfere with the intestines absorption of nutrients. If they continue to develop in number they can block the intestine.

### **Treatment**

Tests on droppings will not always show Tapeworms as they do other worms as they can be difficult to diagnose.

A course of Praziquantel which is found in products such as Droncit™, Avitrol™ and Wormout™ or a course of Oxfendazole which is found in products such as Benzelmin™, Synatec™ and Systemex™ should be administered to any birds that show symptoms Tapeworm.

### **Prevention**

- Regular cleaning of aviaries
- Using safe insecticide sprays eg Coopex

By regularly cleaning aviaries the risk of birds being infected by tapeworms or any other worms is reduced. If possible it helps if aviary floors are made of concrete as faeces can be easily hosed away as apposed to an aviary with soil which can still hold faeces in it after it has been hosed.

Referenced from from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

## Proventricular Dilatation Disease (PDD) (Infectious Disease)

### **Specific Signs**

- Vomiting or regurgitation
- Depression
- Weight loss
- Poor appetite
- Diarrhea
- Excessive urine in droppings
- Undigested seed in droppings
- Weaned birds reverting back to begging for hand feeding
- Abdominal enlargement
- Hypotension
- Central Nervous System problems such as abnormal head movements

### **Cause**

The etiology of Proventricular Dilatation Disease (PDD) is currently unknown. The virus was first discovered in Macaws during the late 1970's which then was called Macaw wasting or fading syndrome and gastric distention. Since the late 1970's PDD has been found in over 50 species of Psittaformes as well as in Canadian Geese, Spoonbills, Toucans and Weavers.

Whilst and infectious agent has been implicated as the cause of PDD further research is required to identify the virus that is causing the disease. Scientists have found that not all birds exposed to the diseases contract it, which would suggest an innate resistance.

### **Treatment**

Currently there is no treatment for PDD and it usually causes death within 4-12 months after initial exposure. Vets have found that clinical changes respond well to the drug interferon, however it is not a cure for the disease with death still occurring.

### **Prevention**

Since PDD cannot be treated it is vital that all birds entering a collection be properly quarantined. It is also important to monitor all birds in the collection for their health so that if a bird does show signs of PDD it can be immediately isolated from the collection. It is also important to actively maintain hygiene in the animals enclosure to reduce the risk of contraction of PDD and other diseases which could weaken the birds immunity leaving it susceptible to PDD.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996) and [www.funnyfarmexotics.com/IAS/pdd96.htm](http://www.funnyfarmexotics.com/IAS/pdd96.htm)

## **8.5 Quarantine Requirements**

Quarantine is the best preventive program an institution can have against minimizing the introduction of disease into their collection. Quarantine involves isolating new arrivals coming into the collection for a period of 6 weeks before they can enter the collection. In this period of 6 weeks the birds are tested for diseases and parasites as well as having their health monitored for any thing that may be abnormal. Quarantining birds coming into a collection also allows them to get used to new routines as well as get properly acclimated to their new surroundings.

Quarantine setups for Red-tailed Black Cockatoos can be as simple as a small flight aviary that provides the essentials for its well being, perching, shelter, food, water and browse to provide something to do. The most important aspect about a quarantine aviary is that it is isolated from the rest of the birds in the collection.

Another important aspect of quarantine is that it is essential that the bird or birds in care be attended after the rest of the birds in the collection. This is important because it stops you contaminating the rest of the collection if the bird in quarantine is infected with something.

Whilst the bird is waiting in quarantine it presents a good opportunity to treat the bird for parasites. A spray with a good quality lice spray (Vetafarms Avian Insect Liquidator) every two weeks for three treatments should prevent external parasites from being introduced into the collection. It is also advisable to worm the bird in care at least twice whilst it is in quarantine, this should be done via a crop needle so that you know that the bird has received the correct dosage.

Whilst the bird is in quarantine it should pass 3 clear faecal tests before it can be released into the collection. Along with passing faecal tests the bird must also pass Psittacine Beak and Feather Disease tests and Psittacosis disease tests.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)  
And *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## **9 Behaviour**

### **9.1 Activity**

Red-tailed Black Cockatoos are a diurnal species, being active during the day lit hours. They have good eyesight and hearing which complemented with being agile manipulators gives keepers a lot to work with when it comes to enrichment.

“These Cockatoos are noisy and conspicuous, their raucous cries always attracting attention. Peak activity is in the early morning, when birds leave roosting trees, come to watering place to drink, and then disperse to feeding areas. Activity again peaks in the late afternoon when they resume feeding before coming back to drink at favoured watering places, and then at sundown they can be seen flying overhead on the return journey to their roost in large eucalypts along the banks of a watercourse.” (Forshaw 2002)

### **9.2 Social Behaviour**

Red-tailed Black Cockatoos are known to congregate in flocks and sightings of up to 500 hundred birds have been sighted on numerous occasions. These birds have been sighted feeding and drinking together in the wild.

In the wild family parties have been reported congregating in a foraging flock, often flying over 40km and passing suitable food sites to join the flock.

Referenced from *Handbook of Australia, New Zealand and Antarctic Birds. . Volume 4: Parrots to Dollarbird.* (Higgins 1999)

### **9.3 Reproductive Behaviour**

“ In courtship display, the males raises the crest and brings it forward onto the upper mandible. The cheek feathers are puffed out and brought forward to cover much of the bill, and the tail is spread to show the red band. Uttering a soft growling note, he struts or even bounces along a branch in front of or beside the female and bows towards her two or three times” (Forshaw 2002)

In Sindel and Lynns (*Australian Cockatoos* 1989) it was stated that the male feeds the female following the courtship display.

### **9.4 Bathing**

Bathing is an important, healthy and enriching activity for Red-tailed Black Cockatoos and should be offered on a frequent basis. A hose can be pointed above the aviary so that water falls down on the birds or alternatively a sprinkler system installed on top of the aviary. A wide shallow bowl can also be filled and provided instead of a sprinkler.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

## **9.5 Behavioural Problems**

### **Feather Plucking**

Feather plucking can be common in Red-tailed Black Cockatoos, which can develop into a serious problem if not treated properly. Before diagnosing behavioural problems in which feather plucking is commonly associated with, it is important to rule out medical problems by consulting a veterinarian who can conduct a blood and feather test as there can be many diseases in which feather plucking is a symptom ( see 8.4).

Once medical problems have been ruled out behavioural reasons for feather plucking can now be addressed. Behavioural causes for feather plucking can be related to boredom, fear, separation anxiety and insecurity. Each of these should be individually addressed and solutions tested.

- If the bird is bored it needs more things to do (see 9.7).
- If the bird is in fear, work out what it may be afraid of and eliminate it from the environment or condition the bird to accept it into the environment.
- If the bird is suffering from separation anxiety (see 9.7) or consider getting it a mate.
- If the bird has a mate it is possible that the mate is feather plucking it. If feathers are missing around the neck and head then this is most likely caused by the mate.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

### **Screaming**

Another behavioural problem that may occur with Red-tailed Black Cockatoos is screaming. Screaming can occur when they are frightened or excited which is a normal reaction to the environment, but it becomes a behavioural problem when they are randomly screaming out of boredom, to get attention and for extended periods of time.

When treating screaming as a behavioural problem it is important to identify what is triggering the screaming. If you are able to identify what is causing screaming you are then able to work out solutions to stopping the problem.

If a bird is screaming at a certain time of day you may be able to provide a training session or other activity before this time to provide the bird with some interaction or with something to occupy it during the time that it would normally be screaming.

It is important to never scream back at a screaming bird as this can reinforce the behaviour and increases the likelihood of screaming occurring again.

By providing the bird with lots of things to keep it occupied throughout the day screaming can be reduced.

Referenced from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

## Aggression

It's not uncommon for male Red-tailed Black Cockatoos to display aggression towards females Red-tailed Black Cockatoos during the breeding season. Males can severely stress, injure and even kill the female if the keeper does not intervene.

One method to manage the male's aggression towards the female is to feather trim about 30-50mm of the male's wings prior to breeding season so he flies slower than the female and so the female can evade his attacks more easily. In the worst case scenario the male may need to be removed which could impact on the breeding season but ensures the female will live to see another breeding season.

Aggression does not always have to occur within the breeding season with some birds exhibiting aggression year round and not just to their mate but to their keeper as well. Aggression towards a keeper can not only effect husbandry but is also a serious OH&S issue. Below are different types of aggression:

- Fear aggression: "When a parrot is afraid of something, his instinct is to escape what he fears... if he cannot escape he is forced to deal with the fearful situation". (Heidenreich 2005)
- Physical state-induced aggression: "An injured animal can be extremely aggressive when touched. Pain can sometimes elicit a reflex-type reaction of aggression"
- Redirected aggression: The bird reacts to a stimulus and displays aggression towards something other than the stimulus. EG Bird gets scared of something in its environment and bites the keepers hand it is standing on. (Heidenreich 2005)
- Territorial aggression: Aggression over a perceived territory. Can be brought on by hormonal changes. (Heidenreich 2005)
- Possession aggression: Possession aggression is aggression over the ownership of an item eg this is mine and I'll bite you if you touch it. (Heidenreich 2005)
- Excitement that turns into aggression: Over stimulation in something like playing that results in the bird playing too hard and biting. (Heidenreich 2005)
- Social aggression: 2 birds may not get along well together and display aggression towards one another. (Heidenreich 2005)

Whilst there are many differing types and levels of aggression it is important to identify what kind of aggression is being displayed so that one can work out solutions towards reducing and eliminating aggressive behaviour.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005) and *The Parrot Problem Solver: Finding Solutions to Aggressive Behaviour* (Heidenreich 2005)

## **9.6 Signs of Stress**

Signs of stress in Red-tailed Black Cockatoos can be seen in many different symptoms. These symptoms can include:

- Screaming
- Feather plucking or over preening.
- Being chased by other birds.
- Weight loss or visible poor health.
- Poor feather condition or the loss of feathers.
- Little or no social interaction with aviary mates.
- Reduced activity.
- Little or no appetite.
- Changes in the birds routine and general behavior.
- Stereotypic behaviors such as pacing or head bobbing.

Possible stressors can include

- New aviary mate.
- Loss of an aviary mate
- New or unfamiliar location
- Change to routine.
- Change to the environment. (New objects in enclosure or out of enclosure)
- Provoked by the public.
- Breeding season.
- Sickness.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005) and from *A Guide to Basic Health and Disease in Birds* (Cannon 1996)

## **9.7 Behavioural Enrichment**

Behavioural enrichment is an important practice in the captive husbandry of Red-tailed Black Cockatoos as in the wild much of their time would be spent foraging for food. The search for food is significantly decreased in captivity as foods are often presented in a bowl and are freely available for the entire day.

Enrichment is defined as: *An added feature or quality that improves something.*

In the captive care sense behavioural enrichments main goal is to give a species as many opportunities to display a full variety of species-specific behaviours, which is aimed at maintaining the natural behaviours with their original functions.

“When designing a form of enrichment

- Keep in mind the species’ feeding habits and the way its time is naturally spent.
- Vary the period of enrichment.
- Be imaginative.
- Don’t be afraid to ask for help.” (Woodward 1999)

Below are some enrichment strategies used for Cockatoos in captivity.



**Table 1**

Enrichment Item	Description of Enrichment
Bendy Branches	Can be used to attach food chunks to. Increases fitness and balance. More naturalistic feeding.
Fresh Browse	Can be used as furniture, food and destructables. Encourages natural behaviour and feeding. Encourages natural food recognition
Nuts	Encourages natural behavior and increases activity and exercise.
Pine Cones	½ buried pine cones encourage digging and foraging. Increases exercise and play.
Coconut feeder hung by rope.	2 halves of a hollowed out coconut are connected together and filled with food and hung in the aviary.
Pineapple tops	Sprinkle seed, nuts or mealworms into the leafy top of a pineapple. Top of the pineapple can be placed on the aviary floor.
Bathing	Install sprinklers on top of the aviary to simulate rainfall and promote bathing behaviour.
Kebab Style feeders	Branches stripped of leaves can have fruit skewered onto them. It increases fitness and balance.
Egg cartons filled with seeds and nuts.	Destructible item with food inside. Increases activity.

Referenced from *Behavioural Enrichment: Lets Not Overlook Our Feathered Friends* (Woodward 1999), and *Australian Animal Enrichment Handbook, Edition 2* (A.S.Z.K 2003)

## **9.8 Introductions and Removals**

When two birds are being introduced to one another they should be introduced by placing them in 2 aviaries side by side with some form of visual barrier between the two aviaries allowing only a few clear visual areas between the two. By doing this both birds can see each other when they want and one can retreat from the others view if they want.

Once the birds behaviour has been observed and they appear to get along then can they be introduced together in the same aviary. It is better to introduce the two birds in a new aviary that neither have been in, this will hopefully prevent territorial aggression.

If a pair need to be split up and a strong pair bond has been formed it is well advised to move one of the birds into an aviary next door so that both birds can still see each other, this is good if the male has been beating on the female during the breeding season.

## **9.9 Intraspecific Compatibility**

At Taronga Zoo, Red-tailed Black Cockatoos are housed on exhibit with several other species of Australian parrots. In this exhibit there is:

- Superb Parrots (*Polytelis swainsonii*)

- Major Mitchells Cockatoo (*Cacatua leadbeateri*)
- Yellow-tailed Black Cockatoos (*Calyptorhynchus funereus*)
- Sulphur-crested Cockatoos (*Cacatua galerita*)
- Carnabys Black Cockatoo *Calyptorhynchus latirostris*
- Eastern Rosella (*Platycercus eximius*)

All of the birds on exhibit appear to be in good feather and compatible together. Pers obs

### **9.10 Interspecific Compatibility**

In the wild Red-tailed Black Cockatoos can be found in pairs, trios of parents with offspring or small to large flocks. This would indicate that they are social and compatible amongst their own kind, granted that in captivity they are provided with adequate space.

“In captivity males cannot be placed together but are generally not aggressive to other species.” (Higgins 1999)

Contra to (Higgins 1999) male Red-tailed Black Cockatoos can be housed together provided that they are managed appropriately. Juvenile males that are well socialized can be readily housed together. There has also been some success in colony breeding Red-tailed Black Cockatoos in private aviculture which would suggest that adult males can be housed together provided that there is adequate space provided (see Connors 2005 p43).

Referenced from *Handbook of Australia, New Zealand and Antarctic Birds. . Volume 4: Parrots to Dollarbird.* (Higgins 1999)

### **9.11 Suitability to Captivity**

“Being the least specialized of the *Calyptorhynchus* cockatoos, Red-tailed Black Cockatoos adapt more readily to captivity” (Forshaw 2002)

“Red-tailed Black Cockatoos are the most commonly kept and bred species of black cockatoo in Australia” (Sindel and Lynn 1989).

## **10 Breeding**

### **10.1 Mating System**

Red-tailed Black Cockatoos are believed to be monogamous and mate for life, with sexual maturity occurring at 4 years of age.

Referenced from *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbird* (Higgins 1999)

### **10.2 Ease of Breeding**

“Red-tailed Black Cockatoos breed more freely in captivity than do other *Calyptorhynchus* species, and some pairs are quite prolific” (Forshaw 2002 p104)

“This species is ideal for the novice aviculturist as it is hardy, easy to cater for and keen to go to nest” (Connors 2005 p122)

### **10.3 Reproductive Condition**

“In Courtship display, the male raises the crest and brings it forward on to the upper mandible. The cheek feathers are puffed out and brought forward to cover much of the bill, and the tail is spread to show the red band. Uttering a soft growling note, he struts or even bounces along a branch in front of or beside the female and bows towards her 2 or 3 times.” Forshaw (2002 p100)

#### **10.3.1 Females**

Females should be of sexual maturity, with maturity occurring around 4 years of age. They should be in good health with no previous illness or disease in the previous months and they should be in good feather.

#### **10.3.2 Males**

Males should be of sexual maturity, with maturity occurring at around 4 years of age. They should be in good health, with no previous illness or disease in the previous months and they should be in good feather.

### **10.4 Techniques Used to Control Breeding**

There are various techniques to control breeding in Red-tailed Cockatoos whether it be to provide a sabbatical for a pair that have been to nest multiple times in a breeding season or to breed only to requirements of a parks census plan.

- Nest logs can be removed after breeding provided that there is adequate shelter in the enclosure that offers protection from the elements.
- Nest logs can be replaced by nest logs that are slightly less desirable to raise young in, but still provided protection and shelter from elements.
- Pairs can be moved in with other pairs to reduce privacy. Pairs should be monitored for aggression as this may occur between males.
- Pairs can be moved onto exhibit where there is less privacy for breeding.

- Eggs can be removed and replaced with fake eggs so that the pair can still go through the natural process of mating and incubating an egg, however they don't produce the young.
- Separate the pair, this is drastic and can be stressful for birds that have already formed a strong pair bond but may be necessary to control breeding.
- In zoos and parks it may be possible to transact the breeding pair to another zoo that would like a breeding pair. Whilst this may not control breeding it still fits in with captive management plans and still allows the pair to go through the natural process of mating, incubating and rearing young.

### **10.5 Occurrence of Hybrids**

“What I believe to be the only known incidence of interspecific hybridization in *Calyptrorhynchus* is reported by Branston (1997). A female Red-tailed Black Cockatoo and a male Yellow-tailed Black Cockatoo *Calyptrorhynchus funereus* produced a single chick, which closely resembled a young Red-tailed Black Cockatoo, but with a noticeably longer tail and discernible yellow patch of the ear coverts. Head features, including length of the crest and shape of the bill, resembled those of *C.funereus*.” (Forshaw 2002)

Hybridization of Red-tailed Black Cockatoos should be avoided at all cost as it poses as a threat to the gene pool of captive stocks and serves no real purpose.

### **10.6 Timing of Breeding**

“Climatic changes may influence the timing of breeding, but in northern Australia it generally takes place in the dry season, that is from March to September, while in southern regions it occurs during late spring or early summer to autumn.” (Forshaw 2002)

### **10.7 Age at First Breeding and Last Breeding**

Red-tailed Black Cockatoos generally commence breeding at around 4 years of age however some birds have successfully reared young at 3 years of age.

The oldest documentation of captive breeding that I could find was in *Australian Cockatoos* (Sindel and Lynn 1989) where Sindel reported that Robert Lynns breeding pair of Red-tails Black Cockatoos bred for over 20 years, which if they were 1<sup>st</sup> bred when they reached maturity would put them at 24+ years when they were still breeding.

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds*. (Connors 2005) and *Australian Cockatoos*.(Sindel and Lynn1989).

### **10.8 Ability to Breed Every Year**

In Sindel and Lynns *Australian Cockatoos*, Sindel documents that Robert Lynns breeding pair of Red-tailed Black Cockatoos consistently nested every 7 months for over 20 years. In this time the parents successfully fledged over 30 young.

“A single egg is laid. If the egg is removed for artificial incubation, the hen may lay again. This can be repeated several times during the breeding season. A number of instances have been recorded where the hen has gone to nest more than 10 times in a season” (Connors 2005)

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds*. (Connors 2005) and *Australian Cockatoos*. (Sindel and Lynn 1989).

### **10.9 Ability to Breed More than Once Per Year**

Red-tailed Black Cockatoos have the ability to breed multiple times in a year if conditions are right. In Sindel and Lynns *Australian Cockatoos*, Sindel documents that Robert Lynns breeding pair of Red-tailed Black Cockatoos consistently nested every 7 months for over 20 years.

“A single egg is laid. If the egg is removed for artificial incubation, the hen may lay again. This can be repeated several times during the breeding season. A number of instances have been recorded where the hen has gone to nest more than 10 times in a season” (Connors 2005 p122,124)

Referenced from *A Guide to Black Cockatoos as Pet and Aviary Birds*. (Connors 2005) and *Australian Cockatoos*. (Sindel and Lynn 1989).

### **10.10 Nesting, Hollow or Other Requirements**

In Sindel and Lynns *Australian Cockatoos* Sindel documents that “Bob Lynn favors vertical hollow logs standing on the ground under shelter which measure approximately 1.5 m long and 30-40 cm internal diameter with a natural spout entrance. They are filled to within 60cm of the top with rotten wood, dirt or soft termite nest. Bob fills the logs to this depth to allow easy examination of the nest and has found that most Black Cockatoos will accept the depth of the nest provided, as long as it is not too deep.”

In Forshaw’s *Australian Parrots: Third Revised Edition*, Forshaw states that his pair nested in a hollow log positioned vertically on top of a metal stand measuring 90cm high, the log atop was 80cm high with an internal diameter of 35cm and was open at the top. The log was filled with *Eucalyptus* sawdust to a depth of 30cm.

In *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005) Connors states “A suitable nesting log should measure approximately 90-100cm deep with an internal diameter of 30cm. It should be open at the top and have a hole for nest inspections. Ideally the log should be hung vertically in a location, which allows the first rays of morning sunlight and just a little rain to enter the nest. Every effort should be made to place the nest in a rodent free situation.”

Referenced from *Australian Cockatoos*.(Sindel and Lynn1989), *Australian Parrots: Third Revised Edition* (Forshaw 2002) and *A Guide to Black Cockatoos as Pet and Aviary Birds* (Connors 2005)

### **10.11 Breeding Diet**

Diet should be slightly increased week-by-week several weeks before the breeding should start. This should be done to mimic the favorable conditions that would occur pre-breeding season in the wild. A calcium additive should also be added to the diet to aid in healthy egg production by the hen and to prevent calcium deficiency in chicks. A calcium supplement can be a commercial made product such as Calcivet™, which is added to the water or can be calcium carbonate powder which is added to food, or cuttlefish bone to chew.

A complete and varied diet should be provided in order to provide a good calcium to phosphorus ratio as the metabolism between these to minerals is linked. (Sheppard 1989 p25).

### **10.12 Incubation Period**

The incubation period of Red-tailed Black Cockatoo eggs is between 28-30 days.

Referenced from *A Guide to Incubation and Handraising Parrots* (Digney 1998)

### **10.13 Clutch Size**

“A single egg is laid. If the egg is removed for artificial incubation, the hen may lay again. This can be repeated several times throughout the season.” (Connors 2005 p122)

“Very rarely are two eggs laid, but if the second egg hatches the chick is neglected and soon dies” (Forshaw 2002 p102)

### **10.14 Age at Fledging**

Fledging in Red-tailed Black Cockatoos occurs between 75-95 days of age.

Referenced from *A Guide to Incubation and Handraising Parrots* (Digney 1998)

### **10.15 Age of Removal from Parents**

Branston (1995) reported that at a male parent in his collection became aggressive towards the young bird when it was 21 weeks old. This would suggest that his bird was removed when its father showed aggression towards it.

Forshaw (2002) reported following the breeding success of his Red-tailed Black Cockatoos that both parents were protective of the young bird, which remained in the aviary until commencement of the next breeding season. This would be due to the risk of the younger bird accidentally breaking the egg if the parents were to breed again.

## ***10.16Growth and Development***

### Weight Gains In Grams

**Table 2**

<b>Days Old</b>	<b>Weight In Grams</b>
1	24
2	26
3	32
4	34
5	35
6	39
7	46
8	54
9	62
10	71
11	83
12	94
13	105
14	118
15	132
16	144
17	160
18	172
19	181
20	192
21	205
22	217
23	230
24	245
25	258
26	273
27	289
28	301
29	323
30	340
31	362
32	381
33	398
34	419
35	433
36	452
37	469
38	484
39	504

40	522
41	536
42	548
43	567
44	581
45	588
46	605
47	613
48	622
49	635
50	643
51	652
52	666
53	678
54	686
55	Peak Weight
56	

Forshaw (2005) documented the different stages of development that he observed with his Red-tailed Black Cockatoo chicks, these were:

- 32 days old, opening of pin feathers occurred
- 50 days old, able to rest on one leg
- 54 days old, peak weight reached
- 55 days old, introduced to an open cage during the day
- 60 days old, starting to perch on a dowel rod
- 72 days old, cracking sunflower seeds
- 83 days old, first flight
- 151 days weaned and independent

Table 1 referenced from *A Guide to Incubation and Handraising Parrots* (Digney 1998)



## **11 Artificial Rearing**

Generally speaking in a Zoo environment handraising is not the most desirable outcome for keepers and the bird. It is not desirable for keepers as it is expensive and time consuming and it is not desirable for the bird being raised as it is away from its own kind and often is imprinted on by its carer. Hand raised birds generally grow slower than parent reared birds which can be linked to not receiving the parent birds gut flora. Handraised birds may not ever acknowledge their own kind, which could pose a threat to the captive population by reducing the number viable breeding birds.

### **Criteria for Intervention**

- Parents are not feeding the chick at all.
- There are no suitable birds to cross foster the young chick with.
- A handraised bird is needed for a certain reason Eg a public interaction bird or for a birdshow.
- Raising the chick is needed in order to encourage the breeding pair to nest again. (could be necessary for recovery plans)
- Parents have not successfully reared a chick in the past. In a scenario like this it may be an option to aid the parent birds by providing a feed to the chick a some times throughout the day. The chick stays in the nest but gets fed by both the keeper and parent birds. This sets the both the parent bird and chick up for success which could increase the likelihood of the parent birds raising a chick unaided in the next breeding season.
- Rarely 2 eggs are laid but often the parents will only raise 1 chick even when 2 eggs are laid. In the event of this happening cross fostering can be considered for the second chick, if no suitable foster parents are available then handraising may be an option.

### **11.1 Incubator Type**

“While a unit that turns eggs automatically commands a somewhat higher price, it is worth the extra money. Parrot eggs need to be turned at least 3 times a day for almost the entire duration of the incubation process, so unless you have plenty of spare time and are constantly in attendance, an auto-turn model is the wiser choice” (Digney 1998 p12)

“A fan forced (moving air) model will alleviate a problem often encountered with still air models, variable temperature zones...A fan forced model will distribute the warm air evenly throughout the unit, providing a much more stable environment” (Digney 1998 p13)



*A.B Newlife 75 Mk6 Incubator in use at Priam Psittaculture*

## **11.2 Incubation Temperatures and Humidity**

“ Most Australian aviculturalists set the incubator dry temperature at 37.2 °C and this setting works well for most species” (Digney 1998 p20)

“ A humidity or wet bulb thermometer reading of 82°-83°F is the preferred setting by most aviculturalists for incubating the majority of parrot species.” (Digney 1998 p21)

“Target parrot egg humidity is variable but it is directly dependant on egg shell thickness and thus weight loss trends. We run incubators at different relative humidity, normally one at relative humidity 35-40% and one at relative humidity 70-80%. When multiple incubators are not an option I would start all small eggs at a relative humidity of 50%+ and large cockatoo/macaw/amazon eggs at 40%.”

Pers comm. Daniel Gowland of Priam Psittaculture

“Relative humidity should be maintained at about 45% and preferably not be allowed to exceed 50%. If this level is maintained your Cockatoo eggs should hatch without problems” (Connors 2005 p49)

## **11.3 Desired % Egg Mass Loss**

“The generally accepted ideal weight loss of 16% over the whole (incubation) period should be aimed for” (Sindel and Lynn 1989 p50)

“Most avian species” eggs lose in the range of 15% (13-16%) of their original weight during the incubation process, and this is also true for the order Psittaciformes” (Gage and Duerr 2007)

“Commonly 13.5-15% but a variation between 10% and 20% should not cause significant problems.”

Pers comm. Daniel Gowland of Priam Psittaculture

Daily Weight Loss Target Aim:

= (Fresh laid weight X Desired % Loss to pip) / Number of Days to Pip

Weight loss formula from (Gage and Duerr 2007)

### **Step 1**

$$\frac{\text{Starting weight} - \text{current weight}}{\text{Days incubated}} = \text{Grams lost per day of incubation}$$

EG

$$\frac{34.00\text{g} - 32.2\text{g}}{10 \text{ days}} = \frac{1.8\text{g}}{10 \text{ days}} = 0.18\text{g/day}$$

### **Step2**

Calculate anticipated weight loss for the total incubation period.

Grams lost/day X Incubation Period = Total weight loss for incubation period

EG

$$0.18\text{g/day} \times 29 \text{ days incubation} = 5.22\text{g}$$

### **Step 3**

Calculate the overall weight loss as a percentage of the original weight.

$$\frac{\text{Anticipated weight loss}}{\text{Starting weight}} \times 100 = \% \text{ weight loss}$$

EG

$$\frac{5.22\text{g}}{34\text{g}} \times 100 = 15.35\% \text{ weight loss}$$

Referenced from *Hand-rearing Birds* (Gage and Duerr 2007)

“This weight loss is regular and consistent throughout the entire (incubation) period, and as a result, these calculations allow for predictability of the ultimate percentage loss to be anticipated. This linear weight loss relationship is a grossly underutilized monitoring tool in psittacine egg artificial incubation at present time” (Gage and Duerr 2007)

### **Other Equations**

**Units of Measurement:**

Length (L) –Centimeters

Weight (W) – Grams

Time (T) –Days  
Volume (V) – Cubic Centimeters  
Density (D) -g/cm<sup>3</sup>/day

**Egg Volume Equation:** =Length X Breadth X Breadth X 0.51

**Egg Density:** =Egg weight/ Egg Volume

**Calculation of an Incubation Period:**

= {[Time (mins)/60 + Time (hours)] / 24}+days

EG: In initial Start Time (T1) = 1350 hrs 6/1/08

If Time of Period (T2) = 0715 hrs 13/1/08

Therefore T1-T2 =[(10/60+10)/24]+6+[(15/60+7)/24]  
=0.424+6+0.302  
=6.726 days

**Estimated Daily Change in Egg Density:**

= [Egg density at time T(1) – Egg density at time T(2)] / Time T(2) – Time T(1)

**Estimated % Weight Loss Trend at Time T (t)**

= {[ (Fresh weight-Actual weight at T (t)) / T(t)] X Estimated Days to Pip} / Fresh Egg Weight} X 100

Pers. Comms. Daniel Gowland of Priam Psittaculture

“Unquestionably the faster the allantoic membrane is developed to 100% coverage of the inner cell membrane, the more likely you will have a healthy, viable chick hatching. Ideal development in parrots is 100% allantoic membrane coverage by 50-52% of the incubation period.” Pers.comm. Daniel Gowland of Priam Psittaculture

### ***11.4 Hatching Temperature and Humidity***

“Ideally, when drawdown has commenced and pipping is evident, the egg should be hatched in a separate hatcher/brooder set at 37°C” (Connors 2005 p50)

“Humidity in the hatcher should be raised to 94°F wet bulb or higher to prevent the membranes from drying out and trapping the chick” (Digney 1998 p26)



*Brinsea Octagon 20 Mk 3 Incubator/Hatcher in use at Priam Psittaculture*

### **11.5 Normal Pip to Hatch Interval**

“Most parrot species normally hatch within a 24-hour period from internal pip to completed hatch” (Gage and Duerr 2007)

“Between 12-48 hours after internal pipping, expect the first signs of external pipping. Hatching can seem to take forever and it may take at least two or three days after external pipping commences before the chick emerges from the egg.” (Connors 2005 p50)

### **11.6 Brooder Types/Design**

“Fan forced brooders are preferred over still air models when dealing with small chicks requiring a more uniform and stable temperature. Chicks up to 10 days old are quite susceptible to fluctuating and marginal temperatures and this can be a problem in some still air units” (Digney 1998 p42)

“The other advantage of the fan forced unit is that when a chick is placed back in the unit after feeding, it is warmed quicker. When removing a chick from a brooder for feeding and with young chicks that will be from 8-10 times a day, much of the warm air is lost. When placing that chick back into the still air unit it can be observed shivering for a few minutes until the air around it warms up. This regular chilling can cause slow crop movement.” (Digney 1998 p42)



*A.B Newlife 75 Mk 3 Brooder in use at Priam Psittaculture*

### **11.7 Brooder Temperatures**

“Impact of brooder temperatures on weight gains and crop motility is direct...a chick shivering or huddling in ball is too cold and a panting and restless chick is too hot.” (Digney 1998 p43)

“ Following are temperature guidelines for brooding of chicks:

- Newly hatched: 36.6°C
- 5-12 days: 35°-31.6°C
- 12 days pin-feather: 31°-28°C
- Once pin feathers begin  
To cover the body : 26.5°C” (Digney 1998 p43)

### **11.8 Diet and Feeding Routine**

**Table 3**

<b>Age In (Days)</b>	<b>Average Brooder Temperature °C</b>	<b>Weight (Grams)</b>	<b>Amount Average Per Feed (ml)</b>	<b>Number of Feeds</b>
1	36.0	21.72	0.5	Hatch
2	36.0	25	1	11
3	36.0	30	1.5	10
4	36.0	35	2	9
5	35.0	39	2.5	9
6	32.5	48	3.3	8
7	31.0	55	4.5	7
8	30.0	65	6.0	7

9	30.0	72	8.0	4
10	30.0	80	8.0	4+T
11	28.4	105	9.0	5
12	27.2	113	14.0	4
13	26.5	120	15.0	4+T
14	25.4	140	15.0	4
15	25.4	150	17.0	4
16	25.4	170	20.0	4+T
17	25.4	200	25.0	4
18	25.4	225	25.0	4
19	25.2	245	25.0	4
20	25.2	265	25.0	4
21	24.6	275	28-30	4
22	24.6	285	30-35	4
23	24.4	310	30-35	4
24	24.4	335	35-38	3
25	24.2	350	35-45	4
26	24.2	390	40-45	4
27	24.0	410	35-50	4
28	24.0	445	44-52	4
29	24.0	460	50-55	3+T
30	24.0	485	30-55	3+T

T= Top up feed

Table referenced from *Handrearing Red-tailed Black Cockatoos at Auckland Zoo* (Rogers 2004)

“The majority of chicks hatch weak and in some cases dehydrated. Therefore they should be rehydrated by feeding an electrolyte solution with the addition of an energy source, before introducing handraising formula.” (Digney 1998 p60)

“Assuming the chick hatches during the night, begin feeding fluids at approximately 7:00am and go through until approximately 1:00am, being fed over an 18 hour period. Whether to feed again between approximately 1:00am and 7:00am is an individual choice, depending on the chicks condition. For example, if the chick hatched around lunchtime or mid-afternoon it is suggested to feed every 2 hours through the first night to rehydrate and strengthen the chick as quickly as possible. Similarly, should the chick be very weak or dehydrated at hatch, it is wise to rehydrate every 2 hours for the first 24 hours.” (Digney 1998 p65)

An important practice when handraising birds is crop stretching. Crop stretching involves a slight increase in food volume each feed. The slight increase in feed stretches the crop and creates more downward pressure speeding up digestion. Improving crop motility will see faster growth rates and a higher peak weight which is highly desirable when handraising birds.

“The change from rehydrating fluids to handrearing formula, and in fact any change in diet, is best done on an empty crop and after the extended night break. Introducing formula will see the crop slow a little as the body digests the food. This may result in the total volume fed per 24hrs remaining the same or even reducing a little for the first day change over. Although this is fine, keep moving forward from that point.” (Digney 1998 p65)

“ We have reared many birds on Lakes <sup>TM</sup> formula commencing with a watery mix and then per the manufacturers directions.” (Connors 2005)

“At Priam we handrear all of our birds on Harrisons handrearing formula with the formula and ratio depending on the species and age of the species.”  
Pers.comm. Daniel Gowland of Priam Psittaculture

### **Harrisons<sup>TM</sup> Formulas**

**Table 4**

<b>Formula</b>	<b>Crude Protein</b>	<b>Crude Fat</b>	<b>Crude Fibre</b>	<b>Moisture</b>
Neonate	26%	14%	1%	10%
Juvenile	18%	11%	4%	10%

Harrisons foods also contain varying traces of: Calcium, Phosphorus, Iron, Folic acid, d-Calcium, Vitamin K, Vitamin A, Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Vitamin B6 (Pyridoxine), Vitamin B12 (Cyanocobalamin), Vitamin D3, Vitamin E, Biotin and Niacin. Harrisons Bird Foods are also all organic.

Referenced from [www.harrisonsbirdfoods.com/ingrediants.html](http://www.harrisonsbirdfoods.com/ingrediants.html)

### **Harrisons<sup>TM</sup> Ingrediants**

**Neonate formula:** Soy Protein Isolate, Hi-Oleic Sunflower Oil, Corn Starch, Sugar, Calcium Carbonate, Potassium Chloride, Di-Calcium Phosphate, PhosphatadylCholine, Vita-min supplement (Vitamin A Acetate, Vitamin D3, dl-alpha tocopheryl acetate, Vitamin B12, Riboflavin, d-calcium pantothenate, Niacin, pyridoxine hydrochloride, d-biotin, thiamine mononitrate, folic acid, zinc sulphate, manganese sulfate, copper sulfate, sodium selenite, calcium carbonate..

**Juvenile formula:** Ground Hulled Grey Millet, Ground Hi-Oleic Sunflower Kernal, Ground Hulless Barley, Ground Yellow Corn, Ground Soybeans, Ground Shelled Peanuts, Ground Split Peas, Ground Green Lentils, Ground Toasted Oat Groats, Ground Brown Rice, Tapioca Maltodextrin, Psyllium, Ground Sun-Dried Alfalfa, Calcium Carbonate, Spirulina, Montmorillonite Clay, Ground Sun-Dried Sea Kelp, Vitamin E Supplement, Vitamin A Supplement, Vitamin D3 Supplement, Niacin Supplement, Vitamin B12 Supplement, Riboflavin Supplement, d-Calcium Pantothenate, Pyridoxine Hydrochloride, d-Biotin, Thiamine Mononitrate, Sodium Selenite.

Referenced from [www.harrisonsbirdfoods.com/ingrediants.html](http://www.harrisonsbirdfoods.com/ingrediants.html)



### **Other Commercially Made Formulas**

**Table 5**

<b>Brand</b>	<b>Protein</b>	<b>Fat</b>	<b>Fibre</b>
Lakes™	17%	5%	4.5%
Vetafarm™	22%	14%	10%
Roudybush™	21%	7%	5.5%
Wombaroo™	22%	8%	5%
Pretty Bird™	19%	8, 12 or 15%	2%

Table 4 referenced from (Digney 1998)

### **Bob Lynns Handrearing Diet**

“Bob uses this diet to handrear reasonably advanced baby Black Cockatoos, or as a supplementary food for young Black Cockatoos whose parents neglect their feeding duties after the youngsters fledge.”

“This diet is not suitable for chicks under 7 days old”

1 cup ground sunflower kernels  
¼ cup ground raw peanuts  
¼ cup ground almonds  
¼ cup wheat germ  
¼ cup ground canary seed  
4 crushed wheatmeal biscuits  
1 tablespoon glucose powder  
1 tablespoon calcium powder  
1 tablespoon cornflower

“All mixed together and stored in a dry, airtight container. To feed, mix with hot water to the consistency of a wet porridge.” (Sindel and Lynn 1989 p37)

### **More handrearing recipes**

#### **Recipe 1**

1 cup raw wheat germ  
1 cup high protein dog biscuits (ground fine)  
1 cup hulled sunflower seeds (ground fine)  
1 cup corn (maize) meal  
1 cup millet meal  
2 cups high protein Farex™ baby cereal  
Referenced from (Digney 1998 p49)

or

#### **Recipe 2**

1 cup ground sunflower seeds  
1 cup ground almonds  
4 Granita™ biscuits (blended)  
1 packet high protein Farex™ baby cereal  
1 tablespoon glucose powder  
1 cup corn (maize) meal  
Referenced from (Digney 1998 p49)

“ When necessary place the above ingredients into a blender to grind into a fine consistency.” (Digney 1998 p49)

### **Branstons Recipe**

This recipe was use by (Branston 1995) to handrear a chick removed from the nest at 16 days of age.

500g finely ground sunflower kernels  
150g buckwheat flower  
100g stabilized wheatgerm  
125g infants rice cereal  
125g infants high protein cereal  
250g finely ground milk arrowroot biscuits  
50g wheat-based breakfast cereal.

All ingredients are blended together, and for each feed the required amount is mixed with warm water to right consistency; small amounts of strained baby food (mixed vegetables, apples or creamed corn) were added, together with a vitamin and calcium supplements.

Referenced from *Breeding the Red-tailed Black (Banksian) Cockatoo: The Magnificent Black* (Branston 1995)  
And *Australian Parrots: Third Revised Edition* (Forshaw 2002)

“Feed temperatures for all chicks should be 40.5°-41°C (105°-105.8°F), however anywhere between 37.7°- 43.3°C (100° - 110°) is tolerable.” (Digney 1998 p64)

“ Following are some guidelines to work towards:”

On Day 1	2 Hour feeds	(9-10 feeds a day)
By Day 8	3 1/2-4 hour feeds	(5-6 feeds a day)
By Day 14	5 hour feeds	(4 feeds a day)
By Day 24-30	8 hour feeds	(3 feeds a day)
At Peak		(2 feeds a day) “ (Digney 1998 p68)

“The growing chick should gain some weight every 24 hours. The gains will be erratic and generally a large gain is followed by a small one.” (Digney 1998 p69)

“Never mix formula with extremely hot water. Not only does it turn gluggy, it destroys many of the nutrients.” (Digney 1998 p49)

The benefit of feeding a commercially available like Harrison's™ is that one knows exactly how much protein, fat and fibre are actually in the formula compared to homemade recipes which don't really give much insight into the actual nutritional value inside of them. Commercially made formulas will always contain the same ratio of ingredients where as homemade recipes have much room for error. Pers obs

### **11.9 Specific Requirements**

“Not long after peak, many species, especially the Black Cockatoos, go through a particularly strong curiosity phase and if this window is used to its maximum advantage, the chick can be weaned in a minimum of time.” (Digney 1998 p75)

“Weaning a Black Cockatoo purely on sunflower seed is to be avoided because once it develops a taste, it is addicted and is an extremely difficult habit to break.” (Digney 1998 p78)

“The parent fed chick is constantly receiving friendly bacteria and natural gut flora from the parent via regurgitated foods which contributes to the much better start that parent fed chicks display in the first few days. To compensate for this in the nursery, it is common practice to add some sort of live culture to the formula such as acidophilus lactobacillus powder or Probotic™, an Australian product containing eight different strains of friendly bacteria. It is strongly recommended that a pinch be added to every feed for the first few days of life and to any bird suffering slow moving crop or sickness, including adults.” (Digney 1998 p51)

### **11.10 Pinioning Requirements**

Pinioning may not be performed on birds of the Order Psittaciformes as written in the NSW Guidelines for the Pinioning of Birds by The Department of Primary Industries.

It is an offence to Pinion parrots under section 4(2) of the Prevention of Cruelty to Animals Act, 1979 which states:

“ An offence has been committed if an animal is unreasonably, unnecessarily or unjustifiably: beaten, kicked, wounded, **pinioned**, mutilated, maimed, abused, tormented, tortured, terrified or infuriated”.

Referenced from *NSW Guidelines for the Pinioning of Birds* (Department of Primary Industries 2005)

[www.dpi.nsw.gov.au/agriculture/livestock/animal-welfare/codes/general/bird-pinioning](http://www.dpi.nsw.gov.au/agriculture/livestock/animal-welfare/codes/general/bird-pinioning)

Cited 16/3/2008

### **11.11 Data Recording**

#### **11.11.1 The Egg**

When artificially incubating eggs it should be considered best practice to collect data on the individual egg throughout the incubation process. By collecting data on the egg you

will be able to identify any issues with incubation such as to greater or slower weight loss of the egg and correct it so that the egg hatches into a healthy young chick.

Initial data that should be documented once you have an egg is:

- Species
- Avairy number (to ID parents)
- Egg number
- Fresh Weight (g)
- Egg volume (cm<sup>3</sup>)
- Length (cm)
- Breadth (cm)
- Date layed
- Collection date
- Egg condition at collection

It is also worthwhile documenting the exact incubator being used and it turning regime.

Daily data that should also be collected is:

- Day
- Notes
- Actual weight (g)
- Density (cm<sup>3</sup>)
- Vein growth (%)
- Date
- Time

When documenting the growth and development of a chick one should always keep in mind the expected incubation period and expected days to pip.

### **11.11.2 The Chick**

“Whether raising one chick or 30-40 chicks, the best keeping of records is an important aspect of the handraising process. The memory is at best unreliable, while records allow you to do several things”:

- Accurately monitor chicks weights and development.
- Experiment with brooder temperatures, feed intervals etc and thereby finetune your regime.
- Monitor feed volumes to avoid underfeeding.
- Go back and pinpoint possible causes of a problem.
- Keep weaning times to a minimum. (Digney 1998 p39)

In Zoos it is vital to the long-term sustainability of a species that an animals parents be identified so that a studbook keeper can maintain the genetic diversity of the captive population.

Information on the chick should be:

- Common name
- Species
- Father
- Mother
- Sex
- Egg number
- Ring number
- Name
- Micro-chip number
- ISIS Id
- ARKS Number
- Hatch weight
- Hatch Date

The documentation of a young chicks growth is important as it allows you to accurately monitor the chicks growth and assess any problems encountered along the way as well as help to keep weaning period to a minimum. Recording the following is a good way to assess growth and development:

- Date
- Time
- Age in days
- Brooder temp
- Weight (g)
- Weight change
- Crop status
- Food consumed
- % of formula solid
- Food type
- Notes

The use of a growth chart is also useful as you can plot growth per day and compare it visually to other birds that have been hand raised.

### ***11.12 Identification Methods***

Leg banding is a simple way to identify a chick as it is clear, effective and inexpensive. Leg bands should have individual and unique numbering on them, which is to identify specific birds. Leg band numbers should be documented in the birds records as it is important information that will be used throughout the birds life.

Black Cockatoos should be banded between 19-24 days of age and have an internal diameter that is 12-14mm. (Digney 1998)

Birds in large collections should also be micro chipped as in the event that the leg band somehow be removed there is an alternate means of identification. Micro chipping is also

positive proof of ownership should the bird escape. is Micro chipping should only be done by a Veterinarian.

“Preferably two methods of identification should be used in case one method fails. The attributes of effective identification techniques may include:

- Being permanent.
- Positively identifying the animal as an individual.
- Being easy to apply.
- Not unreasonably damaging the individual.
- Having a relatively painless application.
- Not interfering with the animals’ mobility.
- Being adaptable to modern data retrieval systems.
- Being clearly visible.
- Being unalterable.”

(Department of Primary Industries 1986) Clause 33

### **11.13 Hygiene**

“Poor hygiene directly contributes to nursery problems in terms of illness and poor development, therefore frequent, thorough cleaning and disinfecting will keep bacterial, fungal and viral contamination to a minimum.” (Digney 1998)

“All feeding instruments should be cleaned thoroughly under running water after each feed then left to soak in a disinfecting agent, such as Milton™ solution or Avisafe™. Rinse in clean water just prior to feeding to remove excess solution...” (Digney 1998)

### **11.14 Behavioural Considerations**

“A naturally imprinted bird, raised by its natural parents, would be classed as a true imprint. A bird that has been handreared and imprinted on a human is classed as a „malimprint“, a bird which is not raised by its natural parents in their natural environment.” (Mander 2002)

With handraised birds being classed as malimprints it is important to ensure that the bird being raised knows indeed that it is a bird. This can be done by properly socializing the bird being raised at a young age. Properly socializing a young bird can be done by raising the young bird with other birds around a similar age and size. Whilst adult birds can be socialized it can be often a lengthy process as they have to learn to be a bird, so it is best to socialize at a young age.

Malimprinted birds that go unsocialized can often reject their own kind and may not breed, which can be a big problem in terms of conservation and managing a small captive population.

### **11.15 Use of Foster Species**

“Amazons, Macaws, medium sized Cockatoos basically any parrot of similar size would make a suitable foster parent on the grounds that they have successfully reared chicks in the past” pers. comm. Daniel Gowland of Priam Psittaculture

An important consideration when using a foster species is to recognize the difference in weaning time between the foster species and Red-tailed Black Cockatoos. It is important because it may mean that the foster species is only suitable for a short period of time as the weaning age of the foster species chicks could be much less than for Red-tailed Black Cockatoos. EG Blue and Gold Macaw weans chicks between 85-95 days compared to Red-tails Black Cockatoos 120-150 days.

### **11.16 Weaning**

“The average weaning age of Red-tailed Black Cockatoos is between 120-150 days.” (Digney 1998)

“The type of weaning foods presented has a major influence on how quickly the Black Cockatoo chick is weaned. Offer a wide variety of foods...” (Digney 1998)

“Use imagination when providing weaning foods. Some favored foods are”:

- Corn on the cob
- Apple
- Carrot
- Lettuce
- Passionfruit halves
- Orange
- Wholegrain bread
- Nutrigrain™
- Silverbeet
- Mealworms
- Commercially made pellet diets eg Pretty Bird™, and Kaytee™
- Peanuts
- Almonds
- Brazil nuts
- Walnuts

“Sprouted sunflower and lupins are also an excellent supplement for weaning chicks, however be sure to practice tight hygiene when sprouting. (eg soaking the seeds in Aviclen™)” (Digney 1998)

“It does not hurt to even introduce weaning foods prior to peak (weight) as some species begin to seriously chew around the late pin-feather stage. This early introduction may actually help to usher in independence a little quicker.” (Digney 1998)

“When dropping from 2 to 1 feed (Hand feed) a day, drop the morning feed. The chick will be slightly hungry during the day encouraging it to begin finding its own food. It

pays to monitor the chicks weight by weighing every 3 to 4 days for up 3 weeks after the very last feed, to ensure that its is in fact eating enough food to at least maintain weight.” (Digney 1998)

### **11.17 Rehabilitation Procedures**

Rehabilitating a chick to be released into the wild is a lengthy process that can be very difficult to do successfully

Rehabilitating a young chick that has to be rehabilitated should ideally be provided:

- Minimal contact with care.
- When feeding, the carer should not talk to the chick as the chick may develop an association with the carers voice and food.
- Possibly use a puppet when feeding to imprint the bird on what appears to be its own kind and to not develop an association with its carer.
- Ideally another bird of similar age to be raised with.
- Once fledged the chick should be well socialized with other birds.
- The chick should only be weaned on a natural diet.
- The chick should have a large flight aviary once confident flying, to allow long distance flights.
- The young bird should have a healthy fear of people.
- Once weaned, the young bird should not beg for food to its carer.
- Socialisation with other birds of its own kind should continue throughout the raising process.
- When it is time for release the young bird should be in top feather condition, strong and confident when flying, in good health and disease free, should be eating only wild foods and should be avoiding humans when approached.
- When releasing the young bird should be released into a flock or with another bird of the same species that it has been socialized with.



## 12 Acknowledgements

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## 15 Glossary

Allantoic Membrane: The blood vessels that develop inside the egg that supply oxygen to the unhatched chick.

Aviculture: The keeping and breeding of birds in captivity.

Beak: The projecting jaws of a bird and their horny covering.

Bill: Synonymous with beak.

Browse: Fresh leafy branches supplied for enrichment.

*Calyptorhynchus lathami* : The Glossy Black Cockatoo is a member of the same genus as The Red-tailed Black Cockatoo, their habitats overlap.

Cloaca: Combined terminal region of the digestive, urinary and reproductive systems and having a single opening to the exterior.

Clutch: The number of eggs laid by a female at a single nesting attempt.

Drawdown: The noticeable movement of the eggs air cell prior to hatching.

Eucalypt: Collective term for trees belonging to the genera *Eucalyptus*, *Corymbia* and *Angophora*.

Family: The level of taxonomic classification above genus that usually comprises of a number of genera.

Forest: Vegetation dominated by trees with canopies that touch or overlap and the foliage cover exceeds 30%.

Genus: A group of closely related species (plural = genera).

Grevillea: Collective term for plants belonging to the genus *Grevillea*.

Habitat: The environment in which a plant or animal or lives.

Hakea: Collective term for plants belonging to the genus *Hakea*.

Mandibles: The upper and lower halves of the bill.

OH and S: The abbreviated version of Occupational Health and Safety

Periophthalmic Ring: The ring of skin surrounding the eye.

Petpak: A sturdy plastic animal transport container that is readily available from pet stores.

Photoperiod: The period of daylight in every 24 hours. Seasonal changes in photoperiod may trigger certain activities in birds, such as reproduction.

Pinioning: A surgical procedure performed on a birds wing to render the bird permanently incapable of flight. See 11.10

Population: Group of individuals from the same species sharing the same habitat and capable of interbreeding.

Psittaciformes: Taxonomic order containing the families Cacatuidae and Psittacidae.

Sheoak: Collective term for species belonging to the genera *Allocasuarina* and *Casuarina*.

Species: A group of individuals or populations that can be identified as a type of bird and that generally do not breed with other types of birds. The level of taxonomic classification between a genus and a subspecies.

Subspecies: Populations or groups of populations of the same species that are distinct enough from one another to warrant individual recognition.

Wattle: Collective term for plants belonging to the genus *Acacia*.

Woodland: Vegetation dominated by well spaced trees where the foliage cover is less than 30%.

Zygodactyl: Feet where two toes face forward and two toes face backwards. The first and fourth toes point backwards and the second and third toes point forward.



## 16 Appendix

### 16.1 Annual Cycle of Maintenance

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northern Australia Breeding Season			X	X	X	X	X	X	X			
Southern Australia Breeding Season	X	X	X	X	X						X	X
Full Enclosure Clean: Scubbed with disinfectant.		X				X				X		
Minor Aviary Repairs	X			X			X					
Major Aviary Repairs										X		
Annual Veterinarian Medical Checks		X								X		
Routine Health Checks (Visual observation)	X	X	X	X	X	X	X	X	X	X	X	X

## **16.2 Suppliers**

### **Vetafarm**

3 Bye St, P.O. Box 5244 Wagga Wagga NSW Australia  
Telephone (02) 6925-6222 Fax (02) 6925-6333  
Email: [vetafarm@vetafarm.com.au](mailto:vetafarm@vetafarm.com.au)  
Internet: <http://www.vetafarm.com.au>

Products: Aviclens™, Calcivet™, Psittavet™ and Probotic™

### **Health and Hygeine (Pty) Ltd**

Chemical Essentials (Pty)  
13 Abelia St, Doncaster East  
Victoria 3111  
Emergency Telephone Number: 03 9841-9901  
Fax: 03 9841-9909  
Email: [info@healthandhygeine.co.za](mailto:info@healthandhygeine.co.za)

Product: F10™

### **WA Poultry Equipment**

WA Poultry Equipment  
1170 Baldivis Road,  
Baldivis  
Western Australia 6171  
Telephone: +61 895241251  
Fax: +61 895241716  
Email: [chris@wape.com.au](mailto:chris@wape.com.au)  
Web: [www.wapoultryequipment.com](http://www.wapoultryequipment.com)

Product: Brinsea Incubators™

### **A.B Incubators**

Unit 1, Church Farm, Chelmondiston,  
Ipswich, Suffolk, IP9 1HS, UK  
Tel/Fax: +44 (0) 1473 780 050  
Email: [info@abincubators.co.uk](mailto:info@abincubators.co.uk)

Product: AB Newlife Incubators™

**Dr. Ross Perry: Veterinary Surgeon and Physician**

7 Lillihina Ave, Cromer NSW Australia 2099  
Tel/Fax: +61 (2) 9982 5831  
Mob: +61 (0)419-693-279  
Web: [www.drrossperry.com.au](http://www.drrossperry.com.au)

Product: Harrisons™ Bird Foods

**Kimani Aviaries**

Diana Anderson & Kym Gaunt  
P.O. Box 605  
Kalamunda  
Western Australia 6076

Tel: 08 9291-9795  
Mob: 0416-146-465  
Fax: 08 9291-3117  
Email: [kimani@wn.com.au](mailto:kimani@wn.com.au)

Product: Roudybush™ Bird Foods

**Wombaroo Food Products**

PO Box 151  
Glen Osmond  
South Australia 5064  
Tel/Fax: (08) 8391-1713  
Email: [wombaroo@adelaide.on.net](mailto:wombaroo@adelaide.on.net)  
Web: [www.wombaroo.com.au](http://www.wombaroo.com.au)

Product: Wombaroo™ bird foods

**Masterpet Australia Distributor**

Lot 1/126 Jedda Road  
Prestons NSW, Australia 2170  
Tel: (2) 8784-1200

Product: Kaytee™ pelleted bird foods

### 16.3 Enrichment Forms and Sheets

**Taronga Zoo Animal Watch and Environmental Enrichment Programme**  
**SUMMARY OF ENRICHMENT DEVICE OR TECHNIQUE EVALUATION**  
**SPECIES:**

## ANIMALS' RESPONSES TO ENRICHMENT IDEAS TRIED

[illegible]

### Grading Key of Animals' Responses

(From Disney's Animal Kingdom Animal Enrichment Program website: [www.csew.com/enrich](http://www.csew.com/enrich) )

- 1 = animal runs/flees or obviously avoids enrichment  
2 = animal ignores or appears to avoid the enrichment  
3 = animal orients to or looks at but does not physically contact the enrichment  
4 = animal makes brief contact with enrichment (<10 minutes), sniffs/licks enrichment.  
5 = animal makes substantial contact with enrichment (>10 minutes).  
IE = indirect evidence, response not observed but signs of response to enrichment can be graded from 1(no evidence) to 5(significant evidence of interaction).  
UK = unknown, no information.

### Grading Key of Changes to Goal Behaviour

- 0 = enrichment encourages undesirable/dangerous behaviour (describe what)  
1 = no reaction, did not encourage goal behaviour  
2 = animal reacted but behaviours were unrelated to planned goal (describe)  
3 = some reaction; some goal behaviours observed  
4 = moderate reaction, achieved moderate amount of goal behaviour.  
5 = strong reaction, encouraged many or substantial amount of goal behaviour.

**Taranga Zoo Animal Watch and Environmental Enrichment Programme  
EVALUATION OF ENRICHMENT: ACTIVITY AND REACTION TO DEVICE**

# EVALUATION OF ENRICHMENT: ACTIVITY AND REACTION TO DEVICE

**SPECIES:**

**INSTRUCTIONS:** On interval record behaviour for each animal (it is not usually necessary to distinguish between individuals) and how many are at the item being

evaluated if there are several in the group\*. Within the interval note details of activity at the enrichment device/s. I

**ENRICHMENT PRESENT:**  
If making periodic visits note time of visit, location and activity on arrival, and device

[illegible]

Kansas City Zoo

DAILY ENRICHMENT LOG

Month/Year

Species

Area

Reaction / Outcome Key

1. Foraged for food item
2. Explored / examined item: sniffed, tasted, watched etc
3. Listened to, vocalised
4. Shredded, chased, batted item around
5. Manipulated item or device.
6. Used item as nesting material
7. Ignored item showed no interest
8. Avoided item, area
9. Other (describe reaction in comments)

Duration Key

- A. unknown
- B. 0-5 min
- C. 5 - 20 min
- D. 20 - 60 min
- E. Off and on all day

DATE	ENRICHMENT PROVIDED	REACTION	DURATION	COMMENTS	INIT
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

## DESCRIPTION OF ENRICHMENT

Please sketch object (if applicable)

## SAFETY CHECKLIST

Please complete checklist to ensure all avenues of potential dangers have been considered.

Yes

No

Can the animal ingest the object or pieces of it?		
Does the object have potentially toxic components? Eg treated wood, paint, epoxy etc		
Have nails been used? (Screws are better when glued in place with non-toxic glue)		
Does it have any plastic or nylon? (Natural fibres are better).		
When using cardboard – is it free from wax, staples or plastic tape?		
When using browse – is it non-toxic, free from chemicals and washed of bird faeces?		
When using feathers and sloughs, have they been autoclaved to remove parasites and micro-organisms?		
Has the use of body parts or carcasses been cleared with the vet department?		
Can the animal injure itself or cage mate with object? Can it be used as a weapon, missile or for destruction (ie elect. fence short) or escape?		
Can the animal trap any part of it's body in the object?		
Is food enrichment being included as part of the animal's regular diet to reduce potential overfeeding?		
Could the method of delivery cause aggression in the group?		
In a multi-species exhibit or family grouping, could a larger or smaller animal become stuck or injured?		
Will the enrichment cause abnormally high stress levels? Explain		





PERTH ZOO DRAFT MONTHLY CALENDER

MONTH:

SECTION:

ROUND:

DATE									COMMENTS
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**KEY:**

**Sensory Stimulation:**

S1 = herbs  
 S2 = scents (oils, perfume etc)  
 S3 = faeces  
 S4 = blood trails/blood iceblocks  
 S5 = other

**Husbandry/Feeding**

H1 = scattered food/forage  
 H2 = puzzle or other feeder  
 H3 = browse  
 H4 = live food (mealworms, crickets, termites)  
 H5 = iceblocks with food inside  
 H6 = nuts in shells

**Novel Objects/Devices:**

N1 = natural item  
 N2 = non-natural/man-made item

**Exhibit Design/Furniture**

E1 = varied exhibit, moved furniture  
 E2 = new furniture added (logs etc)

**Social Groupings**

G1 = same species  
 G2 = like species

**Behavioural Training**

B1 = training  
 B2 = interaction  
 B3 = husbandry (weigh)

## ***16.4 Material Safety Data Sheets***