

Table of Contents

	Page
1. Introduction	4
1.1. History in Captivity.	4
1.2. Education, Conservation and Research.	5
2. Taxonomy	5
2.1. Nomenclature	5
Class:	
Order:	
Family:	
Genus Species:	
2.2. Etymology.	6
2.3. Subspecies:	6
2.4. Other Common Names	6
3. Natural History	6
3.1. Diagnostic features.	7
3.2. Distribution and Habitat.	8
3.3. Longevity.	10
3.3.1. Wild	10
3.3.2. Captivity	10
3.3.3. Techniques to determine the Age of Adults.	10
4. Housing Requirements	10
4.1. Exhibit Design.	10
4.2. Holding Area Design.	11
4.3. Spatial Requirements.	11
4.4. Position of Enclosure.	12
4.5. Weather Protection.	12
4.6. Heating Requirements.	12
4.7. Substrate.	12
4.8. Nest Boxes or Bedding Material.	12
4.9. Enclosure Furnishings.	13
5. General Husbandry	14
5.1. Hygiene and Cleaning.	14
5.2. Record Keeping.	14
5.3. Methods of Identification.	14
5.4. Routine Data Collection.	15
6. Feeding	15
6.1. Wild Diet	15
6.2. Captive Diet.	16
6.3. Supplements.	17
6.4. Presentation of Food.	17

7.	Handling and Transport	18
	7.1. Timing of Capture and Handling.	18
	7.2. Catching Bags.	18
	7.3. Capture and Restraint Techniques.	18
	7.4. Weighing and Examination.	19
	7.5. Release.	19
	7.6. Transport Requirements.	19
	7.6.1. Box Design.	20
	7.6.2. Furnishings.	20
	7.6.3. Water and Food.	20
	7.6.4. Animals per Box.	20
	7.6.5. Timing of Transportation.	20
	7.6.6. Release from the Box.	20
8.	Health Requirements	20
	8.1. Daily Health Checks.	20
	8.2. Detailed Physical Examination.	22
	8.3. Routine Treatments.	22
	8.4. Known Health Problems.	23
	8.5. Quarantine Requirements.	25
9.	Behaviour	25
	9.1. Habits.	25
	9.2. Reproductive Behaviour.	27
	9.3. Bathing.	28
	9.4. Behavioural Problems.	28
	9.5. Behavioural Enrichment.	28
	9.6. Introductions and Removals.	28
	9.7. Interspecific Compatibility.	29
	9.8. Intraspecific Compatibility.	29
10.	Breeding	30
	10.1. Mating System.	30
	10.2. Ease of Breeding.	30
	10.3. Techniques Used to Control Breeding.	30
	10.4. Occurrence of Hybrids.	31
	10.5. Timing of Breeding.	31
	10.6. Age at First Breeding and Last Breeding.	31
	10.7. Ability to Breed Every Year.	31
	10.8. Ability to Breed More Than Once Per Year.	31
	10.9. Nesting/Hollow or other Requirements.	31
	10.10. Breeding Diet.	31
	10.11. Incubation Period.	31
	10.12. Clutch Size.	32
	10.13. Age at Fledging.	32
	10.14. Age at Removal from Parents.	32

10.15. Growth and Development.	33
11. Artificial Incubation and Rearing	33
11.1. Incubator Types.	33
11.2. Incubation Temperatures and Humidity	34
11.3. Desired % Weight Loss.	34
11.4. Hatching Temperature and Humidity.	34
11.5. Normal Pip to Hatch Interval.	34
11.6. Brooder Types/Design.	34
11.7. Brooder Temperatures.	34
11.8. Diet and Feeding Routine.	35
11.9. Specific Requirements.	36
11.10. Pinioning Requirements.	37
11.11. Identification Methods.	37
11.12. Hygiene.	37
11.13. Behavioural Considerations.	37
11.14. Use of foster Species.	38
11.15. Weaning.	38
11.16. Rehabilitation.	38
12. References	40
13. Bibliography	43
14. Glossary	43
15. Appendix. 1. Equipment and suppliers.	43
2. Standards for Exhibiting Animals.	
3. IATA Travel Requirements.	
4. Blood Chemistry for Palm Cockatoos	

1. Introduction:

The Palm Cockatoo is the only member of the genus *Probosciger* and is the largest of the Australian parrots. It was described in 1701 by the Dutch author S. Van der Meulen and first figured, rather poorly, by Pelvo Scheuk as *Corvus indicus* in a book published in Amsterdam. The species was more adequately described and portrayed by Edwards in his 'Gleanings of Natural History' in 1764. Gmelin scientifically categorized this species in 1788. (Sindel, S & Lynn, R. 1989).

Up until the later half of the 20th century Palm Cockatoos were considered moderately common. By 1996 reports stated that the species occurred patchily and in low densities. Further investigations are required to determine more precisely the status of Palm Cockatoos on Cape York Peninsula and to identify potential or real threats to their survival. It is therefore imperative that the population be afforded effective protection. (Forshaw. J. M. 2002).

1.1. History in Captivity

This species was first exhibited in Europe by the Director of the Zoological Gardens of Amsterdam in 1860, and in England by the Zoological society of London in 1861. (Sindel, S & Lyn, R. 1989).

The earliest report of a Palm Cockatoo in captivity in Australia appears to be of one survivor of two babies taken from nests on Cape York Peninsula in 1912. Both chicks were sent to Dr. E. A. D'Ombra in Sydney. (Sindel,S &Lyn,R. 1989).

What has been acclaimed in Australia as the world first parent reared breeding of the Palm Cockatoo was achieved by Bob Lyn of Sydney in 1968. (Sindel, S & Lyn, B. 1989).

In 1983, 100 Palm Cockatoos were confiscated by the United States Fish and Wildlife Service (USFWS). Ten zoological institutions received ten birds each to hold until the legalities of the confiscation case were completed. After the case was resolved, each holding institution was allowed to keep two pairs. The remaining birds were auctioned off to private individuals by the USFWS. (Taylor,M. 1998).

As a result of this incident, the American Zoo and Aquarium Association (AZA) have kept a studbook for the Palm Cockatoos. There has been a total of 235 hatchlings (94:71:70) from the original foundation stock. There were 154 (73:53:28) of these captive bred birds alive as of January 1997. (Taylor, M. 1998).

Until recently, of the few Palm Cockatoos in captivity in Australia, only a male that was held at Currumbin Wildlife Sanctuary, (CWS) until 1999, was positively known to have come from Cape York Peninsula.

Sindel and Lynn (1989) state that in 1971, Kerry Muller then Curator of Birds at Taronga Zoo, breed a pair of Palm Cockatoos. Unfortunately the chick was lost as a result of

psittacosis, some time after being taken for hand rearing. In 1973 a second pair at Taronga Zoo nested and successfully hatched a chick which died soon after fledging.

Taronga Zoo received a pair of Palm Cockatoos in 1959, a probable donation from Sir Edward Hallstrom's collection. This pair were sent on to Adelaide Zoo in 1998 and are still held within their collection. There is however some speculation as to whether they are *P. aterrimus* or *P. goliath*.

Adelaide Zoo recently acquired a young male Palm Cockatoo from the Cape York Area, and are actively seeking a female for him.

Adelaide and Taronga Zoos are working to collect *P. aterrimus* cooperatively for the long term.

1.2 Education Conservation and Research.

In some parts of the range the woodland habitat in which hollow trees occur is being invaded by rainforest. However, fire which is used to maintain the stability of the rainforest/woodland ecotone, also has the potential to reduce hollow availability if managed incorrectly, by destroying hollow-bearing trees. (Garnett, S.T & Crowley, G.M. 1997). The Qld. Department of Environment has recommended that research data be collected to determine the effects of fire on Palm Cockatoo habitat, and use as the basis for fire management where the species occurs.

The National Federation of Zoos in Britain has coordinated the controlled captive breeding programs to generate greater genetic diversity for threatened species of parrots from around the world, only four species have so far been selected for special attention the Palm Cockatoo is one of the four mentioned species. (Birchall, A. 1990).

There is a strong need for further research into the understanding of the ecology of the Palm Cockatoo. Steve Murphy (2001) states that more information is required on reproduction, such as, how often do pairs attempt to breed, what is happening to chicks and eggs that go missing from nest logs? Murphy is also attempting to define "good breeding habitat", and whether birds move between the different sub-populations in Australia.

2. Taxonomy.

2.1 Nomenclature

Class:	Aves
Order:	Psittaciformes
Family:	Cacatuidae
Sub Family:	Cacatuinae
Tribe:	Proboscigerini
Genus:	<i>Probosciger</i>
Species:	<i>aterrimus</i>

2.2 Etymology

Probosciger

proboscis – Greek for nose

gero – Greek for carry

aterrimus – Latin for very black

2.3 Subspecies

The Palm Cockatoo has 4 recognized subspecies:

Probosciger aterrimus aterrimus which is the nominate sub-species and ranges from the Aru Islands through southern West Iran, eastward to the Gulf of Papua and to the Cape York Peninsula. (Sindel, S. & Lyn, R. 1989).

Probosciger aterrimus macgillivrayi occurs in the Trans-Fly region, southern new Guinea, and on Cape York Peninsula. On the eastern coast of Cape York the range extends south to Princess Charlotte Bay and inland to the western slopes of the Tozer and McIllwraith Ranges, while on the western coast it extends south to the Archer River, inland to Kinlock Creek, and extralimitally to the Edward River. Vagrants occasionally reach the southernmost islands in the Torres Strait. (Forshaw. J.M. 2002).

Probosciger aterrimus goliath. Generally speaking this sub-species ranges from the western Papua Islands and from Vogelkop in West Irian eastwards through the central areas to eastern Papua New Guinea. (Sindel,S & Lyn, R. 1989).

Probosciger aterrimus stenolophus is similar to *P.a.goliath* but has narrower crest feathers. It ranges from Japen Island in Geelvink Bay through West Irian eastwards across northern New Guinea to Collingwood Bay. (Sindel, S & Lyn, R. 1989).

2.4 Other Common Names

Great Palm Cockatoo, Great Black Cockatoo, Goliath Cockatoo, Cape York Cockatoo, Goliath Aratoo, Black Macaw (Forshaw, J, M. 2002).

3. Natural History:

In Wood's (1988) field notes he reports that birds roosted separately, though in the same tree, and one pair used the same group of trees during a period of 30 months. It was also noted that the birds often came out to display trees before sunrise and were observed flying about on calm moonlit nights.

Particular trees serve as focal points for the formation of parties. As birds arrive at the congregating tree, activity increased and playful antics were carried out. Preening is carried out with the feathers between the claws or between the upper mandible and the tongue, and birds were seen also to rub their bare facial-patches along a branch. Displays

include mock combat, and involved raising of the crest, bowing, outstretching of the wings and swaying, but lacking were the raucous screeching, body contact and intensity that characterized territorial disputes between males. (Wood 1988).

Forshaw (2002) mentions that there is little information on social organization and suggests that breeding pairs are territorial, spending much of the year in their territories, where they may be accompanied by off-spring from recent and past breeding seasons, while groups of non-breeding birds move about more widely. Wood (1988) notes that in the Iron Range district two pairs resided in an area of approximately one square kilometer, and within this square kilometer were 23 sites used regularly by the birds for territorial display. These display sites focused on trees containing potential nesting hollows, and were visited regularly by the birds throughout the year, usually at the beginning and end of the day.

Wood (1984) describes the territorial display, which is performed by the male atop a dead, hollow eucalypt tree to 15m high and standing near vertically. With crest raised, wings outspread and bare facial patches intensely flushed, the cockatoo slowly pirouettes while striking repeatedly the dead trunk with a stout twig, stone or large seed held in the left foot, thus producing a loud, resonant knocking. All the while strident whistling calls are emitted.

These displays took place in the morning and late afternoon, reaching peak levels during June and July, but occurring also at other times of the year. Duration of the display varied from two to more than 100 strikes. Once a display is completed, the drumstick may be discarded or chewed into splinters and dropped inside the hollow (Wood 1984).

Throughout their range Palm Cockatoos are present in all months, and it is suspected that breeding pairs remain within or near to their breeding territories. However, wandering does take place, probably by younger non-breeding birds (Forshaw, J.M. 2002).

The normal flight is heavy and labored, with slow, full wing beats, and the bill is held down against the breast (Forshaw, J.M. 2002).

Wood (1988) points out that significant variation in calls results from the birds changing the modulation and arrangement of basic notes. Cockatoos from the Bamaga district, at the northern extremity of Cape York Peninsula, are said to have the same calls, but with modulations constantly different from those present in calls of birds from the Iron Range area, some 200 km to the south. A different dialect is reported also from the Weipa district, giving rise to speculation that this population may be isolated.

3.1 Diagnostic Features:

The Palm Cockatoo is distinct from all other cockatoos with its massive protruding upper mandible and smaller lower mandible, which do not completely fit together when closed. This allows the small red, black tipped tongue to be visible. The patches are similar to the bare cheek patches of the Macaw family and gave rise to the name of Macaw

Cockatoo, which was often used for this species in the 19th century. This possibly reflects parallel evolution between the two. Like the Macaw the cheek patch is capable of changing its depth of color, becoming a deeper red in the mating season and when the bird becomes excited or agitated. The crest is more extensive than any other cockatoo and consists of long narrow feathers which curve backwards over the head. Unlike other black cockatoo species the cere is feathered and unlike all other cockatoos the thighs are bare of feathers (Sindel, S & Lyn, R. 1989).

Palm Cockatoos are easily identified in the wild, as they are the only black cockatoo without a band across the tail (Sindel, S & Lyn, R. 1989).

Length is 49 -68 cm.

Adult Male: General color, both above and below black, feathers heavily coated with powder-down to give a bluish-grey appearance; forehead and lores black without powder-down; bare facial skin crimson; bare thighs bluish-grey; exposed gape red; tongue red with black tip; bill grey-black; iris dark brown; legs dark grey; weight 882-1040 g. (Forshaw, J. M. 2002)

Adult Female: Similar to male, but smaller and with appreciably smaller bill; weight 710-765 g. (Forshaw, J. M 2002).

Juveniles: Little or no bluish-grey suffusion to black plumage; feathers of abdomen, flanks and underwing-coverts finely margined and barred with pale yellow; becoming almost white on feathers of upper abdomen; shorter crest; smaller bill pale grey with contrasting white culmen; white instead of grey eye-ring (Forshaw, J, M. 2002).

Peters (1991) has noted that the upper mandible of the male Palm Cockatoo is longer than the female; however, the female's upper mandible is more curved than the males. The eyes of the male dip deeper into the naked red cheek patch than the eyes of the female do.

3.2 Distribution and habitat

The Palm Cockatoo is closely associated with monsoon rainforest, for the southern limits to its range on both coasts of Cape York Peninsula coincide roughly with the southern boundary of the rain forest. However, it is less dependant on the rainforest than other species such as the Eclectus Parrot *Eclectus roratus* (Forshaw. J, M. 2002). See figure 1 & 2 for habitat.



Figure 1: Tropical Woodland – Cape York Peninsula (Forshaw, J, M 2002)

This cockatoo inhabits the rainforest edges and adjacent eucalypt forest. It often moves considerable distances from the rainforest areas through the drier eucalypt forests bordering water courses in search for food. During the middle of the day they tend to retreat into the rain forest, presumably to shelter from the heat. (Forshaw, J, M. 2002).



Figure 2: Tropical Rainforest of Cape York Peninsula (Forshaw, J. M. 2002)

The Palm Cockatoo ranges through Cape York Peninsula, northernmost Queensland; and also occurs in New Guinea, and on the Aru Islands, Indonesia, see figure 3.

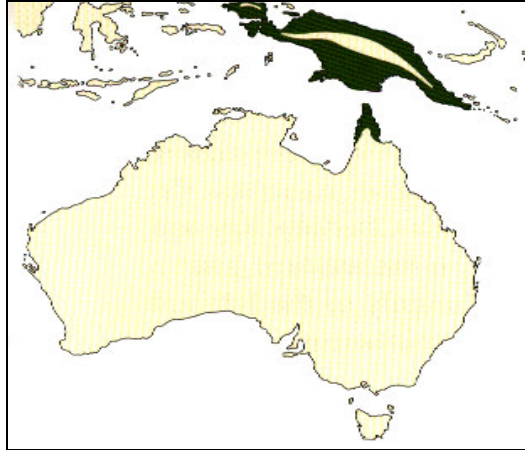


Figure 3: Distribution Map (Forshaw, J, M. 2002)

3.3 Longevity

3.3.1 Wild

The life span for the Palm Cockatoo in the wild is unknown. One would assume them to be long lived as with most species of cockatoo (pers. obs)

3.3.2 Captivity

The pair of Palm Cockatoos currently held at Adelaide Zoo were wild caught adults when they came into captivity. They were donated to Taronga Zoo in 1959; therefore they could be at least 50 years old.

3.3.3 Techniques to Determine the Age of Adults

There is no reliable technique available to determine the age of birds once they reach maturity and grow adult plumage. However Dr. Michael Pyne, associate veterinarian at CWS (pers. comm. 29.12.03) explained that the flattening of the papillae on the feet is an indication of advanced age in birds. Dr. Pyne also went on to mention that with the use of a laparoscope the scaring of the ovaries of a hen bird could give an indication of maturity.

There is also the technique of skull pneumatization for aging birds. However this technique is only available post mortem (Pyne.M. pers, com).

4. Housing Requirements:

4.1 Exhibit Design

For the physical and mental well being of these birds the cage size should allow adequate flight and recreation. Basically, only a large, roomy aviary of stable construction is suitable for the keeping of Palm Cockatoos (Taylor, M. 1998). Bob Lyn (1989) states that Palm Cockatoos' aviaries should be a minimum of 9.2 m long, 2.4m wide and 2.7 m high. Unsited to small cages, they become dull and listless if held in close confinement (Forshaw.J. 2002).

Twelve gauge wire is recommended to contain palm Cockatoos due to a report that a bird chewed through 14 gauge wire. A further safety precaution would be to double wire the aviary to ensure birds do not escape by chewing out of the exhibit (Taylor, M. 1998).

Figure 4a below shows the aviary at Currumbin Wildlife Sanctuary which was used to house their Palm Cockatoo, with figure 4b the floor plan.



Figure 4 a Aviary at CWS (Treby.D)

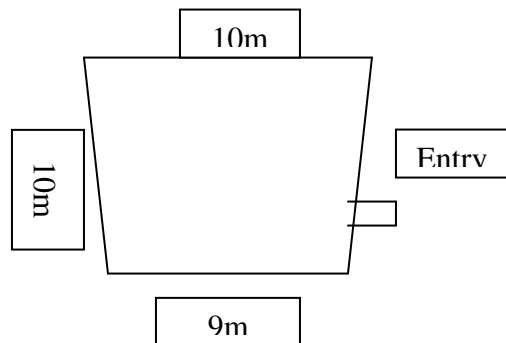


Figure: 4 b Plan of Currumbin Aviaries

4.2 Holding Area Design

The holding area design is of a very similar principle to the exhibit and only needs to be quite basic in its design.

4.3 Spatial Requirements

There are no specific requirements pertaining to Palm Cockatoos in captivity in Australia. See Appendix 2. for general standards.

4.4 Position of Enclosure

Aviaries in the southern hemisphere should ideally face north or at least have one side facing north so as to provide maximum sunlight (Sindel & Lyn 1989).

4.5 Weather Protection

Palm Cockatoos should be housed in a warm, humid environment, with a temperature variation not exceeding 10-20° C. The birds will not tolerate exposure to cold, windy weather, so adequate shelter against such conditions must be provided. In arid, hot climates, provision of a fine water spray is recommended (Forshaw.J. 2002).

4.6 Heating Requirements

Mike Taylor (1998) advises that an indoor heated area must be provided in locations where the ambient temperatures go below freezing for more than a day or two. Wind breaks and heat lamps may provide adequate protection for birds located in areas which experience freezing weather for less than a 24 hr period.

4.7 Substrate

Palm Cockatoos have been housed and bred successfully in enclosures with cement and natural substrate and also in suspended cages. They seem to enjoy utilizing the natural earth substrate when given the opportunity (Taylor.M. 1998).

Keith Collingridge (private aviculturist 07.01.04 pers.com) prefers to keep them on a blue stone road base with mesh underneath. This enables ease of cleaning and prevents rodents tunneling into the aviary.

4.8 Nest Boxes

If the cage is large enough, two boxes can be used. Rotterdam Zoo has had breeding from a pair with many nest boxes on offer. An example of the nest box used at Rotterdam Zoo can be seen with figure 5. A rectangular box situated on end is the generally accepted type. (fig.6) Both open top boxes and boxes with large entrance holes, such as 30cm diameter, are used. These types allow the birds to drop nesting material into the box, which is an important breeding behaviour. It is recommended that the nest box be between 1m to 1.3m deep. Any deeper may cause the birds to spend too much time filling the box with nesting material. Open top boxes, with a minimum of 60cm of clearance to the top of the cage, have been the most successful (Taylor.M 1998).

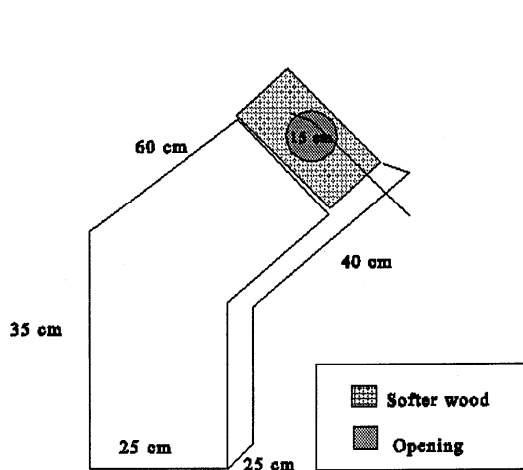


Figure: 5

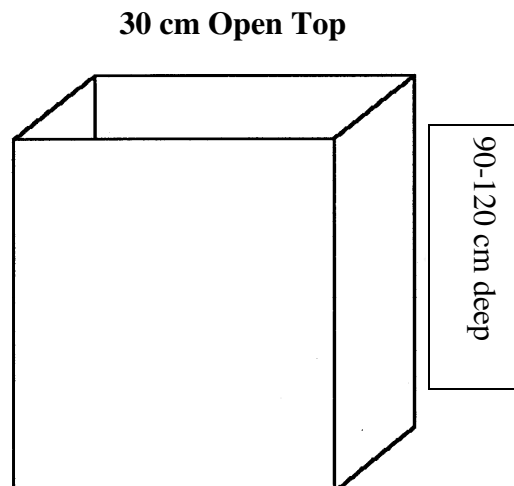


Figure: 6

Bob Lyn found that his Palm Cockatoos favored a natural looking irregular shaped vertical log about 1.5m high and 37-45cm internal diameter with a substantial perch located alongside the entrance of the log (see figure 7) Taronga Zoo also found that their pair of palms preferred a similar nesting log (Sindel, S & Lyn R. 1989).



Figure 7: Bob Lyn's nest log – Sindel & Lyn 1989

4.9 Enclosure Furnishings

Palm Cockatoos create their own nesting material from soft branches such as eucalyptus, bamboo, acacia and willow. The cockatoos will splinter the branches and take the pieces into the nest, as mentioned above (Taylor, M. 1998).

Perching is required at both ends of an aviary with additional perches of various sizes and diameters from 5cm- 10cm. The perches should be low enough so that the birds' crests do not touch the top of the enclosure, but kept generally to the upper part of the cage. Palm Cockatoos seem to spend more time on the higher perches when given a choice. One long perch to allow the male to strut and display should be positioned in the aviary away from human disturbance. A post on end in the ground is also enjoyed by these birds. (Taylor,M. 1998).

5. GENERAL HUSBANDRY:

5.1 Hygiene and Cleaning

Palm Cockatoos are best maintained by high standards of daily care.

- Food and water bowls should be cleaned and disinfected daily with a high quality product such as 'Avisafe'. (See Appendix 1).
- Daily removal of fecal matter, food scraps, old browse and feather molt.
- If a bird permanently leaves an enclosure, the aviary should be scrubbed and disinfected with 'Avisafe' before a new bird goes in.

5.2 Record Keeping

Birds should be checked daily and the following records kept:

- Identification numbers
- Veterinary examinations conducted
- Treatments provided
- Body condition (physical appearance) or behavioural changes.
- Reproductive, stage, condition and behaviour
- Behavioural problems
- Weights and measurements
- Changes in diet
- Movements of individuals between enclosures or institutions
- Hatchings and deaths

5.3 Methods of Identification

Permanent individual identification is crucial for keeping track of inventory and maintaining accurate health and genealogy records.

Closed leg bands should be used for captive hatched chicks. The bands should be stainless steel instead of aluminum as a Palm Cockatoo is capable of crushing an aluminum band. Open leg bands are not recommended as they have been known to catch on the side of the cage causing injuries and deaths (Taylor, M. 1998).

The Australian Bat and Bird Banding Scheme (ABBBS) recommends that for female Palm Cockatoos a number 33 or ABBBS size 22 (13.0 mm) be used, and for males a number 34 or ABBBS size 12 (14.0 mm) band. (www.deh.gov.au/index.html downloaded 02.01.04).

Microchips (Trovan, Microchips Australia See Appendix 1) inserted in the left pectoral muscle is another means of permanent identification. They do require that the bird be caught to confirm identification with a microchip scanner. .

Tattooing on the underside of the wing can be used, but is not useful for long range identification.

Visual identification can be of limited use. Only keepers who know their individual birds well will be able to reliably use this method.

5.4 Routine Data Collection

Whenever an occasion arises for collection of data for long term record keeping, every opportunity should be taken to collect bloods for biochemistry and measurements for growth and development.

6. FEEDING:

6.1 Wild Diet

Palm Cockatoos feed on fruits, nuts, berries, seeds, leaf buds and probably insects and their larvae (Sindel S & Lyn. R 1998; Forshaw.J, M. 2002). Wood (1988) reports that , birds were seen feeding on the seed of Indian almond *Terminalia catappa*, while other important food items were *Pandanus* (fig8) and *Parinari nonda* fruits, seeds of *Grevillea glauca* and *Canarian australis*.



Figure 8: Pandanus Palm Fruit – D Treby

A field study conducted by Barker and Vestjens (1998) examined the crop contents of Palm Cockatoo's and came up with the following information.

Plant Material	Seeds Fruits Berries
Monocotyledons	
Pandanaceae	
<i>Pandanus sp.</i>	Fruit
Dicotyledons	
Rosaceae	
<i>Parinari nonda</i>	

6.2 Captive Diet

Currumbin Wildlife Sanctuary

'Large Parrot' seed mix

*Breeding greens

Almonds

Fruit

Vegetables

Native Nuts *Allocasuarina*, *Pandanus*

Sunflower Seed

Occasional course meat mix (kangaroo meat rolled in "Vetafarm" Insectivore Mix)

Eucalypt Branches for chewing

Cuttlebone

Mineralized grit

*Breeding greens – Chopped spinach, lettuce, endive, broccoli, sprouted seeds, peas, corn and carrot.

Taronga Zoo

300g mix of soaked mung beans, sunflower, sorghum, wheat, with apple pieces and finely chopped green food (spinach, silver beet and endive) topped with a variety of fruits (pawpaw, kiwi fruit, grapes, pear and banana), supplemented with fresh corn and a selection of mixed nuts.

* This is the diet that the Palm Cockatoos were bred on in the 1970's

Denver Zoo

Diet is for 2 birds

1/3 cup Sunflower Seed Mix

3/4 cup Safflower mix

1/2 cup Scenic Jungle Pellets

1/2 cup chopped assorted fruits

1/4 pomegranate

2 Purina monkey chow biscuits

1tbspn pinion nuts when in season

mixed nuts

* These birds have bred successfully on this diet.

Jurong Birdpark

* Birds are fed twice per day

Soft and hard fruits

Raw vegetables

Sunflower seed mixed with groundnuts

* These birds have successfully bred on this diet.

ARBC Palm Cockatoo Diet, % Contribution to Total Diet by Weight.

1.0% Nuts: Peanuts, brazil nuts, hazel nuts

16.5% Fruit and Vegetables: Oranges, apples, grapes, sweet potatoes, carrots, beets, broccoli, kale

33.0% Seed Mixture: Sunflower seeds (70%), nutritionally complete manufactured diet (15%), dehydrated whole corn (10%), cuttlebone (5%)

33.0% nutritionally complete manufactured diet containing: 18.0% crude protein Kaytee Rainbow chunky breeder pellets 7.0% Crude fat

12.0% Moisture

6.0% Ash

5.0% Crude fiber

6.3 Supplements

Generally multi vitamin/ mineral/amino acid supplements are not necessary. However if the birds are sick, adding a supplement may be warranted (Taylor. M 1998).

6.4 Presentation of Food

Palm cockatoos are primarily arboreal feeders, so food should be placed in a high position within the aviary (Forshaw.J,M. 2002).

Currumbin Wildlife Sanctuary (CWS) always offers large parrot species their food in heavy ceramic bowls to prevent tipping and chewing (pers. obs.)

Feed stations should always be located under shelter in an area that creates the least disturbance to the birds. Palm Cockatoos do not like going into a box-like feeder, but have accepted food bowls being placed inside a wire basket. Birds reach through a hole in the top of the basket to feed, but are unable to tip the bowl. This could be adapted to a water bowl as well see figure 9 (Taylor, M. 1998).

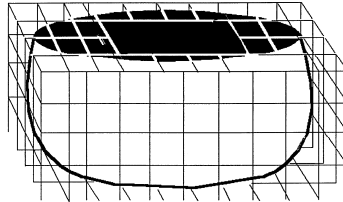


Figure 9: (Taylor, M. 1998).

Water can be provided in a variety of ways, from a standard water dish to a free flowing pond. (Taylor, M.1998).

7. HANDLING AND TRANSPORT:

7.1 Timing of Capture and Handling

The catching, handling and transportation of birds are stressful events that can easily result in injury or death if not undertaken with care. The following basic rules should be adhered to:

- Always catch early in the morning {especially in summer} if possible. This avoids heat stress and public spectators.
- Ensure enough staff is available to complete the procedure quickly and effectively.
- Ensure that all equipment required for the procedure is present.

7.2 Catching Bags

Large sturdy portable pet packs are used for transporting birds (pers. obs.).

7.3 Capture and Restraint Techniques

The recommended capture method is by netting, toweling or a combination of both. Palm Cockatoos should be handled the same as other psittacines, see figure 10. Some birds may have prolonged effects from being caught. After they are released back into

their aviary they may show signs of being depressed: crest lowered tightly to their head, not moving about, being very quiet, and their cheek patches stay pale in color. After a time, normal behaviour returns.(Taylor, M. 1998).



Figure 10: Walraven. E. 1990

7.4 Weighing and Examination

Large parrot species are generally best weighed by wrapping them snugly in a bath towel, then subtracting the weight of the towel to give the birds weight. Restraining parrots for quick examinations can be done by hand as seen in figure 10. However for a more detailed examination an anesthetic is recommended to prevent undue stress (pers.obs.)

7.5 Release

Place pet pack on the ground, facing away from handler and door ways. Open the door and allow the bird to exit in its own time (pers. obs)

7.6 Transport Requirements

IATA Container Requirement 11D (Figure 11)

The AZA feels that many of the specifications are inappropriate for Palm Cockatoos and will make recommendations to IATA to modify these guidelines in the future. Below is a sketch of the shipping crate used by ABRC, (figure 12) all measurements are imperial. (Taylor, M. 1998)

For full details on box construction see Appendix 3.

7.6.1 Box Design

The transport box design is as per IATA specifications.(figure 11.)

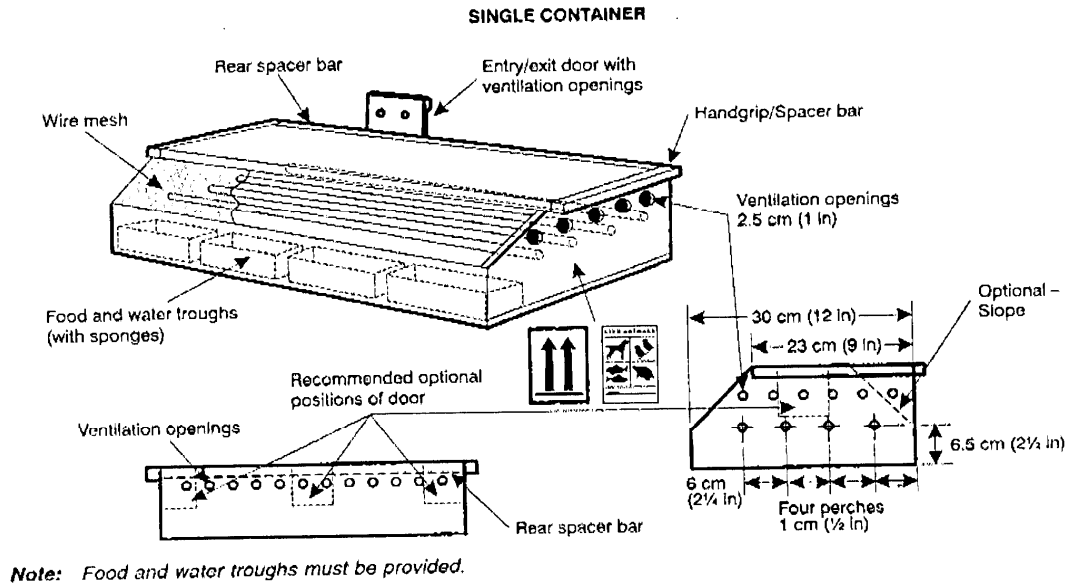
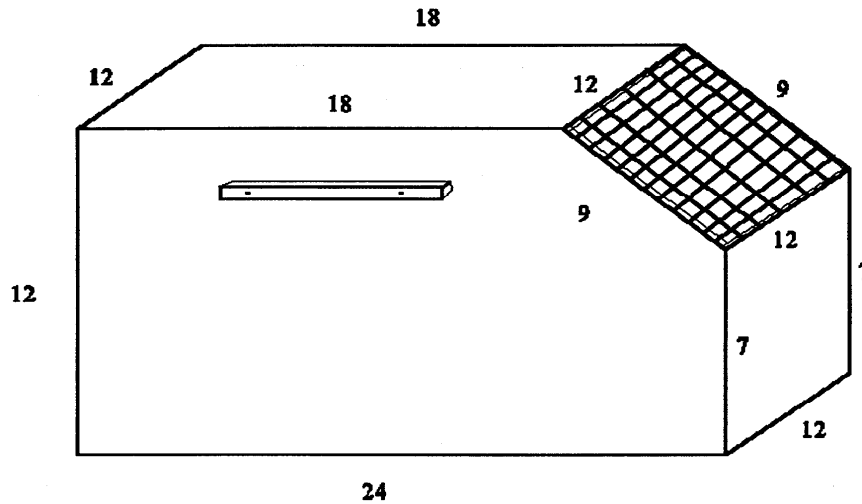


Figure 11: IATA Container Requirement 43



Shipping Crate used by ABRC

Figure 12: (Taylor,M 1998)

7.6.2 Furnishing

Some type of bedding material, such as straw or wood shavings, should be provided to prevent the birds from slipping on the floor. A secure perch bolted to the sides of the container (Taylor. M 1998).

7.6.3 Water and Food

ABRC suggest providing some fresh fruit or nuts for shipment (Taylor. M. 1998). Water is unnecessary and not recommended for continental flights within Australia.

7.6.4 Animals per Box

It is preferable with parrots to transport them individually as they do have a tendency to show aggression towards each other from fear when confined (pers. obs).

7.6.5 Timing of Transportation

Whenever possible shipments should be carried out to ensure that the animals arrive at their destination as quickly and smoothly as possible. During the hotter months, transportation should be overnight or morning during the cooler months.

7.6.6 Release from the Box

Place transport box in new enclosure, open it and allow the Palm Cockatoo to exit the box in its own time. Remove the box from the enclosure.

8. HEALTH REQUIREMENTS.

8.1 Daily Health Checks

Observations are generally undertaken during cleaning and feeding each morning and include:

- All limbs appear to be moving freely.
- Feeding well.
- Eyes clear and fully open.
- General appearance – body condition and condition of feathers.
- Discharges – any nasal, ocular or cloacal discharges should be noted.
- Changes in behaviour.
- Consistency of fecal material – is it sloppy, not the normal color or contains blood.

8.2 Detailed Physical Examination

A detailed physical examination should be conducted at least once per year, while the bird is under anesthetic. The following should be included and recorded in the health check process, as defined by Jackson (2003):

- Weight – is recorded and compared to the previous weights recorded. Animals in captivity should be weighed at least monthly to gain an indication of trends in body weight.
- Body Temperature – normal
- Body condition
- Pulse rate
- Respiratory
- Feathers
- Limbs – Check claws, feet, legs and wings
- Eyes: should be clear, bright, alert, normal bilateral papillary light response, normal corneal reflex, and no discharge should be present.
- Nostrils: should be clean. If discharge is present then swab for pathogens
- Ears:
- Mouth:
- Abdominal palpation
- Vent
- Blood sampling

See Appendix 4, for Blood Chemistry Values for Adult Palm Cockatoos.

The most commonly used avian anesthetic is Isoflourane, this is very short acting and birds will recover within minutes. Induction is via mask at 5% initially and reducing to 2% for maintenance. A new anesthetic, Servoflourane which is slightly safer and shorter acting and will become more common with time (Dr. M. Pyne Associate Veterinarian CWS pers, com.,. 02.01.04).

Taylor (1998) states that Palm cockatoos are sensitive to anesthetics from the Ketamine family of drugs. It has been reported that some European zoos feel that appropriate dose is approximately ½ the normal dose of Ketamine.

8.3 Routine Treatments

Regular fecal checks minimum of every 3 months. If positive treatment orally with moxydectin/praziquantel mix at 0.2 - 0.4 mg/kg (Nicolson, V. Senior Veterinarian Currumbin Wildlife Sanctuary. pers. comm., 11.02.04).

8.4 Known Health Problems

Below is a list of disease's which are most commonly encountered. All information is obtained from Seymour.J. (2000) except where indicated.

Aspergillus sp.

Cause – Inhalation of spores

Signs – Anorexia, polydipsia, abnormal respiratory sounds

Treatment – amphotericium B and 5 – fluorocytosin (5FC) or itracorazole and clotrimazole. Particularly the latter two in combination, are efficacious in the treatment of known cases of aspergilliosis.

Prevention – Non stressful environment

Gram negative gastroenteritis

Cause – Poor hygiene, bites from cats and rats

Signs – Diarrhea, depression, anorexia, polydipsia, conjunctivitis

Treatment – Wound care, Broad Spectrum antibiotics. Doxycycline 75 – 100 mg/kg IM every 2nd day over a period of 6 – 8 days

Prevention – Good hygiene and security

Sarcocystosis

Cause – Protozoan contamination from the feaces of carnivores

Signs – asymptomatic – Dyspnea and lethargy

Treatment – Trimethoprim, sulfadiazine 60 mg/kg (combined constituents) bid 3 days on, 2 days off, 3 days on

Prevention - Good hygiene and security.

Chlamydia

Cause – Respiratory infection. Faecal contamination is also possible

Signs – Dyspnea, depression

Treatment – Enrofloxan 10 mg/kg
Doxycycline 75mg/kg IM, in pectorals 9 injections with 5 day intervals.
Chloretracycline (CTC) 10 mg/kg daily over 45 days.
Supportive therapy with multivitamins is indicative.

Prevention - Good hygiene

Circovirus

Cause – Via contact with infected birds.

Signs – Tail and flight feathers missing, barring of feathers and beak deformities

Treatment – None. Vaccine is still in the trial stages

Prevention – In the captive situation, the removal of eggs from the parents for artificial incubation will reduce the incidence of transferal to the chicks.

***Avian Malaria plasmodium spp.**

Cause – Transmission via mosquitoes

Signs – Anorexia, depression, vomiting and dyspnea for a few hours or days before death.

Treatment – *Quinacrine (psittaforms) oral 0.5 mg/kg BID - * has a low therapeutic index.

Prevention – Prevention of mosquito breeding where possible

* Ritchie. B.W *et al* (1994).

Bumblefoot

Cause – overweight, inactive birds. Poor perching.

Signs – Swelling and lesions of the plantar region of the foot

Treatment – Antibiotics 7 – 10 days if infection is noted

Prevention – Balanced diet, perches of different sizes, weight reduction.

Zinc Toxicosis

Cause – newly manufactured galvanized wire.

Signs - Weight loss, anemia, regurgitation, polydipsia,³ polyuria,⁴ hyperglycemia, ⁵ataxia, convulsions.

Treatment – D – Penicillamine (PA) 55 mg/kg PO twice daily for 10 days. In severe cases Dimeracapol (BAL) 2.5 kg/mg IM every 4 hours for 2 days followed by twice daily administration until clinical signs are resolved.

Prevention – Wash galvanized wire with a neutralizing solution such as vinegar. Coat wire with appropriate paint

Trauma

Cause - Self inflicted, injury from other cage mates, misadventure

Signs – Wounds or injury to body parts or extremities

Treatment – As per standard trauma procedures

Prevention – Remove aggressive cage mates. Remove cage furnishings that can cause injuries.

8.5 Quarantine Requirements

The standard 45 days for psittacines would seem sufficient.(Dr. M. Payne. pers.com 03.01.04). However, at ABRC they quarantine their new arrivals for 90 days (Taylor.M 1998).

9. BEHAVIOUR:

9.1 Habits

Palm Cockatoos have a complex system of calls, displays and other behaviours unique to the species. They incorporate these vocalizations, displays and behaviours into a rich complex vocabulary in order to communicate in their heavily forested environment and to maintain the social organization of their family groups and flocks(Taylor, M. 1998).

Forshaw (2002) observed that Palm Cockatoos roosted singly in the topmost branches of tall trees standing at or near the edge of the rainforest. The birds did not stir until well after sunrise. Before leaving the tree, each cockatoo spent some time preening. Wood (1988) also reports that in the same district he noted birds roosting separately, though in

the same tree. It was also noted at this site birds often came out to display trees before sunrise and were observed flying about on calm moonlit nights.

Wood (1998) goes on to inform of territorial behaviours he noted. On one occasion he approached a pair at a display site, which elicited foot stamping and raucous alarm calls. Birds will occasionally engage in drumming performances after such a disturbance. Birds disturbed at a display site will occasionally leave the area and return shortly after with others. Wood once noted, five birds returning with the resident pair. Palm Cockatoos may also retreat some distance, conceal themselves in thick foliage and use their cheek feathers to conceal their red cheek patches. This covering of the cheek patch has also been observed during cold winds or rain.

Forshaw (2002) describes one display observed many times at a congregating tree. Always it was accompanied by the disyllabic, whistle-like contact call. As the first note of the call was given, the bird adopted an upright stance with the crest half-raised, as shown in figure 13a. With emission of the shrill, drawn out second note, the cockatoo lunged forward, extended the wings and raised the crest and tail, adopting the posture pictured in figure 13b. This display was performed frequently two or three times in succession by different birds in the tree. Wood (1988) also recalls similar behaviour amongst birds congregating at a neutral site.

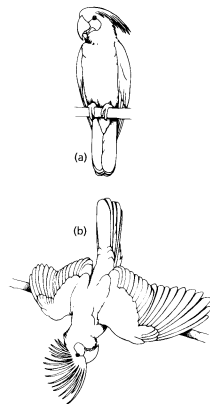


Figure:13 a,b (Forshaw 1969)

This same display has been captured by Roland Seitre in figure 14 below.



Figure: 14 (Seitre.R)

Palm Cockatoos are usually encountered singularly in pairs or in small groups, the last being more prevalent outside the breeding season, but occasionally larger flocks of up to 30 birds will congregate to feed. The scant information of social organization suggests that breeding pairs are territorial (Forshaw, J. M 2002)

9.2 Reproductive Behaviour

Reproductive behaviour as described by Murphy (2001) is as follows. The male landed on the limb of a large paperbark tree, and sat there whistling, wing spreading and stomping his left foot. Shortly after, a female arrived and the pair bowed their heads to one another, presented their brilliant scarlet cheek patches and synchronized their calls in an impressive courtship display. Within the next few minutes, several more males arrived in the area and all started trying to out-do one and other with more ear splitting calling. This was obviously too much for the resident male who promptly attempted to round up all his rivals. Once the intruders were seen off, the resident rejoined his female and got down to business again. Wood (1998), also describes this behaviour, however once the intruding males were driven off the resident male engaged in outstanding drumming performances. Murphy (2001) suspects that, for Palm Cockatoos, breeding involves an extremely long lead up time of complex courtship displays and never-ending vigilance for potential rivals.

In captivity the nesting behaviour of Palm Cockatoos is considerably different than that seen in other psittacines. They construct a nest of very small toothpick-size splinters from branches. These are placed in the nesting site by both the male and female. The depth of the nest may vary from a few centimeters to approximately 60cm. In captivity the birds should be provided with some type of non-toxic branches to construct a nest. Some cockatoos in captivity have reproduced without being supplied with branches for nesting material. These pairs were supplied with pine shavings as nesting material. It must be noted that allowing the Palm Cockatoos branches for nest making seems to be a very important aspect in the breeding of this species.(Taylor, M. 1998).

Peters (1991), notes that before the female lays her single egg, the male spends the preceding nights in the log. When incubation starts, both parents incubate, the female overnight from 5.p.m – 9. am. During the day the male incubates. The changeover is quick and takes only seconds, accompanied by some shrill whistles.

Wood (1988) notes that allopreening feature in courtship, with the female uttering soft calls similar to those given by chicks. With the upper mandible, male and female stroke each other's head and neck. Both birds also tilt their head sideways, and take each other's neck between their mandibles. Display involves outstretching of the wings, raising of the crest, and stomping of a foot, while a pair has been observed to stand opposite each other, throw open their wings and bow towards each other. Bowing, outspreading of the wings, raising of the crest, and foot stomping are features of courtship displays performed by captive pairs.

Copulation of the Palm Cockatoo in captivity has been observed to occur primarily in the morning after sunrise. However, breeding behaviour and copulation have also been observed during other periods of the day (Taylor, M.1998).

9.3 Bathing

Rain – bathing display has been seen in the early mornings of captive birds. The cockatoos hang inverted with outstretched wings and tail. This display can be provoked by the sight or sound of rain, sudden alteration in light intensity, as at dawn, or the covering of the sun by a dark cloud (Taylor, M.1998).

9.4 Behavioural Problems

Feather plucking has been noted in some birds in America as well as occasional aggression between pairs (Taylor. M. 1998).

9.5 Behaviour Enrichment

Branches can be given to the birds year round, but should at least be provided at the onset of the breeding season and at regular intervals until an egg is laid. The birds may become frustrated if there is a long periods when they do not have access to nesting material. In one instance, aggression to the female by the male was thought to be the result of this situation (Taylor.M. 1998).

Behavioural enrichment devices can be used as a means of food presentation. Fruit placed on spikes in high perches would mimic natural foraging techniques. Thick natural fiber ropes for perching or climbing on are also commonly used with all parrot species.

9.6 Introductions and Removals

Palm Cockatoos are generally peaceful birds. They can also be extremely social and territorial. Their rich vocabulary of displays and vocalizations are used to maintain social harmony and to exclude outsiders from their territories. In captivity, there have been numerous aggressive incidents with several being fatal. Most of these occurrences have been between recently introduced pairs: however, a few have occurred with established pairs, some of which had previously produced a chick. Great care should be used when introducing birds. A new bird should be housed in close proximity to the rest of the collection to give them sufficient time to learn the vocabulary before an introduction is attempted (Taylor, M. 1998).

Several methods have been used to introduce Palm Cockatoos: (Taylor, M. 1998).

- The male is introduced into the female's aviary to give her the home turf advantage.
- The male and female are placed in adjacent aviary's to get acquainted then placed together into either her aviary or into a neutral aviary.
- A trio, of either 1:2 or 2:1, can be placed into three adjacent aviaries with the single sex bird placed in the center, allowing it to choose a mate.
- Both birds are placed in a neutral aviary without an introduction period.

The following are a few guidelines also recommended by Taylor (1998).

- Caution should be taken with every introduction
- Following the introduction, the pair should be observed as much as possible.
- Do not introduce a female into a males aviary
- Do not introduce a young female to an older male without using ample caution and observation.
- If the female is repeatedly found on the floor of the enclosure, aggression from the male is probably the cause. One bird should be removed from the cage at this point. It is possible to try them together again at a later date, but close observation is needed due to the low probability of the pairing working out.

9.7 Interspecific Compatibility

During periods of aggression by male Palm Cockatoos at Rotterdam Zoo, separating the male from his mate and placing him in a smaller cage within the enclosure on several occasions has produced favorable results. Separation for only a few hours was successful in reducing the male's aggressive behaviour and did not interfere with incubation and chick rearing, which proceeded relatively uninterrupted (King, C.E 2000).

Similar measures have been taken with a Palm Cockatoo pair at Loro Parque Fundacion, although in this case the separation was in response to the aggression by the female, and the results were also positive (King, C.E 2000).

9.8 Intraspecific Compatibility

Due to the shy nature of this species, it is best to house pairs away from other psittacines, especially macaws, and to limit human disturbance. Even though one institution has successfully bred Palm Cockatoos in a mixed exhibit (see Table 1.), and another institution has bred them near other Palm cockatoos, the latter has found that some pairs start to reproduce only after being moved to private, more secluded aviarys (Taylor, M. 1998).

List of Species Housed with Palm Cockatoos.

Common Name:	Taxonomic Name:	Success= Y/N
Long-billed Corella	<i>Cacatua t .tenurostris</i>	Yes
Blue-eyed Cockatoos	<i>Cacatua ophthalmica</i>	Yes
Pheasant Pigeons	<i>Otidiphaps nobilis</i>	Yes
Plover	<i>Vanellus spp.</i>	Yes
Beach Stone Curlews	<i>Burhinus magnirostris</i>	Yes
Eclectus Parrots	<i>Eclectus roratus</i>	No
Yellow-tailed Black Cockatoos	<i>Calyptorhynchus f. funereus</i>	No

Table: 1 (Taylor,M 1998)

* It must be noted that when the Palm Cockatoos are raising chicks, the male became very aggressive and the other parrot species had to be removed.

10. BREEDING:

10.1 Mating System

Palm Cockatoos are monogamous and probably remain paired for life. In addition to territorial advertisements, the spectacular ‘drumming’ display probably functions in the formation and maintenance of pair-bonds (Forshaw. J.M. 2002).

10.2 Ease of Breeding

Forshaw (2002) points out that the Palm Cockatoo has proved to be one of the most difficult of all parrots to breed in captivity, with hand rearing of chicks being particularly beset by problems.

Egg breaking has been noted (Sindel S. & Lyn, R 1989, Taylor. M. 1998. Peters. R 1991) in many pairs.

Ellis *et al* (1996) have had success with cranes that break eggs by using unbreakable wooden dummy eggs. Once a pair had incubated and accepted the fake eggs, they went on to lay and incubate their own eggs without further breakage.

10.3 Techniques Used to Control Breeding

Techniques to control breeding are by separation of pairs, removal of eggs and culling.

At Rotterdam Zoo a pair of Palm Cockatoos showed no aggression towards their young, so it was left in with them. However, 4 weeks after removal of the offspring an egg was laid. This may have been coincidental, and there are plans to leave the chick with the adults for longer to gain further insight into the influence of the continued presence of young on reproductive behaviour of the parents and the suppression of breeding activity. (King, C.E. 2000).

Ellis *et al* (1996) states that cranes will stop producing eggs if eggs are added to the nest.

10.4 Occurrence of Hybrids

Hybridization has not been recorded. Apparently, the only reported mutation is of an albino bird acquired in Indonesia and sold by a dealer in Singapore (Sindel. S & Lyn, R 1989).

10.5 Timing of Breeding

Murphy (2001) notes that Palm Cockatoos are loosely seasonal breeders, with most egg laying occurring about August, but long nesting periods, coupled with renestings by pairs after failed attempts result in a protracted breeding season, and active nests have been found in all months of the year on Cape York Peninsula.

Taylor (1998) states that in the USA Palm Cockatoo's have reproduced in all months of the year in captivity.

10.6 Age at First Breeding and Last Breeding

Immature birds have a non-pigmented central ridge in the maxilla for up to two years of age. A Female Palm Cockatoo that was received with immature plumage, and white coloration in the maxilla, produced offspring after being at the Avicultural Breeding and Research Centre (USA) for five years, indicating that Palm Cockatoos can reach sexual maturity at about 7 – 8 years (Taylor. M 1998).

10.7 Ability to Breed Every Year

If the birds are rearing their own chick probably not. The weaning and fledging period is quite extended.

10.8 Ability to Breed More Than Once Per Year

If the young are lost or removed for fostering or incubation the birds will lay again (Forshaw.J.M 2002, Taylor M. 1998 & Murphy. S 2001).

10.9 Nest Requirements

See housing requirements 4.7

10.10 Breeding Diet

There seems to be no specific stimulus which consistently triggers the Palm Cockatoo to breed in captivity (Taylor, M. 1989). However, a diet slightly higher in protein would be expected during breeding.

10.11 Incubation Period

33 Days (Sindel. S. & Lyn. R. 1989)

10.12 Clutch Size

1 Egg layed per clutch (Sindel. S. & Lyn. R 1989 , Taylor.M 1998, Lim.D & Nyut, K.M. 2000)

Calculations For *P.aterrimus* Eggs

Measurements	n	Mean	Range
Fresh Egg Weight (gm)	27	26.22	23.44 - 29
Breadth (mm)	39	32.94	31.94 - 33.94
Length (mm)	39	46.66	42.57 - 48.75
Hatch Weight (gm)	38	17.9	16.1 – 19.7

Table 2: (Taylor M 1998)

n = the number of individuals in the sample population.

10.13 Age at Fledging

Approximately 70 days (Forshaw. J.M. 2002)

81 Days (Sindel. S. & Lyn. R 1989)

80 – 100 days (Taylor. M. 1998)

10.14 Age at Removal from Parents

6 months. (Sindel.S & Lyn. R.1989)

6 – 7 months (Taylor. M 1998)



Photo: Sindel & Lyn (1989)

10.15. Growth and Development

See Table 3

Physical Development and Growth Characteristics

AGE (in days)	CHARACTERISTICS
Hatch	No down feathers
Hatch	Ears open
14-18	Eyes open
21-118	Crest feather development
21-91	Down feather development (body)
21	Bright red facial color and blushing
21	Tips of mails turning black
25-154	Secondary feather development
25	Red skin pigment
28-61	Primary feather development
36-161	Tail feather development
40-50	Black pigmentary striations on beak
41-91	Flank down development
43-105	Skin developments black pigmentation
62	Tongue begins to turn grey
110	Toenails completely black
140	Tongue deep red with black tip
161	Total feather maturity
29 months	Beak completely black

Table 3: (Taylor, M. 1998)

11. ARTIFICIAL INCUBATION & REARING OF BIRDS:

Taylor (1998) states that institutions in the USA which have breeding Palm Cockatoos are using combined methods of natural and artificial incubation. The majority of Palm Cockatoo eggs are pulled from the breeding pair as soon as the egg is discovered. This is done because of the rarity of the species and the favorable results of incubating this species from day one. Whenever possible at the Avicultural Breeding and Research Centre (ABRC), the egg is left in the nest box for the first 14 – 20 days before being pulled for artificial incubation.

It appears that disease transmission to parrot chicks is lowered considerable by artificially incubating the eggs (Jordan, R. 1989).

Given that Palm Cockatoos do lay all year round, Jordan (1989) states, that this is a good reason why an artificial incubation program should be on line and ready to go at any time.

11.1 Incubator Type

San Diego Zoo use Grumbachs Incubator and AB New Life Hatchers. (Beutel, A. Team Area Lead. Avian Propagation Centre. San Diego Zoo. pers. com. 09.02.04) see Appendix 1

11.2 Incubation Temperatures and Humidity

The temperature setting for the incubators at ABRC is a dry bulb reading of 37.5° and a wet bulb reading of 28°C - 29°C, or 48% humidity. (Taylor.M. 1998)

Jurong Birdpark regulated their incubator temperature between 34°C - 36°C and humidity was maintained at 70% - 80% (Lim. D & Nyunt. K.M 2000).

11.3 Desired % Weight Loss

12.33 – 15.61% (Taylor. M. 1998)

11.4 Hatching Temperature and Humidity

Taylor (1998) recommends that the temperature in the hatcher should be lowered to between 36°C - 37°C , with the wet bulb increased to 33°C - 34°C to aid the hatching process. Newly hatched chicks are dry and the skin appears quite flakey. This apparent dryness of the chick implies that high humidity is required for successful incubation. This important factor must be taken into consideration when attempting artificial incubation of Palm Cockatoos. Several South African breeders experienced problems with prolonged hatchings from artificially incubated eggs. This may have been alleviated by raising incubator humidity to a higher level than that required for other cockatoos (Oldfield, M. 1997).

Oldfield (1997) notes that around the hatch time it is not uncommon to find large pieces of moist vegetation added to the nest with the egg and also with the newly hatched chick, and believes it is possible that this moist vegetation is used as an aid to increasing the humidity in the nest at this critical time.

11.5 Normal Pip to Hatch Interval

Palm Cockatoo eggs can be candled each morning and evening to monitor their development. Once the embryo progresses to the draw down stage of development it should be placed in the bottom of the incubator and no longer turned. This allows the embryo to position itself for internal pipping. The time period from internal pip to external pip is between 24 - 48 hours. The hatching time is between 49 – 72 hours. Palm cockatoos take longer to hatch than other psittacines. ABRC assists hatches only after 72 hours, or if they feel there is a problem with the chick. (Taylor. M. 1998).

11.6 Brooder Types / Design

San Diego Zoo use, AICU (Animal Intensive Care Unit). (Beutel. A. Pers. com. 09.02.04). See Appendix 1.

11.7 Brooder Temperatures

Parrot chicks require a temperature of about 36.1° C the first two or three days, which can then be gradually dropped to 32.2° C. over the next three weeks (Stodley, J & P 1983).

11.8 Diet and Feeding Routine

ABRC.

Monkey Chow Based Formula.

0.95 liter Zupreem monkey chow

0.95 liter water

112 cc Gerber Oatmeal & Banana Cereal

29 gm peanut butter

7 ice cubes (25 cc each)

7 gm calcium carbonate powder

Cook monkey chow and water in microwave for 8 minutes. Add other ingredients.

Blend thoroughly in blender.

First three days: dilute 25 cc formula with 8 cc of water.

Or

Palm Cockatoo formula developed by Ms. Dreama Skidmore of ABRC

43 gm macadamia nuts (raw and unsalted)

70 gm sunflower seed (raw, hulled, and unsalted)

42 gm. Whole wheat bread (high fiber/low cholesterol)

75 gm. raw carrot or yam

55 gm. raw broccoli

100gm. raw apple

300 cc water

Blend thoroughly in blender. Freeze into cubes for later use.

St. Catherine's Survival Centre.

Pretty Bird 19/12 hand rearing formula. (see appendix 1 for supplier). Mix as directed and add a small amount of peanut oil when the chicks start to feather.

Jurong Birdpark

Kaytee Exact™ handfeeding formula for baby birds was used for the first week of the chick's diet but was later replaced by Kaytee Exact™ handfeeding formula for macaws and Vetafarm™ Parrot Handrearing formula. Finely ground sunflower kernel and ground nuts were added to the diet to improve weight gains and skin texture.

Supplements like Vetafarms Probiotic™ and Spark™ (an electrolyte) products were included in the diet to aid in the chick's digestion and to provide an energy source.

Spirulina powder was added to enhance the chick's immune system while Nekton's MSA™ provided a source of calcium. Lactated Ringer's solution was also introduced in the diet when the chick started to show signs of digestion disorder after the first week. This product was highly recommended by the ABRC to ease crop emptying and for preventing dehydration. *The above products were used on a rotational basis depending on the chicks' digestion. See table 4 below. Syringe feeding is the most popular and easiest method of hand-feeding. Formula should be fed at 41.5° C. Catheter tipped syringes, with or without a soft rubber tip, can be used. Palm Cockatoo chicks also have a vigorous and eager feeding response (Taylor, M. 1998).

Table 4 Feeding Schedule for Palm Cockatoo Chicks. (Taylor.M. 1998)

AGE (Days)	ROOM TEMPERATURE	FEEDING SCHEDULE	COMMENTS
1	35°C	Begin with 0.2cc. Increase amount 0.2 cc at each feeding, until bird is receiving 1 cc per feed. Bird received 10 feeds on day 1. First feed at 5.00 a.m., last feed 9.00 p.m.	Example: 0.2cc,0.4cc,0.6cc,0.8cc Then 1cc at each feed for the rest of the day.
2	35°C	1cc at each feed. Bird receives 10 feeds per day 2. First feed 5.00 a.m. and last feed at 9.00 p.m.	
3	35°C	1.5 cc x 6 feeds. First feed at 5.00 a.m and last feed 9.00 p.m.	
4	35°C	2cc x 4 feeds. First feed at 6.00 a.m and last feed at 9.00 p.m.	
5 - 14	33° - 35°C	Continue to feed 4 / day. First feed at 6.00 a.m. and last feed at 9.00 p.m. Begin to increase amount fed daily. Increase total of 2cc / day divided by 4 feeds (0.5cc increments). If the bird is digesting well after several days on this schedule, this may be changed to an increase of 4 cc/day x 4 feeds /day	Example: Day 5: 2.5cc x 4 feeds Day5: 3cc x 4 feeds Day6: 3.5cc x 4 feeds Day 7: 4cc x 4 feeds Day8: 4.5cc x 4 feeds Day 9: 5cc x 4 feeds
15 (approx)	29.5° - 32°C	3 Feeds/ day. First feed 6.00 a.m and last feed 9.00 p.m. Begin to increase the amount from 1 – 5 cc daily divided between 3 feeds, according to the individual needs of the chick.	Example: Day 15: 7.5cc x 3 feeds Day16: 8.5cc x 3 feeds Day 17: 9.5cc x 3 feeds Day 18: 11cc x 3 feeds Day 19:12.5cc x 3 feeds Etc
30 (approx)	29.5° - 32°C	Begin to increase the amount from 1 – 5 cc daily x 3 feeds, according to the individual needs of the chick.	Formula should be fed at 36°C
50 - 60	27°C	Begin to offer solid food to encourage independent feeding. Feed x 2 / day. First feed at 6.00 am and last feed at 4.00pm	Make fresh formula, or defrost cubes, for each feeding. Do not reuse or reheat formula.
100-120	27°C	1 feed/ day at 6.00 a.m	

11.9 Specific Requirements

Care and husbandry of the Palm Cockatoo chick in the nursery is similar to that of other cockatoo species. Plastic bowls, tubs, and wire cages are used for housing, depending on the age of the chicks. Paper towels, rubber mesh, pelleted bedding and wire have all been used as flooring substrates. Brooders of several varieties, including human isolettes, have been used. Cleaning and disinfection procedures are the same as those used for other psittacines (Taylor. M. 1998).

Due to the lack of first down and the length of time for feather growth in Palm Cockatoo chicks, it is important to keep them in a warm environment longer than other cockatoo species. Temperatures at day one begin at 35°C - 37°C and are gradually decreased as the chick grows. They are best kept in brooders or warm rooms until they are fully feathered. Digestion and skin color may be directly related to environmental temperature (Taylor. M 1998).

The most frequently observed manifestation of illness in the Palm Cockatoo chick is failure to digest. Palm Cockatoo chicks are most vulnerable to digestive problems a few days after hatch, at around two months of age, and at weaning. Always assess brooder temperature and intervals of feeding. Problems related to temperature of the environment, formula temperature, feeding amounts, and intervals between feeding are the most common cause of digestive disorders. Cultures should be taken, though bacterial infections are not always the cause (Taylor. M 1998).

According to a survey conducted by the ABRC, young Palm Cockatoos were found to be susceptible to a fungal strand *Candida albicans*. This strand of fungus was stated to be one of the more probable causes of high mortality encountered in handreared captive Palm Cockatoos. Jurong Birdpark made sure that the oral cavity of the chick was thoroughly cleaned with cotton buds soaked in Betadine solution after each feeding to prevent any bacterial and / or fungal growth in the mouth (Lim, D & Nyunt, K.M. 2000).

11.10 Pinioning Requirements

Not Applicable to Psittaforms.

11.11 Identification Methods

Chicks should be housed individually or by clutch until banded. An alternative is application of a soft tape ID bracelet around the leg: rapid growth will require frequent adjustment and inspection (Stooder, J & P. 1983). Closed bands can be applied at 10 – 14 days.

11.12 Hygiene

Hygiene is most important, as chicks are lost through lack of proper cleanliness. All containers and feeding utensils must be thoroughly washed and sterilized in an appropriate solution such as Milton (Stoodly, J & P. 1983).

11.13 Behavioural Considerations

Palm Cockatoo chicks have unique characteristics. They start foot stomping from as early as two weeks. Head shaking, often considered a serious problem, is actually quite normal in development. When approached with food, Palm Cockatoos are quite vocal, attempting to pump on anything available. Facial color is quite variable within the first few weeks, though a strong facial flush is typical. Pale facial color, sleepiness and constant crying are behaviours that may be associated with illness (Taylor. M. 1998).

11.14 Use of Foster Species

African Grey parrot *Psittacus erithacus* and Eclectus Parrots *Eclectus roratus* have been successfully used in zoos in the USA (Taylor, M. 1998). King (2000) states the domestic pigeons *Columbia livia* have been used successfully for incubation periods with Palm Cockatoos.

11.15 Weaning

There is no hard, set rule regarding weaning times. Each bird should be treated as an individual. Careful weight monitoring is critical at this period; care must be taken to ensure that the bird does not become malnourished due to low caloric intake. Some chicks will wean completely at five months but others may take up to nine months (Taylor.M. 1998).

11.16 Rehabilitation Procedures

‘Oscar’ the Palm Cockatoo was a confiscated bird from the Cairns region. He came to CWS in early 1995 he was thought to be 15 years old at the time. On his arrival he was in a generally poor condition and malnourished, his conditioned was noted as being ‘an imprinted bird with physical and behavioural abnormalities’.

Allison Beutel (pers com., 05.02.04) who was a keeper at CWS at the time, states that when Oscar initially arrived at CWS he refused to perch and was only happy when allowed on the ground. He could not fly (pinioned) could not perch and ate a diet of dog food and sunflower seed; he actually slept with the family dog and knew no different. His feather quality was extremely poor and his cheek patches white. Allison spent many hours bonding with Oscar in an attempt to gain his confidence. Initially, Allison started introducing new food items to him such as fruit, vegetables and nuts to get his diet more balanced. It took many weeks but after taking food from the hand initially, he eventually

began to feed himself after nearly six months. Oscar was also supplemented with 20mls of Vetafarm Hand Rearing Mix daily to which peanut butter had been added.

Allison also attempted to teach Oscar how to perch, as he had always been on the ground his tars metatarsal joint was over extending, and he did not appear to be able to hold himself up while perching. Perches were placed all over the ground in his cage, so he had to use them. Oscar was also afraid of heights so extra care had to be taken that he would not fall. Allison goes on to say that he was perching some what near the end but was still not good at it so he was let to continue living on the ground, with the option to move onto a low perch if he wished.

Oscar initially had many physical problems. When he left CWS in 1999 most of these had been overcome. However, his behavioural problems from his early imprinting had shown little improvement (pers.obs.)



Oscar - D Treby

12. References:

1. Australian Bird and Bat Banding Scheme www.deh.gov.au/index.htm; Downloaded 02.01.2004
2. Barker, R. D & Vestjens, W. J. N 1989, *The Food of Australian Birds Non-passerines*, CSIRO, A.C.T
3. Birchall, A (1990). Who's a clever parrot, then? *New Scientist*, 24 February 1990. pp.26-31: Study Guide, Charles Sturt University, Wagga Wagga, NSW.
4. Codes of Practice of the Queensland Wildlife Parks Association <http://epa.qld.gov.au/publications?id=6f> Downloaded 07/01/04.
5. Ellis. H. D, Gee. G.F. & Mirande. C.M. (eds) 1996, *Cranes: Their Biology, Husbandry, and Conservation*. Hancock House Publishers. USA.
6. Forshaw, J M. (2002) *Australian Parrots* 3rd edn, rev. (ill.) W. T. Cooper. Alexander Editions Queensland Australia.
7. Garnet, S. T & Crowley, G. M. 1997. Report to the Queensland Department of Environment on the Feasibility of conducting field research on the Palm Cockatoo at Crater Mountain Wildlife Management Area in Papua New Guinea. Report to the Queensland Department of Environment, Cairns
8. General Standards for Exhibiting Animals in New South Wales: <http://www.agrie.nsw.gov.au/reader/ea-standards> Downloaded 07/01/04
9. IATA Live Animal Regulations 30th Edition October 1 2003 – September 30 2004.
10. Jackson, S. (2003) *Biology and management of captive Australian mammals..* CSIRO Publishing, Victoria, Australia

11. Jordan, R. (1989). *Parrot incubation procedures: A methodical guide to incubation, hatching, and problem hatches for the aviculturist*. Black Cockatoo Press: Prahan, Australia, pp 8-10, 17-20: Study Guide, Charles Sturt University, Wagga Wagga, NSW.
12. King, C. E. (2000) *Situation – dependant management of large parrots by manipulation of the social environment*. International Zoo Year Book (2000) 37: pp 238-244.
13. Lim, D & Nyunt, K.M (2000) ‘The Palm Cockatoo’ *Australian Birdkeeper Vol.13 issue 2 pp103 – 105*. Australian Birdkeeper Publications. Tweed Heads
14. Murphy, S. (2001) Filling in the Gaps ‘The Breeding Biology of Palm cockatoos on Cape York Peninsula’. *Psitta Scene Vol. 13. No:2*, pp 2-3.
15. Oldfield, M (1997). Productive Palm Cockatoos. *Australian Birdkeeper. Vol 10 Issue 9. June/July 1997 pp.450-452*. Australian Birdkeeper Publications. Tweed Heads
16. Peters, Dr. R. 1991, ‘The Palm Cockatoo’ in *Australian Birdkeeper Special Edition, pp 66-67* ed.N.Steele-Boyce, Australian Birdkeeper Publications, Tweed Heads.
17. Ritchie. B.W. *et al.* (1994) *Avian Medicine Principles and Application*, Wingers Publishers, Inc., Florida. USA.
18. Seymour. J. (2000) ed. *Avian Medicine*, Harcourt Publishers. London.
19. Sindel, S & Lyn, R (1989) *Australian Cockatoos – Experiences in the field and aviary*. Singil Press Pty Ltd. Australia

20. Stodley, J & P.(1993) *Parrot production*. Bezels Publications: Porstmouth, UK., pp.83-84,86-87,90,65,68,70: Study Guide, Charles Sturt University, Wagga Wagga, NSW.
21. Taylor, M (1998) ed. American Zoo and Aquarium Association's Palm Cockatoo Husbandry Manual. Caloosahatchee Aviary and Botanical Gardens and the International Aviculturists Society Florida USA.
22. Walraven, E. (1990) 'Taronga Zoo's Guide to the Care of Urban Wildlife' Allen & Unwin Sydney.
23. Wood, G.A (1984) Tool use by the Palm Cockatoo *Probosciger Aterrimus* during display, *Corella*, 8 (4):94-95.
24. Wood, G.A (1986) Further Field observations of the Palm cockatoo *Probosciger aterrimus* in the Cape York Peninsula, Queensland *Corella*, 12 (2):48-52

13. Bibliography:

D’Ombrains, E.A.,(1933) Notes on the Great Black Palm Cockatoo, *Emu*, 33:114-121

14. Glossary: ¹**Polydipsia** - Drinking too much
²**Dyspnea** – Difficulty breathing
³**Polyuria** - Passing excessive urine
⁴**Hyperglycemia** – High blood sugar
⁵**Ataxia** - Loss of co-ordination

15. APPENDIX 1.

List of Suppliers

‘Avi-safe’: Avian disinfectant. Halogenated Tertiary Amines: Avi – safe is non selective and is effective against bacteria, viruses and fungi.

Distributor:
“Vetafarm”
Bye Street
Wagga Wagga
NSW 2650
02-69256222

For a comprehensive list of Incubatores, Brooders and hand rearing formulas and DNA blood sexing contact Priam.

“Priam Psittaculture”
Unit 9/157 Gladstone Street
Fishwick
ACT 2609
Ph: 02-62804876
Email: psittaculture@priam.com.au

“Microchip Australia”
22 Fiveways Boulevard
Keysborough
VIC 3173
Ph: 03-97063100
Email: info@microchips.com.au

Australian Bird and Bat Banding Scheme
Environment Australia
GPO Box 8
Canberra 2601
ACT
Ph: 02: 62742407
Email: abbbs@ea.gov.au

APPENDIX 2.

Code of Practice of the Queensland Wildlife Parks Association

General Standards for Exhibiting Animals in New South Wales

APPENDIX 3.

IATA Travel Requirements.

APPENDIX 4.

Blood Biochemistry for Adult Palm Cockatoos