

## **CHAPTER 3**

### **ETHOGRAM FOR THE GLOSSY BLACK-COCKATOO**

#### **INTRODUCTION**

The purpose of this chapter is to record the available descriptive information on the glossy black-cockatoo's species-typical behavior. The background information and definitions it contains will lay the groundwork for the following chapters, as well as future studies of the species. Besides acting as reference sources, ethograms are useful for drawing attention to behaviors with unknown functions, and suggesting hypotheses for their functions. To this end, I compare the described behaviors with those of related species where possible. For each behavior I have tried to provide a sufficiently complete description to make the behavior easily recognizable to other observers. I have also included any available information on which individuals engaged in the behavior, when, how often, in what contexts, and how other individuals responded. See Chapter 1 for descriptions of the study site and methods.

The list of behaviors is organized into ten categories for more convenient reference. Although an ideal ethogram might categorize behaviors by their functions, many of these behaviors are not understood well enough to do that with any confidence. Instead, the categories are based on a pragmatic mixture of hypothesized function and

behavioral context. The labels for each behavior are capitalized wherever they appear, to indicate that a description is provided elsewhere.

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## **1. Postures**

### **1.1. Perch**

All parrots grasp their perch with a zygodactyl grip, the center two toes pointed forward and the outer two pointed back. The glossy black-cockatoos did not land on the ground except to drink, and in one case to tend a fledgling that could not fly. While Perching quietly the cockatoos sometimes stood on one leg and drew the other up against the body. They stood on the right leg more often than the left (20 vs. 3 observations, see Chapter 7). The cockatoos only Perched on one leg while standing on a branch with a small enough diameter to grasp firmly, and only when they were inactive for longer periods and relatively relaxed. They did not Perch on one leg while in Sleeping Position. A wide range of bird species sometimes stand on one leg, and this has been hypothesized to have the function of retaining heat or avoiding muscle fatigue (Clark 1973).

### **1.2. Open Wing**

Cockatoos in this posture held one wing several centimeters away from the body, but not open. They sometimes propped the leading edge of the open wing against a branch, to help stabilize themselves. This posture was only seen on hot days, and probably helped to dissipate body heat. It was most common among feeding birds, probably because the muscular exertion used to shred seed cones generates considerable heat. The right wing was held open more often than the left (16 vs. 2 observations), probably because the left foot was raised while feeding, obstructing the left wing (Chapter 7).

### **1.3. Sleeping Position**

Resting cockatoos turned the head back nearly 180 degrees over one wing and laid it between the folded wings. The eyes were usually partly or completely closed, and the bird appeared to be asleep. The crest was often partly raised while in this posture, which did not appear to indicate arousal in this context. The birds assumed the Sleeping Position while Roosting at night, and during longer resting periods during the day, usually while Perched in eucalypts. An alternative position used occasionally, especially by one individual, was to simply drop the head forward, again with the eyes partly or completely closed. Paired birds usually turned the head away from their mate while in Sleeping Position (23 of 31 observations, binomial test,  $p < 0.01$ ), perhaps to better coordinate predator vigilance. Females adopted the Sleeping Position more often during the day than did males (20 vs. 7 bouts) and their bouts were longer (mean of 6.3 vs. 4.0 minutes). This position is typical of sleeping birds in many species and orders. The congeneric short-billed white-tailed black-cockatoo, or Carnaby's cockatoo (*Calyptorhynchus funereus latirostris*), either adopts the Sleeping Position described above, or simply drops the head forward onto the breast (Saunders 1979a).

## **2. Locomotion**

### **2.1 Walk**

I use this term to refer to a gait in which an upright bird alternately advanced the feet past each other. This gait was less common than Sidling or Climbing. The cockatoos walked when they landed on the ground to Drink, or on a tree limb that was too thick to grasp (usually in a eucalypt). I have seen them walk on the ground in only two contexts; one was while Drinking, and the other was when a nestling fell from the nest before it could fly, and its parents landed on the ground to Allofeed and Allopreen it. The

other members of the *Calyptorhynchus* genus are less strictly arboreal than the glossy black-cockatoo, probably because of their more varied diets (Forshaw 1977).

## **2.2. Sidle**

In this gait the legs did not cross. Instead one foot is shifted sideways away from the other, the trailing foot is shifted to close the gap. This was the typical gait when a bird was moving along a branch that was small enough to grasp with the claws.

## **2.3. Climb**

The cockatoos often Climbed by using the bill as a third “limb” for grasping. This was the cockatoos’ predominant mode of locomotion in the drooping sheoak trees (*Allocasuarina verticillata*) they fed in, which had many small limbs close together. The cockatoos always grasped with the bill when Climbing from one branch to another, and often while moving along small unstable branches. They used the bill either to pull themselves up, or to help maintain balance. They usually grasped with the bill, but occasionally just rested their weight on the upper bill with the bill slightly open, especially if carrying a seed cone in the bill. Using the bill as a third limb while climbing is typical of parrots generally (Forshaw 1977).

## **2.4. Bill Grasp**

If a branch was out of reach of the feet, a cockatoo often grasped it with the bill to pull it close enough to reach with a foot. They use this method either to Climb onto the new branch, or to remove seed cones from it.

## **2.5. Flap Wings**

When cockatoos lost their balance while Climbing or Perching, they flapped their wings to regain balance without flying. They also Flapped Wings to regain their perch after they Hung Upside Down.

## **2.6. Hop Flight**

Flapping their wings while hopping from one branch to another enabled the cockatoos to cover distances too long to step across, but too short to develop the wing beat rhythm of normal flight.

## **2.7. Flight**

The cockatoos usually took off by launching themselves forward and down from a branch. They rarely soared except while descending, and usually flew within a few tens of meters of the ground. When traveling more than a few hundred meters, they often paused to Perch along the way if suitable trees were available.

# **3. Maintenance Behaviors**

## **3.1. Drink**

Glossy black-cockatoos drink by repeatedly scooping water up in the lower bill and then tipping the head back to swallow, as is characteristic of the cockatoo family (Low 1993, p. 25). They drank in late afternoon after feeding and before moving to the Roosting area, but on hot days they drank in both the morning and the afternoon. They used habitual sites at stream pools or man-made stock ponds with trees nearby for perching, but little ground cover. On several occasions after heavy rains, they gathered at

and drank from tree hollows instead of landing on the ground. While Drinking, the cockatoos were more vigilant and less tolerant of human observers than at other times. They drank in family or larger groups, and usually circled over the site several times before landing. After calling back and forth, one or two birds at a time flew to the ground a meter or two from the water and walked to it while the others Perched warily nearby. Cockatoos that had already Drunk waited nearby for the others before flying off together. Carnaby's cockatoos drink in a similar manner, including drinking in groups and showing noticeably heightened vigilance (Saunders 1979a).

### **3.2. Pant**

Panting birds held the bill open slightly, and small regular movements of the tongue were visible. Birds Panted while Perching inactively during very hot weather, often with the Open Wing posture. Panting apparently functions to lower body temperature through evaporation. Similar behavior has been reported in many other birds, including white cockatoos (Noske 1983) and Carnaby's cockatoos (Saunders 1979a).

### **3.3. Sneeze**

A Sneeze was a sudden expulsion of breath much like sneezing in other birds or mammals. A Sneeze often followed a Head shake.

### **3.4. Chew Non-food**

The cockatoos Chewed Non-food objects including pieces of dead wood, bark, or eucalyptus fruits. They almost never chewed live branches or leaves. They picked or bit the object off with the bill, then held it in the foot while chewing on it, in a similar

manner to feeding. The similarity extended to manipulating small pieces with the bill and tongue after biting them off. On several occasions individuals picked fruits from sugar gums (*Eucalyptus cladocalyx*), and appeared to extract and eat seeds from them. This activity was never sustained, though, and it occurred in the same contexts as chewing dead wood or bark. The cockatoos usually Chewed Non-food items in eucalypts, either in a quiet resting context, or mixed in with social interactions. The behavior was especially frequent when birds were waiting to be Allofed, or had just Allofed another individual.

In the congeneric Carnaby's cockatoo, chewing non-food objects is often associated with preening, but also occurs immediately after aggressive encounters, when the bird that has attacked chews the branch at its feet (Saunders 1979b). Chewing non-food items is also common in many other parrots, and apparently prevents excessive growth of the bill (Dilger 1960).

### **3.5. Wipe Bill**

Cockatoos occasionally wiped the bill against a branch after eating, alternating between the two sides. This behavior was not frequent, as it is in some bird species.

### **3.6. Grind Bill**

While Perched quietly, the cockatoos grind the upper and lower bill against each other in a sideways motion, producing a sound audible over short distances. Many cockatoos and other parrots grind their bills together, and this apparently functions to shape the end of the maxilla and sharpen the cutting edge of the mandible (Homburger & Ziswiler 1972, cited in Rowley 1990).

### **3.7. Autopreen**

Autopreening refers to preening the self as opposed to preening other individuals (Allopreening). The feathers were preened by nibbling and pulling them through the bill. The tongue was probably involved as well though this was difficult to see. The cockatoos engaged in this activity every day. It was most frequent during early morning before the birds left the Roosting area, and during mid-day breaks from feeding when they Perched in eucalypts. They also Autopreened after a rain, and especially after Foliage Bathing. Autopreening presumably functions to remove ectoparasites, clean and arrange the feathers, and spread oil from the uropygial gland over them.

### **3.8. Scratch Head**

To scratch their heads the cockatoos used the fully extended two front toes, lowering the head and reaching forward under the wing. Scratching was usually associated with Autopreening, and was usually followed with a Shake of the head. Scratching the head was not common as a displacement activity, as it is in the lorikeets (*Trichoglossus spp.*, Serpell 1989). Smith (1975) suggested that scratching by pulling the leg forward under the wing is typical of parrots that hold food in the foot, while scratching over the wing is typical of those that clamp food to the perch or feed directly with the bill.

### **3.9. Foliage Bathe**

Foliage Bathing appeared to be an active effort to get wet, particularly on the under surfaces where rainfall would not normally reach. When a rainfall first began the birds flew about from one eucalypt to another, landing on top of the foliage with wings spread instead of landing on a branch as they normally would. They flapped about on top of the foliage for several seconds before taking flight again. They Perched with the wings

held open, but did not Hang Upside Down in this context, as galahs do (Rowley 1990). Foliage Bathing was an excited social activity, usually occurring in an active group with much flying about and loud and distinctive calls. It was followed by bouts of Preening and Allopreening. It only occurred with the onset of a rainfall, and was most common after a long period without rain, especially during summer or early autumn. During winter when rain was frequent the birds did not Foliage Bathe with each rain. Rain bathing, either in wet foliage or by hanging upside down, is characteristic of the cockatoo family (Smith 1975, Forshaw 1977).

### **3.10. Shake**

There were separate movements for shaking the wings, the tail, and the head. A rapid Shake of the head was often associated with other maintenance activities, especially after a Scratch Head, or resuming activity after a long period of rest. The birds often Shook their wings and tail when they were wet after a heavy rain. Both wings were partly opened, and shaken simultaneously. The tail was Shaken from side to side, more slowly if wet and faster if dry. Cockatoos often Shook their tail on the wing immediately after taking off, especially after a period of inactivity.

### **3.11. Stretch**

Several forms of Stretching were common. In one, one wing and leg on the same side were extended downward, with the feathers spread on the extended wing and the tail. In another, both wings were lifted and brought together behind the back without opening them. The tail was also Stretched separately from the wings, with the tail feathers spread wide apart. All forms of Stretching occurred mainly after a long period of rest during the day, especially if the bird had been in Sleeping Position. Stretching usually preceded flight, and may function partly as a signal to coordinate the movements of family groups.

### 3.12. Roost

As darkness approached the cockatoos moved to tall eucalypts, first flying from branch to branch and then Climbing until they reached the small branches in the crown of the tree. They sometimes flew from one tree to another several times before finally settling for the night. Mated pairs always Perched In Contact while Roosting. The cockatoos rarely flew after sunset, even on a full moon, and did not respond even to loud noises while Roosting. Non-paired individuals shared roosting trees, but Roosted at least several meters apart. The cockatoos usually Roosted in traditional sites, particularly in winter when flocks were more cohesive. Family groups were more likely to disperse and Roost separately in summer. Nesting males roosted in or near the nest tree, while females spent the night in the nest hollow.

## 4. Feeding

The cockatoos fed only on seeds from closed cones of *Allocasuarina* trees, almost exclusively drooping sheoaks (*A. verticillata*) (Pepper 1993, Chapter 4). Glossy black-cockatoos are the only cockatoos with such a specialized diet (Forshaw 1977). Feeding behavior was very stereotyped and consistent. The cockatoos first Picked a cone with the bill and transferred it to the left foot (see Chapter 7 on foot preference). They sometimes carried it a few steps to a more stable perch before starting to work on it. They then Shredded the cone completely before Picking the next one. Cones that cockatoos dropped before completely Shredding them were usually malformed or showed signs of insect infestation (Chapter 4). Foraging behavior in this population was very similar to that described by Clout (1989) for *C. l. lathami* feeding on seeds of *Allocasuarina littoralis*. The separate components of feeding behavior are described in more detail below.

The cockatoos transferred the cone to the bill if they broke off feeding to Climb. They also occasionally carried a cone with them in the bill when they left a drooping

sheoak tree to Perch in a eucalypt. They usually picked all the cones within reach before Climbing a short distance to a new clump of cones. They fed in the same tree for hours at a time, and often return to favored trees on successive days. Especially during warmer weather the cockatoos avoided direct sunlight while feeding. They usually fed on the shaded rather than the sunny side of a ravine or valley, and adjusted their position within a tree to stay in the shade as the sun moved. There was a striking age difference in the efficiency with which individuals fed. Young dependent juveniles were incompetent at all feeding behaviors, despite their repeated attempts. Although they were able to feed themselves by the time they separated from their parents, they were still noticeably slower and clumsier. Two paired females that had little or no yellow on their heads and were probably in their second year were also slower and clumsier foragers than other individuals. See Chapter 4 for more details of feeding behavior and ecology.

#### **4.1. Pick Cone**

The birds picked drooping sheoak seed cones with the bill before transferring them to the foot. The cones are attached by short tough stems, and the cockatoos detached them by one of three methods. In the quickest method they cut the stem with one bite, and came away holding the cone by its stem. The other two methods involved twisting the cone until the stem broke. The first was used when the bird's head was oriented perpendicular to cone's long axis. The bird extended the bill and grasped the cone, then pulled back and down, rotating the cone around its axis. This was repeated until the stem broke, leaving the cone in the mouth. The second method was used when the cone was pointing towards the cockatoo with the stem behind it. The bird tilted its head to one side, grasped the cone, then tilted its head to the other side so that the stem was twisted. It repeated this procedure to twist the stem until it broke. The choice of

which technique to use may also have varied between individuals, but I did not investigate this.

#### **4.2. Shred Cone**

After Picking a cone the cockatoo transferred it to the left foot with the stem end up, bit off the stem, and began gouging out material. The front edge of the lower mandible was braced against the side of the cone, and the tip of the upper bill was repeatedly pressed into the cone near its central axis and pulled back. After several such gouges, the bird held the cone in its bill while shifting the foot so as to rotate the cone counter-clockwise. In this way the cone was gradually planed down in a spiral fashion, until the small distal end was dropped. Joseph (1983) reported that glossy black-cockatoos in some areas chew drooping sheoak cones starting from the distal end, but I did not observe this.

#### **4.3. Sort Seeds**

While Shredding cones the cockatoos paused at regular intervals and worked their mandibles and tongue, apparently separating seeds from pieces of shredded cone and splitting seeds to extract their contents.. During this process, which lasted about a second, the lower mandible was shifted to the left so that the right edge of the wider lower mandible was aligned with the right edge of the upper mandible. Small rapid movements of the tongue were occasionally visible inside the bill, and shredded cone material was ejected from the left side only (Chapter 7). According to Sindel & Lynn (1989), glossy black-cockatoos in aviaries bring the protrusion on the right side of the lower mandible in line with the point of the upper mandible in order to split the seed and extract the kernel.

#### **4.4. Beg**

Begging was most frequent in dependent juveniles. The juvenile approached a parent, crouched low with its head drawn in close to its body, looked up with its bill open, and gave repeated Begging Calls. The head was tilted back slightly with each call, and the feathers on top of the head pressed down, producing a distinctive profile with the top of the head looking flattened. Parents often regurgitated food for a Begging juvenile, but juveniles sometimes Begged for many minutes without being Allofed. Adult females also Begged from their mate, especially in the evening, but this was less frequent. Almost all (18 of 20) instances of Begging by paired females were accounted for by three individuals who had little yellow on the head, and were therefore presumably younger. Males did not Beg. Males responded by allofeeding more often and more quickly when their mate Begged than when their juvenile Begged. Carnaby's cockatoos beg in a similar manner (Saunders 1979a), while juveniles in some other parrots species also bob their heads or flap their wings (Smith 1975).

#### **4.5. Allofeed**

One cockatoo transferred food to another by regurgitating into its bill. The donor began with a Bob Head, apparently to bring food up from the crop, then reached toward the recipient with its bill. The recipient was usually crouched in the Begging position, so that the donor was above it. The two birds engage their bills while facing each other with heads tilted in opposite directions, and together pumped their heads up and down. There was no vocalization associated with Allofeeding, unlike in the Carnaby's cockatoo *Calyptorhynchus funereus latirostris* (Saunders 1974). Feedings lasted an average of eight seconds, and occurred in series of up to 10 (average of 4-5) regurgitations. Allofeeding peaked near midday, with a smaller peak in the evening just before the cockatoos went to Roost.

Allofeeding only occurred within families (mated pairs and their dependent juveniles), and typically involved males feeding their mate, females feeding their nestling, or a parents of either sex feeding their dependent juvenile. Females rarely Allofed their mate (this was observed only twice during 42 recorded observations and several times as many unrecorded observations). Males with nests returned each evening to Allofeed their mate, who in turn Allofed the nestling. After juveniles fledged they were Allofed by both parents. Juveniles Begged before being Allofed, but females usually did not (only 1 of 6 Allofeeding bouts during focal follows). When males Allofed their mate, they gave Allofeed Calls before, and Kwee-chuck Calls and Bow Displays before and after Allofeeding. In contrast, these behaviors were not associated with Allofeeding of juveniles.

In many bird species males allofeed their mates or prospective mates, and this behavior is usually limited to the context of courtship. However, some of the parrot species that Allofeed do so year round, and for this reason it is often hypothesized to function in establishing or maintaining pair bonds in parrots (e.g., Dilger 1960, Hardy 1963, Brockway 1964, Power 1967, Buckley 1968). In the glossy black-cockatoo, rates of Allofeeding within mated pairs did not vary seasonally. During focal follows pairs Allofed at an average rate of 0.12 during the breeding season, and 0.10 during the non-breeding season (N = 22 bird-seasons, Mann-Whitney U test,  $p = 0.32$ ). Both sexes Allofeed their mate in some parrot species (e.g., *Agapornis spp.*, Dilger 1960; orange-fronted parakeet, Hardy 1963; orange-chinned parakeet, Power 1967), but only the male does in others, including the Carnaby's cockatoo (Saunders 1979a).

#### **4.6. Take Cone**

In this behavior one bird approached another, reached out with the bill, and took a seed cone that the second bird was eating. This was usually directed by juveniles toward

their parents. Young juveniles have considerable difficulty both picking and shredding cones, and eating a cone that was already picked and partly shredded seemed to be much easier. Parents usually tolerated a dependent juvenile taking cones from them without resisting.

Four different paired females also took cones from their mates. Two of these only took one cone each during a combined total of more than 20 hours of feeding. The other two each took 10-15 cones from their mates over the course of several different observation sessions. A male was only observed to take a cone from his mate once, after his mate took several from him. Males' reactions to their mates taking cones varied from no resistance to attempts at evasion or retrieval, and an occasional tug-of-war. The paired females that regularly took cones from their mates both had little yellow on the head and were clumsy at feeding, suggesting they were only recently independent from their parents. Males are probably much older than females when they first pair, both because of the biased sex ratio and because males have a longer subadult stage (Courtney 1986). Older males paired with newly independent females might allow them to take cones from them as a way of investing in their mate through extended "parental" behavior.

## **5. Predator Responses**

The cockatoos' response to potential predators varied with whether the threat was avian or terrestrial, how many cockatoos were present, and how close the predator came. The cockatoos gave alarm calls and flew up from feeding trees to higher perches when they were disturbed by terrestrial animals (including researchers prior to habituation), but these reactions were relatively mild compared to those provoked by raptors, and never spread to more than a few cockatoos. If the offending animal was not clearly visible the cockatoos sometimes circled overhead for a better view. When a raptor (usually a wedge-tailed eagle, *Aquila audax*) came into view in the distance, the cockatoos usually stopped

feeding at least momentarily, cocked their heads for a better view, gave soft calls, and remained still. If the raptor approached closely, however, they gave loud Alarm Calls and all the cockatoos in the area flew up into an unusually tight flock that often circled, vocalizing loudly, for several minutes before landing. These flocks did not usually mob the predator or flee. Afterward they usually Perched for some time in a tall eucalypt with good visibility before returning to feeding or other activities. They also reacted with alarm to other large birds that apparently posed no threat, including white-bellied sea-eagles (*Haliaeetus leucogaster*), and white-faced herons (*Ardea novaehollandiae*).

## **6. Reproduction**

Because no observations were conducted inside nest hollows, I do not describe behaviors involved in nest hollow preparation, incubation, or brooding of young. In the glossy black-cockatoo only the female incubates and broods. This is true of all *Calyptorhynchus* species, as well as the sister genus *Probosciger*, in contrast to the other cockatoo genera in which incubation is shared by both sexes (Low 1993). Cockatoos in general have small clutches, but long incubation and fledging periods (Shepard 1989). Glossy black-cockatoos are an extreme in this regard, as they lay only a single egg.

### **6.1. Courtship**

I include this heading mainly to comment on the lack of any behaviors specific to the pre-copulation context. Allofeeding and Bow Displays tended to precede Copulation, but did not always, and occurred much more often in other contexts. Allopreening and Allofeeding might be considered to be “Courtship” behaviors if they help create or maintain pair bonds, but they were not restricted to pair formation or to the breeding season. The lack of conspicuous displays associated specifically with both pair formation and Copulation has also been noted in the Carnaby’s cockatoo (Saunders 1974), and is

characteristic of many parrots (Arndt 1986 p. 120), especially those species that are sexually monomorphic (Smith 1975).

## **6.2. Prospect For Nest**

Mated pairs started investigating potential nest hollows about a month before nesting began, and continued well into the nesting season. The male usually Perched nearby while the female repeatedly peered into the hollow, entered it for up to several minutes at a time, and Climbed in and out repeatedly. A pair often visited several different hollows in succession, suggesting they knew their locations in advance investigated them repeatedly, as Carnaby's cockatoos do. However, unlike Carnaby's cockatoos males did not display while their mate was investigating hollows (Saunders 1974). Unlike most black-cockatoos, glossy black-cockatoo pairs stayed year round in the vicinity of nest hollows they had used, but they did not visit them during the non-breeding season as galahs do (Rowley 1990).

## **6.3. Enter Hollow**

Unlike their closest relative, the red-tailed black cockatoo (*Calyptorhynchus magnificus*; Saunders et al. 1982), glossy black-cockatoo females entered nest hollows head first, not by backing into it. They often gave Nest Calls before entering. Males never entered nest hollows during 12 all-day nest watches of six nesting pairs, and many additional hours of nest observation.

## **6.4. Copulation**

At the start of a Copulation the male flew from beside the female and landed on her back. The female raised her tail and shifted it to one side, and the male tucked his tail

forward beneath hers. During the Copulation, the male moved his tail up and down rhythmically, holding his wings up behind his body and sometimes flapping them, apparently to help in balancing. There were no calls during the mating. Uninterrupted Copulations lasted an average of about 40 seconds, with a maximum duration of about a minute (N = 5), and ended with the male dismounting by flying. The behavior preceding copulations was not always observed, but in at least some cases the male Allofed the female and gave Bow Displays and Kwee-chuck Calls. Females did not adopt any conspicuous solicitation posture or behavior. At the end of a Copulation the male flew away a short distance, then returned to his mate. The pair then resumed normal activities, often including Allopreening. Males did not alternate move their tail to the other side of the female's tail during a copulation, as do Carnaby's cockatoos (Saunders 1979a), and some other parrot species (Smith 1975).

Copulation attempts were only observed within well established pair bonds. Most Copulations occurred in the evening, shortly before the pair went to Roost. This contrasts with a report by Connors & Connors (1988) that captive glossy black-cockatoos usually copulate in the morning. Many Copulation attempts by males failed when the female turned her head over her shoulder and fended off the male from landing or staying on her back.

Two of the five Copulations observed (involving two different pairs) were in November, near the middle of the non-breeding season. There is little evidence on whether other parrot species copulate outside the breeding season in the wild, because few field studies have been conducted in the non-breeding season. If pair bonds are important year round (Chapter 6), and copulations strengthen them, this might explain their occurrence outside of the breeding season (e.g., Sever & Mendelsohn 1988). This would be consistent with reports of copulations outside the breeding season in the noisy miner (*Manorina melanocephala*), a bird that maintains heterosexual bonds year-round

and cooperates against conspecifics in closed groups (reviewed by Oring 1982). This idea is speculative however, both because of the few observations of copulations in glossy black-cockatoos, and because a function for copulation in strengthening pair bonds has been suggested many times but never demonstrated (Hunter et al. 1993).

### **6.5. Fly-over**

In a Fly-over, a paired male flew from Perching near his mate to hover briefly over her back, sometimes touching open bills with her. These appeared to be Copulation intention movements, but were not followed by actual mounting. They may have been displays or tests of the female's receptivity, or attempted Copulations that were thwarted by the female's reaction.

### **6.6. Masturbate**

On three occasions unpaired males carried out the stereotypical postures and movements of Copulation while Perched on a branch instead of a female's back. This included flexing the tail forward beneath the branch, moving the tail rhythmically, and flapping the wings to maintain balance. Each observation involved an unaccompanied bird in early morning or late evening during the breeding season, and was comparable in duration to an actual Copulation, lasting between 25 seconds and one minute. Masturbation or "pseudo-copulation" has been reported in other parrots in captivity, including male peach-faced lovebirds (*Agapornis roseicollis*; Kavanau 1987 p. 831) and Fischer's lovebirds (*Agapornis fischeri*; Ficken & Dilger 1960), and both sexes in young spectacled parrotlets (*Forpus conspicillatus*, Garnetzke-Stollmann & Franck 1991). It has also been observed in the wild in Puerto Rican parrots (*Amazona vittata*, Snyder et al. 1987 p. 134). It has apparently been reported less frequently in other orders (e.g., Ficken

& Dilger 1960). My observations differed from most others in that Masturbating males had not just been thwarted in an attempted Copulation, and indeed had not recently interacted with any other individual. This behavior may be related to the population's highly male-biased sex ratio (Chapters 2, 5).

## **7. Affiliative Social Interaction**

### **7.1. Perch In Contact**

To Perch In Contact, two birds Perched side by side facing the same direction and in physical contact. This occurred only within mated pairs and their dependent juveniles. Juveniles made considerable efforts to Perch In Contact between their parents, even physically pushing in between them. Perching In Contact was frequent during quiet resting periods, and was always adopted by pairs and their young when Roosting at night. This behavior did not occur outside of pair bonds and nuclear families. Mated pairs spent an average of 8.9% of the time in contact when both were Perched and not foraging. This rate was lower during the breeding than the non-breeding season (7.3% vs. 10.9%,  $N = 1146$  focal time points,  $p < 0.05$ ).

### **7.2. Solicit Allopreen**

To Solicit Allopreening, one bird approached another to within reaching distance, Perched facing the same direction, and lowered its head. The recipient usually responded by Allopreening the soliciting individual, usually on the back of the neck. Soliciting Allopreening only occurred between mated birds, and between parents and their dependent young. It was not as common or prominent as in some parrot species, and most Allopreening bouts began without a conspicuous solicitation.

### 7.3. Allopreen

Allopreening consisted of one bird preening the feathers of another, either mutually or in only one direction. Allopreening bouts began either with a Solicit Allopreen, or when one bird simply approached another and began preening it. The behavior was only seen within mated pairs and their dependent young ( $N = 243$ ). Parents of both sexes Allopreened their juveniles, and juveniles tried to Allopreen their parents, but parents usually rebuffed them. Allopreening occurred year round, but was more common during the breeding season. Paired birds were Allopreening their mate during 1.0% of focal time points in the breeding season, but only 0.3% in the non-breeding season ( $N = 44$  bird-seasons, Mann-Whitney U test,  $p = 0.003$ ). Carnaby's cockatoos show similar patterns in the seasonality of Allopreening and in who participates, including parental rejection of juveniles' attempts to allopreen them. They differ, however, in that Allopreening between adults is restricted to the head and neck areas (Saunders 1974, 1979a).

To examine sex differences in Allopreening behavior, I used detailed observations from focal follows of eight mated pairs during the breeding season. Males of all eight mated pairs spent more time Allopreening their mate than vice versa, except for one tie (Wilcoxon  $Z = 2.37$ ,  $p = .018$ ). Averaged across pairs, males accounted for 66% of the Allopreening activity, or about twice as much as females. The individual that initiated an Allopreening bout within a pair was usually the male ( $70/78 = 90\%$ ). When bouts of one-way Allopreening progressed to mutual Allopreening, it was usually the male that initiated the bout and the female that reciprocated ( $40/48 = 83\%$ ). The first individual to break off a mutual bout was also usually the female ( $32/44 = 73\%$ ). This difference was not caused by females engaging in less preening generally, as females Autopreened more often than males (97 vs. 78 bouts in focal all-occurrence samples). In field observations

near the nest, male Carnaby's cockatoos allopreened females more than twice as often as the reverse (Saunders 1979a).

Allopreening is common in many bird species, but its functional significance has never been clearly established. Harrison (1965) suggested that allopreening in birds was an aggressive act that asserted dominance over other individuals (see also Potts 1977). However, most authors suggest that allopreening in parrots was involved in establishing or maintaining pair bonds (e.g., Saunders 1974, Rogers & McCulloch 1981, Serpell 1981, Rowley 1990). Allopreening in glossy black-cockatoos did not appear to be aggressive. Birds appeared relaxed while being Allopreened (e.g., crests not raised), and often assumed physically vulnerable positions. Allopreening was associated with affiliative interactions such as Perching In Contact, and was often mutual. Parents frequently Allopreened young juveniles, toward whom they were not aggressive. In the congeneric Carnaby's cockatoo, allopreening between mates was common in the field, but did not occur in aviaries where pairs were unable to separate. This also suggests that it functions in social bonding (Saunders 1979a). If so, it may be significant that parents do not allow juveniles to allopreen them. This suggest that Allopreening is more important to forming an attachment than being Allopreened is.

Several facts suggest that Allopreening in glossy black-cockatoos is also at least partly related to sexual contexts. As described above, males Allopreened more often than females, and at higher rates during the breeding than non-breeding season. (Saunders (1979a) reported the same pattern in the Carnaby's cockatoo). Females sometimes reacted with mild aggression to Allopreening by their mates, as they did to Kwee-chuck Calls and Bow Displays, which clearly occurred in sexual contexts. Male long-billed corellas (*Cacatua tenuirostris*) often allopreen females before copulating (Emison et al. 1994). However, a copulation-related function for allopreening cannot explain its persistence at substantial rates throughout the year in glossy black-cockatoos.

To examine whether Allopreening affected pair proximity, I examined focal follows that included bouts of Allopreening along with pair distance records during both the hour before the bout began and the hour after it ended. I only analyzed bouts for which the pair was engaged in the same activity (either foraging or Perching) both before and after Allopreening. For each one-hour period preceding or following a bout I averaged all pair distances (ranging from one to six time points). Mean pair distance did not change after versus before Allopreening (Wilcoxon matched-pairs signed ranks test,  $p > .05$ ,  $N = 15$  bouts involving seven pairs). To test for effects of Allopreening on orientation, I divided the data based on whether the pair was in a drooping sheoak or a eucalyptus tree, because orientation varied significantly between these two contexts. The proportion of time oriented toward the mate did not change significantly after Allopreening for either sex in either context. Although larger sample sizes would have been more definitive, this suggests that Allopreening does not have a strong short-term effect on the pair bond. However, this does not rule out a possible longer-term effect. Because pairs maintain their bonds at all times, but Allopreen only once or twice a day, any effects of Allopreening on the pair bond might well occur on a time scale longer than one hour.

## **8. Agonistic Social Interaction**

Severe aggression was quite rare, and no injuries were ever observed during agonistic interactions. The following behaviors are listed in order from least to most severe.

### **8.1. Spread Wing Display**

The wings were lifted and spread slightly, and the bird leaned forward as if about to take flight. The Grunt Call was usually produced simultaneously. This intention

movement sometimes succeeded in causing its target to retreat. If not, the displaying bird either gave up, continued giving Spread Wing Displays, or escalated to a Supplant by Flying. Wingspread Displays were given almost exclusively by males (32 of 33 observations). The single exception was a paired female that performed a Wingspread Display before lunging at her mate. This Display was usually directed at conspecifics, but also occasionally at other birds such as red wattle birds (*Anthochaera carunculata*) or ravens (*Corvus spp.*). This display was similar to the “Squawk Display 2” reported by Saunders (1974) in the Carnaby’s cockatoo.

## **8.2. Supplant**

A supplant occurred when one individual or pair moved toward another, forcing it to yield its perch. In a coordinated supplant, a mated pair moved toward the target together. Supplants were also directed at both solitary individuals and pairs perched close together. Supplants were rarely contested. Paired birds that were supplanted individually usually flew directly to their mate. Supplants occurred either by walking toward, flying toward, or directing a Spread Wing Display toward the targeted individual. These variations are described separately below.

Supplants were the most common form of aggression. During focal follows, paired birds were involved in supplants at an average rate of 0.06 per hour, or slightly less than once per day. This rate did not vary significantly either between the breeding and non-breeding season, or between the sexes (Mann-Whitney U test,  $N = 22$  focal follows,  $p > 0.05$  for each).

Many supplants in drooping sheoak trees appeared to be involved in the defense of feeding trees. This was also noted by Clout (1989) in *C. l. lathamii* feeding on *Allocasuarina littoralis* trees. In other cases males supplanted other males when they approached their mate, or when they gave Kwee-chuck Calls and Bow Displays. Other

supplants had no obvious provocation, but may have been involved in establishing or maintaining dominance relationships (Chapter 5).

### **8.3. Supplant by Spread Wing Display**

A Supplant by Spread Wing Display resulted when the target of the display took flight (11 of 38 focal observations of Spread Wing Displays). Juveniles and subadults were never observed to supplant by Spread Wing Display (0 of 31 supplants).

### **8.4. Supplant by Walking**

In a Supplant by walking one bird forced another to move away by walking slowly and deliberately toward it with the head lowered. Within mated pairs, if the targeted bird failed to yield its mate sometimes pushed it off the perch with its head. Supplanting By Walking appeared to be a much less escalated form of aggression within than between mated pairs.

### **8.5. Supplant by Flying**

In this form of supplanting, one bird flew directly to another's perch and landed there, forcing the second bird to take flight. This occurred most often in a feeding tree, or when a bird of the opposite sex Perched near the bird's mate. On rare occasions the targeted individual held its ground, whereupon the would-be supplanter hovered over it briefly, lunging and threatening. Such incidents usually escalated to further aggression. Most supplants (60%) were by flying.

## **8.6. Lunge**

In this display one bird opened its bill and Lunged toward another in an apparent attempt to bite. An actual bite was almost never delivered. The second bird usually moved away in response, but occasionally responded in kind, leading to Bill Fencing. Almost all (49 of 50) Lunges were between pair mates, where it was a mild form of aggression. It appeared to be a much more escalated threat between non pair-mates, usually leading to Bill Fencing or Grapple Fights.

Within mated pairs the lunge was almost always directed by the female toward the male (48 of 49 observations). Females often lunged at their mate when he directed Kwee-chuck Calls and Bow Displays toward them (21 of 48), or attempted to Allopreen them (13 of 48). Most of the remaining cases seemed to involve unwanted approaches by the male. Lunges were usually effective in interrupting the male's behavior at least temporarily.

## **8.7. Fence With Bill**

When one cockatoo Lunged at another and neither withdrew, the conflict escalated to Bill Fencing. Each bird maneuvered in an attempt to bite at the other's head without being bitten. Bill Fencing took a mild form within a mated pair. However, between unrelated birds it was an unusually severe level of aggression, accompanied by raised crests and loud harsh calls. Nearby cockatoos often approached Bill Fencing birds and called loudly.

## **8.8. Chase**

A chase usually began when a the aggressor in a Supplant by Flight continued flying in pursuit of the target instead of landing on its perch. This typically forced the

targeted bird to retreat farther than it would have otherwise. Males in ongoing conflicts also chased one another. In this context one bird, in an apparent attempt to drive the other out of the area, followed and attacked each time it tried to land, resulting in a prolonged chase. These Chases usually involved unpaired males apparently competing over an unpaired female.

### **8.9. Tandem Flight**

In this dramatic behavior pattern, observed only four times, one male flew above and behind another, remaining within a few meters of him. The two stayed aloft in continuous flight for long periods of time, at unusually high altitudes, without traveling in any consistent direction. The flight was uncharacteristically silent, with neither male calling. The leading bird occasionally swooped at the follower in an attempt to Strike With Wing. These long aggressive encounters give the impression of an endurance contest, because they continued for long periods with little physical contact. They differed from a Chase in that the participants did not fly particularly fast.

### **8.10. Strike With Wing**

A Strike With Wing occurred when one cockatoo swooped at another during a chase and hit it with its wing. The target bird was usually able to evade the swoop and avoid being struck, but I witnessed several impacts that were clearly audible from a considerable distance.

### **8.11. Grapple Fight**

On rare occasions two birds, always males, engaged in severe fights in which they grappled with their feet and bills. In one case two birds that had been engaged in Tandem

Flight grappled in mid-air. They were completely unable to fly, and dropped for many meters, disengaging shortly before they would have hit the ground. In another case two males grappled in a tree and fell through the branches for several meters to the ground, where they separated and took flight. Paired birds were almost always joined by their mate when they became involved in fights, and when severe fights break out other birds often become involved as well. If the fight was prolonged, a noisy “audience” of other birds also gathered around the combatants.

## **9. Non-agonistic Displays**

### **9.1. Raise Crest**

The crest is smaller in glossy black-cockatoos than other cockatoo species, but is still conspicuous when raised. Raising the crest occurred in a variety of contexts that seemed to involve excitement or alarm, including the presence of a potential predator, intense social interaction, and aggression. The crest can be erected to varying degrees, which appeared to indicate the level of arousal. An erectile crest used in displays of arousal is characteristic of the cockatoo family (Forshaw 1979).

### **9.2. Fluff Head**

In a Fluff Head all the head feathers were erected, making the head appear larger than usual and “fluffy”. This appeared to be a display, and often immediately followed Kwee-chuck Calls and associated Bow Displays. It was usually maintained for no more than about a second. In contrast to this glossy black-cockatoos, many New World parrots in the Psittacidae fluff the head feathers in agonistic contexts (Smith 1975).

### **9.3. Fan Face**

The generic name *Calyptorhynchus* (“hidden bill”) reflects the fact that members of this genus can fan their cheek feathers forward so that they cover the base of the bill. In contrast to the raised crest, this feather position was associated with a calm, inactive state, and may be maintained for long periods. The cockatoos typically assume this feather position while Perched quietly during mid-day breaks in activity. Although I have listed it along with the other feather positions, there was no evidence that it actually functioned as a display. Carnaby’s cockatoos also fan the face feathers forward when they are relaxed and inactive (Saunders 1979a), in contrast to galahs which fan the face feathers forward when they raise their crest (Rowley 1990).

### **9.4. Bow Display**

In this conspicuous display a male first raised his head briefly, then lowered it and raised and spread his tail. There was noticeable individual variation in Bow Displays, and some individuals begin the display with a small hop as they raise their head. A Fluff Head often immediately followed a Bow Display. Bow Displays were usually delivered in bouts, with one or more Kwee-chuck Calls between each bow. This display was very similar to the “Ah-Ah Display” of the Carnaby’s cockatoo (Saunders 1974). Neither females nor juveniles ever gave Bow Displays (N = 133 displays during focal follows). Paired males usually directed Bow Displays toward their mate. However, unpaired males often gave Bow Displays that did not appear directed towards a specific female, usually from a conspicuous perch. Males gave Bow Displays after winning a conflict or supplanting another bird, but not after losing an interaction. They also gave Bow Displays after being disturbed by human observers. There was generally no obvious reaction from other birds to Bow Displays.

Paired males did not normally display to females other than their mate, but one unusual observation suggests that the Bow Display's message is related to pairing. After displaying to his own mate several times, a male flew to a female whose mate was feeding in a different tree and directed a Bow Display toward her. Within three seconds the two females and the two males were each involved in agonistic encounters. The interactions ended quickly when the mate of the targeted female returned to the tree and supplanted the displaying male.

The Bow Display was similar to pre-copulatory displays given by other cockatoos, including male Carnaby's cockatoos (Saunders 1974), and both sexes in the long-billed corella (Emison et al. 1994). Displays that involve bowing the head and spreading the tail also have courtship-related functions in parrots of other families, including Puerto Rican parrots (Snyder et al. 1987), thick-billed parrots (*Rhynchopsitta pachyrhyncha*, Lanning & Shiflett 1983), white-fronted amazons (*Amazona albifrons*, Skeate 1984), budgerigars (*Melopsittacus undulatus*, Brockway 1964), lovebirds (*Agapornis spp.*, Dilger 1960), and green-rumped parrotlets (*Forpus passerinus*, Waltman & Beissinger 1992).

## **9.5. Bob Head**

A stereotypical bobbing of the head always preceded Allofeeding, and was probably a necessary part of regurgitating food from the crop. In one continuous series the head was bobbed an average of four times, but up to 12 times, at a rate of two to four bobs per second. This was usually repeated several times before Allofeeding began. Males sometimes Bobbed Heads repeatedly without regurgitating. This behavior was directed only toward females and not juveniles, suggesting it functioned as a display in this context. This "display" type of bobbing was often associated with Kwee-chuck Calls.

## **9.6. Strut**

In this display a male Walked along a branch in an exaggerated, deliberate gait with the head feathers fluffed (see Fluff Head). The Strut was usually associated with Kwee-chuck Calls.

## **9.7. Hang Upside Down**

In this odd behavior a cockatoo tipped forward while holding onto the perch, hung upside down with the wings spread for several seconds, then either regained the perch by holding on with its feet while flapping its wings, or dropped into flight. This seemed to be clearly deliberate, rather than an accidental loss of balance. Although birds often Perched in eucalypts during midday, they only Hung Upside Down in early morning or late afternoon, during periods of aggregation and social interaction. The behavior was more common among males than females (22 vs. 8 observations). Although unpaired males made up a small minority of the population and were observed less often, they accounted for a substantial proportion of the observations of males Hanging Upside Down (8 of 22). The data were not sufficient to estimate rates accurately, but the behavior was not obviously restricted to either season.

Glossy black-cockatoos rarely Hang Upside Down while Foliage Bathing, as some other cockatoos routinely do (e.g., galahs, Rowley 1990; white cockatoos, Noske 1983; Major Mitchell cockatoos, Rowley & Chapman 1991). Very similar behaviors have also been noted outside of rain bathing contexts in galahs (Rowley 1990) and Major Mitchell cockatoos (Rowley & Chapman 1991), and might be a form of display or play behavior.

## 9.8. Swooping Flight

Swooping Flight consisted of fast erratic flight close to the ground, often among trees, with many sharp turns and sudden dives and swoops. It almost always involved more than one bird flying together, usually with one taking the lead and others following. There was no consistent direction of flight, or substantial distance traveled. The cockatoos called frequently and appeared excited during Swooping Flight. It lasted for several minutes at a time, and was sometimes repeated intermittently. It was most common during late afternoon social activity, after most feeding had ended and before the birds moved to roosting trees. Many long bouts of Swooping Flight involved a young female not yet in a stable pair bond. The other birds involved were unpaired males, and appeared to be following the female. The behavior also occurred in other contexts however, including when only paired birds were present. It was similar to the “mad flight” described in galahs (Rowley 1990) and the “crazy flights” of Major Mitchell cockatoos (Rowley & Chapman 1991).

## 10. Vocalizations

Most of the black-cockatoos (*Calyptorhynchus spp.*) produce calls that can be distinguished by species, but are recognizably similar to each other (e.g., Saunders 1979b). In contrast, the glossy black-cockatoo vocal repertoire is very different even from that of the closely related red-tailed black cockatoo (pers. obs.). Most calls were noisy squawks or “creaky” calls, rather than the more melodic whistle-like calls of their congeners. Distinct call types were also much less apparent. Although they varied with context, calls were graded across a range of duration, intensity, and frequency structure instead of falling into discrete categories. I do not consider this to be a complete catalog of the species’ repertoire, because I suspect that more subtle call types may also carry specific meanings of the cockatoos. I only describe here those call types that were

relatively easy to distinguish by ear and in spectrograms, and that were associated with specific behavioral contexts. The only congeneric species whose vocal repertoire has been described is the Carnaby's cockatoo (Saunders 1979a, 1983). Although several analogous call types were recognizable, the glossy black-cockatoo's vocal repertoire was surprisingly different overall. The two species share the characteristic that many call types seem to be involved in coordinating the activities of family parties or larger groups.

Representative sound spectrograms of each of the described call types are provided in Figs. 3.1-3.8. I did not attempt to illustrate the full range of variation in these figures, but only provided a few typical examples. I recorded calls using a Sony TCD-5M cassette recorder with a Sony PBR-330 parabolic reflector and a Sennheiser ME 20 microphone. I prepared the spectrograms on a personal computer using the Signal/RTS program (version 3.0, Engineering Design, Belmont, MA). Calls were sampled at 20,000 points/sec, and spectrograms were generated using 512-point Fourier transforms (time resolution, 25.6 msec; frequency resolution, 39.1 Hz). I erased extraneous noise from some figures.

### **10.1. Kwee-chuck Call**

The Kwee-chuck Call (Fig. 3.1) is the longest and most distinctive call in the glossy black-cockatoo's repertoire. As suggested by the name, it consisted of two subunits: a longer more tonal segment and a short broad-band "chuck". These two subunits alternated up to dozens of times in a call that lasted for many seconds, and was often immediately followed by a Bow Display. The Kwee-chuck Call was given only by males (N = 473 calls during focal follows). Subadult males (retaining some bars on the tail feathers) gave shorter calls with a more "creaky" or "rusty" tone and a less regular cadence than adults. Some also followed a Kwee-chuck Call with a Spread Wing Display rather than a Bow Display. Kwee-chuck Calls were most common in early morning and

late afternoon, and were almost entirely restricted to the breeding season. During focal follows, paired males gave Kwee-chuck Calls at a rate of 4.48 per hour during the breeding season, but only 0.01 per hour in the non-breeding season (N = 22 male-seasons, Mann-Whitney U test,  $p = 0.001$ ).

Paired males usually gave Kwee-chuck Calls while Perched next to their mate. Unpaired males also give Kwee-chuck Calls however, and unaccompanied males tend to broadcast the call from a prominent perch, turning to face in different directions or changing perches between calls. Males usually gave Kwee-chuck Calls after Allofeeding their mates and before Copulating. Habituated males also produced Kwee-chuck Calls after being disturbed by a human observer. The most common response to a Kwee-chuck Call from other males was to produce the same call, so that several males sometimes chorused together. More dominant males occasionally responded to a Kwee-chuck Call by supplanting the caller. Females did not usually respond, but the caller's mate sometimes Lunged at him if he was within reach.

The Kwee-chuck Call was similar in structure and context to the "Ah-Ah" call of the Carnaby's cockatoo (Saunders 1983), and also to a call given by male yellow-tailed black-cockatoos in similar contexts (*Calyptorhynchus funereus*; pers. obs.). However, the "Ah-Ah" call is only directed at females (Saunders 1979a, 1983). Several features of the Kwee-chuck Call suggest that it might function as an advertisement of dominance status. It was very loud and long, was coupled with a visual display, and was often broadcast from a prominent perch. Dominant birds often attacked subordinates that gave Kwee-chuck Calls, and males gave the call after winning aggressive interactions. All of these features are very similar to crowing in roosters, which appears to function as a status signal (Leonard & Horn 1995). If so, one would predict that dominant males give Kwee-chuck Calls more often than subordinates, and that the call's acoustic structure provides information about the status of the caller. Individual males' average calling rates were

not correlated with their dominance rank in my focal follow data. This could easily reflect inadequate sample sizes, however. Most Kwee-chuck Calls were concentrated into long bouts, and I did not have enough hours of focal data on most males to include a representative number of calling bouts for each. Thus both predictions of the “dominance advertisement” hypothesis remain to be tested.

## **10.2. Feeding Call**

Mated pairs gave soft, short calls at intervals while foraging, especially after finishing one cone and before Picking the next (Fig. 3.2). Different pairs varied in how often they called, but unpaired birds did not give Feeding Calls. If an observer approached very closely to a feeding pair, their Feeding Calls changed in quality and became louder and more frequent. These calls sometimes evoked an immediate vocal response from the mate. During the non-breeding season the overall rate of calling did not differ significantly between the sexes. However, males were more likely than females to reply to their mate’s calls within one second (17% vs. 11% of calls, chi-square = 8.57, d.f. = 1,  $p < .005$ ). Comparable data were not collected in the breeding season.

This call appeared to function by allowing paired birds to monitor each other’s whereabouts and share information about the environment when they were out of view of each other. This would be especially useful while feeding, because foraging movements would take the pair out of each other’s field of view. The thick bushy drooping sheoaks the cockatoos fed in also reduced visibility much more than the open eucalypts they Perched in when not feeding. A similar function was proposed for vocal exchanges in mated pairs of bar-headed geese (*Anser indicus*) while searching for lost goslings (Lamprecht et al. 1985). Males respond to females, allowing the pair to stay in contact without having to monitor each other visually, which would interfere with the task at hand.

### **10.3. Flight Call**

Cockatoos usually called in flight, especially during longer flights and just after taking off. This loud call (Fig. 3.3) was the longest call that consisted of a single unit, sometimes exceeding one second in length, and was rather flat in pitch. The flight call of the glossy black-cockatoo is more broad-band or “noisy” than that of other members of the genus (Saunders 1979b, 1983).

### **10.4. Begging Call**

The Begging Call was a repetitious high pitched “squeaky” call, composed of a single note type that was produced in long series, sometimes varying considerably in structure even within a series (Fig. 3.4). It was given by both juveniles and adult females while Begging. Adult females usually gave Begging Calls in the evening shortly before Roosting. Dependent juveniles gave Begging Calls at any time of day and for long periods, even (intermittently) hours at a time. This call was similar in structure and context to the “begging grate” described by Saunders (1983) in the Carnaby’s cockatoo.

### **10.5. Allofeed Call**

This was a soft and inconspicuous call that was similar in structure to soft calls given in other contexts (e.g., Feeding Call), but with a rising and then falling element at the end (Fig. 3.5). It was given by paired males before they Allofed their mate, and usually repeated several times. Although males also Allofed their young, I did not hear the Allofeed Call in this context. Females usually approached their mate when he gave Allofeed Calls.

This call has not been described in other parrots. However, it could easily be overlooked in the field, especially if the birds were not habituated to observers.

## **10.6. Nest Call**

The Nest Call was a very grating or “guttural” sounding call, composed of distinct sound pulses at the rate of about 60 per second (Fig. 3.6). It was given only by females, and only when they were in or very near an actual or potential nest hollow. Surprisingly, this call was sometimes rather loud. Females gave this call before entering their nest hollow, or while Prospecting For a Nest.

## **10.7. Grunt Call**

The Grunt Call was a short atonal call with a restricted frequency range that was repeated several times in succession (Fig. 3.7). It was usually accompanied by Spread Wing Displays, and appeared to be a threat. Only males gave this call.

## **10.8. Alarm Call**

There were actually a range of calls that seemed to denote various levels of concern or alarm. Fig. 3.8 illustrates the intense alarm calls that typically accompanied the appearance of a wedge-tailed eagle or other raptor, and evoked immediate flight and other alarm calls from nearby cockatoos.

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