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ASPECTS OF BREEDING OF THE PIED CURRAWONG *Strepera graculina* AT WOLLONGONG, NEW SOUTH WALES

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Sample data were obtained during 223 hours of observation at seven nests of the Pied Currawong *Strepera graculina* in various breeding stages. At least 13 eggs hatched, of which only six nestlings (46%) fledged. In general, females built nests in 11–13 days and incubated the eggs for 73 per cent of daylight hours. In the nest-building and incubating stage, males provided females with much of their food requirements and solicitation displays were common. In the nestling stage, females brooded the young during the day for reducing periods of time until they were about 15 days old and continued to brood them at night until they were 30 days old. The rate at which adults carried food to the nest varied widely between nests from 2.4 visits/hour at a nest with one (or two) nestlings to 11.1 visits/hour at another nest with four nestlings (mean feeding rate = 3.6 visits/hour). Both parents defended an area of about half a hectare (40 m radius) around the nest and foraged within a breeding home range of 12–16 hectares. Dependent juveniles remained in their breeding home range for about eight weeks after fledging. One family was seen 850 metres from their nest 14 weeks after the young fledged and the juveniles were still partly dependent. The syllabised call *currah-currah-currong* was clearly the most frequent phrase uttered by both parents.

INTRODUCTION

The Pied Currawong *Strepera graculina* (Shaw 1790) is a large (350 g, 50 cm), long-lived passerine (24+ years, Anon. 1998) that has recently been classified in the family Artamidae (Christidis and Boles 1994). It is distributed widely throughout south-eastern Australia (Blakers *et al.* 1984). Historically, breeding was confined to tall eucalypt forests (Debus 1996) but in the last 40 years, the species has established breeding populations in suburban areas of Canberra (Lenz 1990) and Sydney (Hoskin 1991).

Nests and eggs of the Pied Currawong have been described previously (North 1901; Campbell 1909; White 1922) but accounts of the reproductive biology are few. At Dangar Island, just north of Sydney, Recher (1976) reported information from observations at one nest. More recently, Prawiradilaga (1996) studied 11 to 14 nests at Canberra during three successive breeding seasons and reported on the breeding biology and foraging ecology. Diet in the breeding season at Wollongong was investigated by observing Pied Currawongs at four nests between 1993 and 1996 (Wood 1998).

In this paper, I document various aspects of breeding from observations at seven nests, six of which were in suburban Wollongong. Four of these nests were the subject of a previous paper on diet (see Wood 1998).

STUDY AREA AND METHODS

The location of nests and land use nearby are given in Table 1. During the observation period, I performed 121 continuous watches, mostly of more than one hour, and a total of 71 short inspections (each <20 minutes). The cumulative number of hours of continuous watches was 223 (Table 1).

Of ten parent birds, only the adult male from nest 2 was banded and temporarily colour-marked, because it became apparent that catching was difficult and made the breeding birds so aggressive towards the observer that meaningful data would not be obtained. For the same reason, nest contents were not inspected from the ground with mirrors. Three fledglings from nest 7 were banded and temporarily colour-marked on the day they fledged.

Sampling periods of observation were at various times of day to allow for possible sources of bias. Nevertheless, the data acquired comprised mostly unequal numbers of repeated measures on a fairly limited number of birds, and given that individuals displayed variable behaviour, these data were not considered amenable to statistical testing. Unless otherwise stated, sample data were not obtained during abnormal weather.

Sexing criteria of individual birds have been described previously (Wood 1998). The incubation and nestling periods are about 21 and about 36 days respectively (see Wood 1998). The first day that eggs were incubated is referred to as D0. The first day that nestlings were fed (= presumed hatching) is d0.

Five main feeding routines were recognized:

1: nest unattended; male arrives and feeds young

2: nest unattended; female arrives and feeds young

3: female brooding; male arrives, female arises and takes portion of food from male and both parents feed young

4: female brooding; male arrives, female arises and takes all of the food from male and feeds young

5: female brooding; male arrives, female arises and allows male to feed all of the food to the young.

The following postures and displays were observed (see Wood 2000):

1: *Threat posture*; a horizontal stare and gaze

2: *Breeding advertisement posture*; wing-drooping with tail cocked

3: *Food-begging display*; begging with wings quivering

4: *Solicitation display*; crouched wing-quivering.

Feeding of the female by the male after the food-begging display is referred to as *courtship feeding*.

Home range and territory terminology follows Odum and Kuenzler (1955). The breeding home range is the maximum area used by the breeding pair in the nest-building, incubation and nestling phases. The defended territory is that portion of the breeding home range around the nest that is physically defended against conspecific and interspecific individuals. To calculate the area of the breeding home range, the furthermost points to which parent birds foraged in all directions were plotted on 1:2 000 surburban cadastral maps. These points were joined by eye and the enclosed area calculated with a planimeter.

TABLE 1
Physical characteristics and observation details of Pied Currawong nests at Wollongong, 1993–2000.

Nest number	1	2	3	4	5	6	7
Nest location	Mangerton	Coniston East	Mt Keira	Mt St Thomas	Mt St Thomas	Mt St Thomas	Coniston West
Nest height	19 m	10 m	17 m	14 m	18 m	12 m	8.5 m
Tree height	24 m	12.5 m	32 m	22 m	22 m	19 m	23 m
Height of vegetation over nest	5 m	2.5 m	15 m	8 m	4 m	7 m	4 m
Horizontal distance from trunk	8 m	3 m	7 m	5 m	3.5 m	6 m	9.5 m
Horizontal distance to extremity of branch	5 m	1 m	1 m	1 m	2.5 m	1.5 m	1 m
Tree species[1]	*E. botryoides*	*E. citriodora*	*E. pilularis*	*E. maculata*	*E. maculata*	*E. maculata*	*E. maculata*
Land use under nest	Public reserve	Light commercial	Wet Sclerophyll Forest	Residential	Residential	Residential	Residential
Observation period	9 Oct–18 Nov 1993	28 Oct 1993–13 Jan 1994	15 Oct–6 Nov 1994	22 Aug–31 Aug 1996	1 Sep–19 Oct 1996	20 Oct–17 Nov 1996	15 Sep 1999–8 Feb 2000
Breeding stage observed	Nestling	Incubation, nestling and fledgling	Incubation	Nest-building	Nest-building, incubation and nestling	Nest-building	Incubation, nestling and fledging
Total duration of continuous watches (cumulative)	29 hrs	74 hrs	23 hrs	10 hrs	50 hrs	15 hrs	22 hrs
Highest number of nestlings seen[2]	2	3	2	0	3	0	4
Number of nestlings fledged	0	3	0	0	0	0	3

[1] *E = Eucalyptus*
[2] One nestling in nest 5 was a Channel-billed Cuckoo *Scythrops novaehollandiae*.

Observations were with binoculars or a 17× Kowa telescope. Vocalizations were taped on a Sanyo radio-cassette recorder with an Audio Technical Super-cardioid Electret condenser microphone AT 815a. The sonograms were developed in the application Software Package Canary 2.1 (Bioacoustics Research Program, Cornell University, USA).

Weather data were obtained from the University of Wollongong Climatological Station. Times mentioned are Eastern Standard Time.

RESULTS

Nesting success

The number of nestlings that fledged from each nest is given in Table 1. At nest 1, two nestlings died or were preyed upon. At nest 3, two nestlings fell to the ground during gale-force winds. Nest 4 was destroyed in a gale before eggs were laid and the Mt St Thomas pair built nest 5 about seven metres away. Nest 5 failed when one or more Channel-billed Cuckoos *Scythrops novaehollandiae* dislodged two Pied Currawong nestlings and a Channel-billed Cuckoo nestling. After nest 5 failed, the same pair of currawongs built nest 6 (a third nest), 35 metres from the second. Nest 6 was abandoned before eggs were laid. One Pied Currawong nestling in nest 7 was decapitated and thrown out of its nest by a Channel-billed Cuckoo on d20. From this small sample of seven nests, at least 13 Pied Currawong nestlings hatched of which only six (46%) fledged.

Nests and nest sites

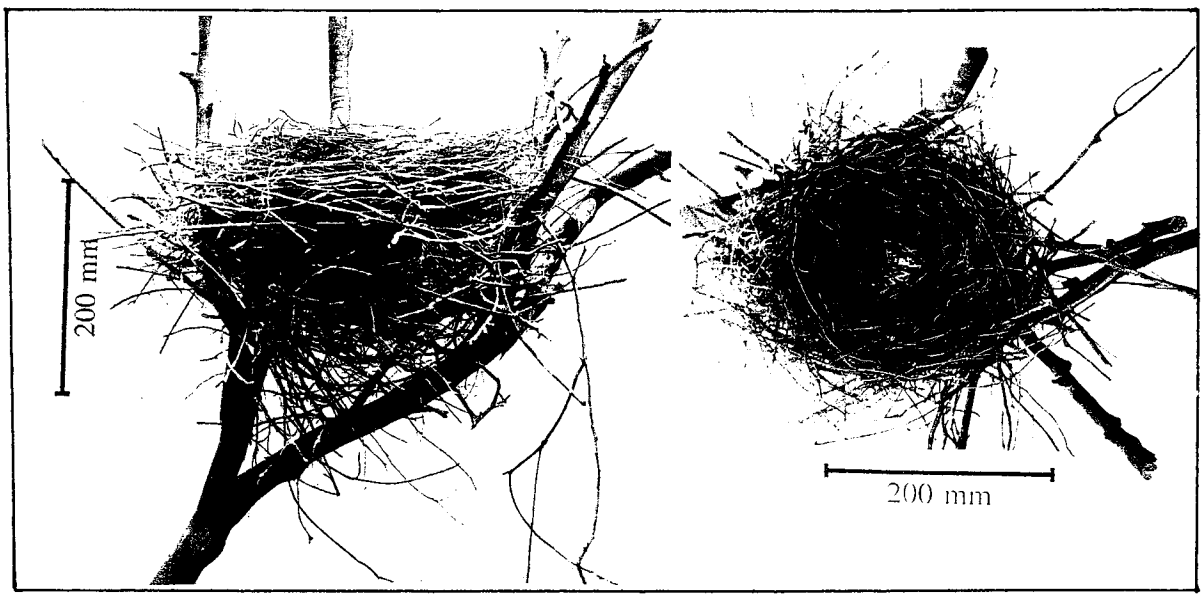
All nests were in eucalypt trees between 8.5 metres and 19 metres above ground (Table 1). They tended to be towards the extremity of a main branch with at least four metres of vegetation vertically above. Nest 2 was typical (see figure on next page). When dismantled, it consisted of 143 items in the outer framework, 348 items in the inner framework, 44 vine tendrils woven through the framework and 247 branchlets of lining (total 782 items). The outer framework was 80 per cent *Melaleuca* spp. and 20 per cent *Eucalyptus* spp. with these items measuring about 3.5 millimetres diameter × 350 millimetres long on average. The inner framework comprised the same vegetation species as the outer framework, but the average dimensions of the items were about 1.5 millimetres diameter × 200 millimetres long. An average piece of lining was about 1 millimetre diameter × 100 millimetres long.

Nest building

Data on nest building were acquired from 43 hours of watching the Mt St Thomas pair at nests 4, 5 and 6. Only the female built nests 5 and 6 but four of 24 visits to nest 4 were by the male adding material. The median duration of visits to the nest was 90 seconds (range 20–270, n = 63). During visits, the female constructed the nest by positioning, probing, tramping and squatting on the materials after changing her orientation regularly. On one occasion, she expanded the outer lining by pushing it outwards with the carpal joints of both wings simultaneously.

The materials collected by the female at Mt St Thomas comprised dead eucalypt twigs, dead *Callistemon* spp. branchlets and live rootlets of Kikuyu grass *Pennisetum clandestinum*. Most of the lining for nest 6 was taken from the lining of the cuckoo-raided nest 5. Up to 10 rootlets were often carried together in the bill to add lining, but framework members were carried individually.

Nests 5 and 6 respectively took 11 and 13 days to build within time intervals of 19 and 21 days from destruction of the previous nest to incubation in the new nest.



Plan view (right) and elevation (left) of removed nest 2 at Coniston.

Construction of nest 6 began four days after the failure of nest 5. Materials for all nests were gathered from distances of 5 to 100 metres (median = 40 m, n = 64). Fifteen of 96 sampled visits to nests (16%) were to inspect only or modify the structure (no materials added, Table 2).

Visits were irregular in occurrence and somewhat clumped. At nest 4, after building had commenced, the female made no visits during four successive watches, then 19 visits in a subsequent watch of 90 minutes. Similarly, during one short watch at nest 6, six visits were made in the first 27 minutes but none in the remaining 13 minutes.

During the nest-building phase, the male and female tended to stay together, mostly within 40–50 metres of the nest. The rate at which pair-bonding incidents were seen varied between 0.32/hour at nest 4 and 1.24/hour at nest 5 (mean 0.93/hr, Table 2). Overall, the number of solicitations performed by the female was 3.7 times the number given by the male. The breeding advertisement pose was commonly employed by both sexes and courtship feeding occurred 21 times in 43 hours (0.49/hr, combined data).

TABLE 2

Visits to the nest and pair-bonding incidents of the Pied Currawong in nest-building stage.

Nest No.	4	5	6	Overall
Number of watches	6	15	24	45
Cumulative hours of watches	9.5	21	12.5	43
Number of visits to nest:				
Inspection only	3	0	0	3
Modify construction	5	1	6	12
Add material	16	30	35	81
Total	24	31	41	96
Number of pair-bonding incidents:				
Solicitation by female	2	5	4	11
Solicitation by male	0	1	2	3
Mutual solicitation	1	0	3	4
Courtship feeding of female	0	20	1	21
Intra-pair copulations	0	0	1	1
Total	3	26	11	40
Number of pair-bonding incidents/hour	0.32	1.24	0.88	0.93

Incubation stage

The female incubated for all but one bout. On d19 at Mt Keira, I commenced the watch before first light and the female was fed at the nest at 04:35 hours, 05:08 hours, 05:10 hours, 05:13 hours and 05:32 hours. Then at 05:52 hours, she left the nest after being fed and the male commenced the next incubation bout. The temperature was less than 17°C, the wind was about 20 knots and the chill factor was high. Overall, the mean incubation constancy was 73 per cent (Fig. 1, all nests combined), but the calculated value for each watch varied widely between 47 per cent during the watch on d12 (concluding at 18:43 h, = civil twilight) and 89 per cent during a watch on d10 (concluding at 12:18 h, Fig. 1). Other than that some sampling durations may have been too short, I found no obvious explanation for such a wide variation in incubation constancy. The female left the nest for a median duration of 5 minutes (range 1–36 minutes, n = 124, Table 3). During her longest rest period of 36 minutes, she accompanied the male in 'shadowing' a Channel-billed Cuckoo about 100 metres away from the nest.

Once incubation commenced, the male spent long periods away from the immediate vicinity of the nest (out of sight). Eight such periods were more than 60 minutes (max. 120 minutes, Table 3). Solicitations then were few (two in 55.5 h), but the rate at which the male fed the female was almost double the courtship-feeding rate in the nest building stage (52/55 = 0.94/hr, Table 3 vs 21/43 = 0.49/hr, Table 2).

Nestling stage

Brooding constancy in the first few days after hatching (66–80%) was similar to the overall mean incubation constancy, but fell sharply to less than 5 per cent by d14

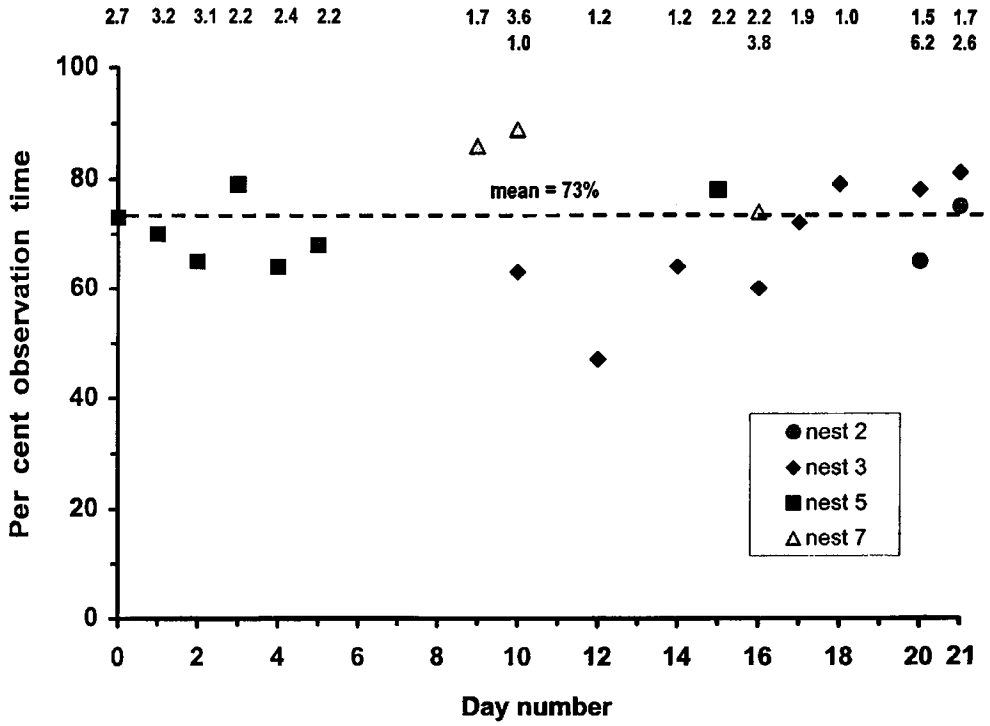


Figure 1. *Incubation constancy based on 54.3 hours of observation at four nests of the Pied Currawong at Wollongong, New South Wales. Observation times (hours) are displayed above each day.*

(Fig. 2). At nest 2, no brooding was observed during watches on d16, d17 and d19 although the female brooded (= loosely covered) the nestlings during 15 minutes of drizzle in the watch of 212 minutes on d20 (Fig 2). On two occasions (nest 2, d5 and d13), I saw the female shade the nestlings with out-stretched wings for short periods (<1 minute) when the ambient temperature was more than 27°C and the nestlings were panting.

Inspections of nest 2 after 21:45 hours on d22, d25, d28, d29 and d30 showed that nestlings were brooded at night (presumably by the female) until d30 but that the female was absent from the nest at night on d31, d32, d35, d36, d37 and d38. The longest continuous brooding period at each nest ranged from 16 minutes at nest 7 to 82 minutes at nest 2 (Table 4). When the nestlings were being brooded, typically when they were less than 15-days-old, the predominant feeding routine was for the brooding female to take food from the visiting male and feed the nestlings herself (routine 4 = 56 visits vs routines 3 and 5 = 12 visits, Table 4). Later in the nestling period, when the nestlings were mostly unattended, the male and female shared the feeding duties more evenly (routine 1 = 144 visits by male vs routine 2 = 171 visits by female, Table 4). Overall, the male made 212 visits to the nest (routines 1,3,4 and 5) compared to 171 visits by the female. The feeding rate for the nestlings varied from 2.4 visits per hour at nest 1 to 11.1 visits per hour at nest 7 (overall mean 3.6/hr, Table 4). During visits, parent birds stayed for a median duration of 15 seconds (range 5–87 secs, n = 136). There were 21 intervals between successive feeding visits that exceeded 30 minutes, the longest interval being 193 minutes at nest 1 on d17 (Table 4).

TABLE 3

Pair-bonding incidents of the Pied Currawong and other breeding information in incubation stage.

Nest No.	2	3	5	7	Overall
Number of watches	4	16	12	3	35
Cumulative hours of watches	7.5	20	18.4	9.6	55.5
Number of pair-bonding incidents:					
Solicitation by female	0	0	0	0	0
Solicitation by male	0	0	0	1	1
Mutual solicitation	0	1	0	0	1
Courtship feeding of female on nest	1	13	26	6	46
Courtship feeding of female off nest	0	4	1	1	6
Intra-pair copulations[1]	0	0	0	0	0
Total	1	18	27	8	54
Number of pair-bonding incidents/hour	0.13	0.9	1.47	0.83	0.98
Number of times female left nest	15	49	38	22	124
Median duration of female rest periods off nest (min.)	9	5	7	4	5
Range of female rest periods off nest (min.)	5–16	1–21	1–36	2–8	1–36
Three longest periods of absence of male (min.)	40, 100, 120	62, 68, 117	13, 15, 92	40, 105, 110	105, 110, 120

[1]One extra-pair copulation seen near nest 5 on d2 (see Wood 2000).

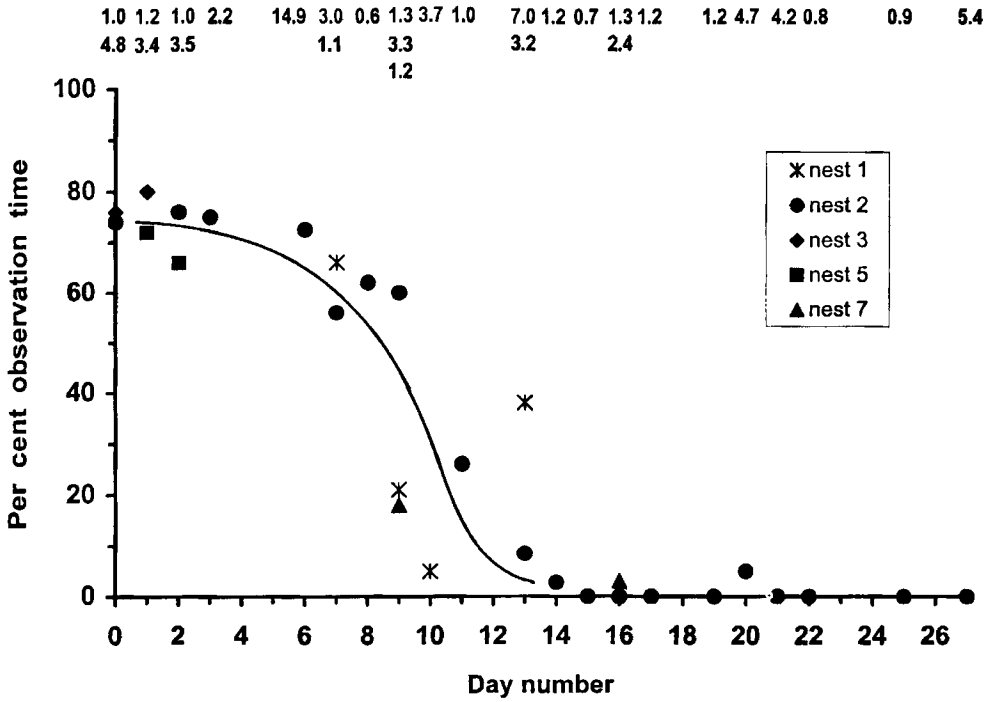


Figure 2. *Brooding constancy curve (fitted by eye) based on 81.4 hours of observation at five nests of the Pied Currawong. Observation times (hours) are displayed above each day.*

Nestling development was gradual. At the end of the first week, their open bills were seen above the horizontal plane of the rim when they were fed. At the end of the second week, the nestlings began to rest their necks on the rim for short periods of 5–6 minutes. During the first two weeks, one parent stayed mostly near the nest (<50 m away), but in week 3, both parents began to forage together 150–200 metres away for up to 15 minutes. Wing-flapping exercises were first seen on d19 and became a regular activity until fledging. On d20, the central rectrices on the decapitated nestling from nest 7 were measured at 32 mm. As well as I could estimate from the ground, the tails of nestlings were about 40–45 millimetres long on d24 and about 60–80 millimetres long on d27. At d25, the young began to preen themselves and wing-flap while standing on the rim. At d31 they left the nest for short periods of 5–10 minutes and stood, preened and wing flapped on adjacent branches up to 70 millimetres away. At this stage of development, sustained wing-flapping was performed isometrically against the muscles of the leg with the claws clamped on the perching branch.

The act of fledging was closely observed at nests 2 and 7. On d36 at nest 2, each of the three young moved in and out of the nest sporadically during the day. They ventured

TABLE 4

Parental duties of the Pied Currawong at Wollongong, New South Wales, in the nestling stage (day number shown in parentheses when appropriate, n.a. = not applicable).

Nest No.	1	2	5	7	Overall
Number of watches	11	36	3	3	53
Cumulative hours of watches	29	63	8	4.5	104.5
Day numbers of first and last watch	d7-d21	d0-d36	d1-d2	d2-d16	n.a.
Number of nestlings during watches[1]	2, 1	3	3	4	variable
Number of faecal sacs eaten at nest	5	11	7	1	24
Number of faecal sacs carried from nest	14	31	1	3	49
Longest continuous brooding period (mins.)	41 (d8)	82 (d0)	33 (d1)	16 (d2)	82 (d0)
Number of feeding visits:					
Routine 1	32	74	14	24	144
Routine 2	27	101	20	23	171
Routine 3	3	0	0	0	3
Routine 4	4	35	14	3	56
Routine 5	3	5	1	0	9
Total	69	215	49	50	383
Number of feeding visits/hour	2.4	3.4	4.9	11.1	3.6
Longest interval between successive feeding visits (min.)	193 (d17)	82 (d27)	40 (d1)	53 (d16)	193 (d17)
Number of feeding visits for which the duration of time at nest was measured (n)	34	91	8	3	136
Median duration of time at nest while feeding (sec.)	12	16	12	16	15
Range of time duration at nest while feeding (sec.)	5–34	5–87	7–26	8–23	5–87

[1]One nestling in nest 5 was a Channel-billed Cuckoo *Scythrops novaehollandiae.*

up to one metre away by jump-fluttering, but all three nestlings were back in the nest at 22:21 hours on d36. During the following day (d37), their behaviour was similar but they spent longer periods out of the nest. At 18:50 hours, the most advanced young flew 16 metres. A night check at 22:40 hours on d37 revealed that two young were in the nest and one was roosting one metre away. On d38 at 07:20 hours, the three young were 10–20 metres from the nest, resting in adjacent trees. They did not return to nest 2.

The behaviour of the three surviving nestlings in nest 7 was similar to that of the nestlings in nest 2 as fledging approached. At nest 7, one nestling left the nest permanently on d36 before 08:20 hours. The second nestling left the nest around 09:30 hours on d37, and the third at about 14:30 hours on d37. On the day of fledging, none of these nestlings could sustain horizontal flight over a distance of 7 metres.

Three solicitation displays and no food-begging displays were seen in the nestling phase. These solicitations were performed on d31 and d36 at nest 2 and on d20 at nest 7 about 60 minutes after the cuckoo raid. As none of these solicitations was during the female's fertile period, it seems likely that they served to maintain the pair bond that already existed.

Nest hygiene

In the first few days after hatching, the female often stood on the rim and probed in bursts with her bill inside the nest near the base of the cup. Her body vibrated somewhat in a manner reminiscent of a regurgitative action. I concluded that the female was devouring refuse after hatching or non-cohesive faecal matter. By d6, faecal droppings were contained in a gelatinous sac and were either eaten at the nest, taken 10–20 metres away and eaten, or taken 10–20 metres away and dropped. About twice as many were taken away as were eaten at the nest (49 vs 24, Table 4). From d16 at nest 2 and d29 at nest 7, the nestlings began to defecate on to the ground with their cloacae placed just beyond the rim.

Defended territory

Both parents physically defended a small area around the nest. Data presented in Table 5 suggest that 93 per cent of attacks were on intruder species within a radius of 40 metres and 83 per cent were on intruders within a radius of 25 metres. Channel-billed Cuckoos and Brown Goshawks *Accipiter fasciatus* were repelled when 80 metres and 50 metres respectively from the nest. The most vicious attacks involved dive-bombing, aerial pursuit, bill-snapping and alarm calling. In general, viciousness was dependent on distance from the nest and size of the intruder. However, attacks could not be predicted with certainty and predatory species, such as Australian Ravens *Corvus coronoides*, Australian Magpies *Gymnorhina tibicen* and other conspecific individuals, were sometimes tolerated just inside the area that was normally defended. Non-predatory species, such as members of the order Psittaciformes were sometimes expelled, apparently because they were simply too close to the nest. At Coniston West, Australian Ravens and Australian Magpies were ignored while attending their own nests 40 metres and 80 metres respectively from the currawong nest, but attacks by the male currawong on White-faced Herons *Egretta novaehollandiae* that were nesting 20 metres away were relentless (19/hr in one measured sample). These attacks were a regular occurrence until d15 when two one-day-old heron nestlings were found on the ground under the heron's nest. No herons attended their nest after d18.

In general, currawong attacks on intruding species seemed most frequent while building the nest and establishing the territory. They often involved both male and female (Table 5). In the incubation and nestling phases, physical attacks were common but parent birds also used the threat and breeding advertisement poses to deter intruders from entering the defended territory. I did not acquire appropriate sample data, but overall, I judged that the male initiated considerably more attacks than the female. The male and female also used high strategic branches in the defended territory to regularly watch the home range and utter their distinctive territorial call (see *Voice*).

TABLE 5

Intruder species and distance from nest (metres) when initially chased by Pied Currawongs. For each intruder species, only the furthermost distance is listed in a watch. M = male, F = female, BS = both sexes, US = unknown sex. Combined data, n = 41 (nest 1, n = 5; nest 2, n = 2; nest 3, n = 3; nest 4, n = 9; nest 5, n = 11; nest 6, n = 1; nest 7, n = 10).

	Chased By			
Intruder species[1]	M	F	BS	US
Brown Goshawk *Accipiter fasciatus* (NP)	50			40
Channel-billed Cuckoo *Scythrops novaehollandiae* (NP)			80	
Australian Magpie *Gymnorhina tibicen* (NP)			7, 15	
Pied Currawong *Strepera graculina* (NP)	20, 15	15, 12, 7	20, 14	30, 25, 5
Australian Raven *Corvus coronoides* (NP)	50, 30, 15		15, 13	
White-faced Heron *Egretta novaehollandiae*	20, 20, 20			
Galah *Cacatua roseicapilla*	14	4	4	
Sulphur-crested Cockatoo *Cacatua galerita*	8, 3			
Rainbow Lorikeet *Trichoglossus haematodus*	4, 3	7, 4		6
Eastern Rosella *Platycercus eximius*			6	10
Little Wattlebird *Anthochaera chrysoptera*				8
Black-faced Cuckoo-shrike *Coracina novaehollandiae*		40		5
Satin Bowerbird *Ptilonorhynchus violaceus*	8	4	25	

[1]Excludes small passerine species that were likely prey; NP = nest predator.

Voice

The syllabised call *currah-currah-currong* (Fig. 3) was by far the most frequent call of both parents. This multi-purpose vocalization was used to advertise the defended territory, to sound an alarm that a nest-predator was nearby, to expel an intruder from the territory and to maintain the pair bond. Other calls that were rarely given were the three-syllable phrase *sing-song-saang* (Fig. 3), the two-syllable phrase *ka-kaah* (Fig. 3) and a few other contact calls of low intensity.

A sample of the daily pattern of territorial calling at nest 3 showed that the calling rate was highest just before dark, moderately high just after sunrise and lowest between 09:00 hours and 15:00 hours (Table 6). While obtaining this sample, the only call given was the territorial *currah-currah-currong*. This diurnal pattern was considered typical in the breeding season and was confirmed in another sample around sunset at nest 6. Parent birds near nest 6, and other currawongs some 200–300 metres away in various directions, uttered a total of 101 *currah-currah-currong* phrases between 18:00 and 18:40 (civil twilight at 18:32).

Breeding home range

The breeding home ranges for the Coniston East and Mt St Thomas nests were 12.2 hectares and 15.7 hectares respectively. At Coniston East, the maximum and minimum distances that parent birds wandered from the nest, irrespective of direction, were 280 metres and 120 metres respectively. At Mt St Thomas, the corresponding maximum and minimum distances were 290 metres and 130 metres respectively. The maximum distance wandered from the Mt Keira nest (see Table 6) and the other nests was about 300 metres. Other currawongs, sometimes in flocks of 10–15 birds, were regularly observed in the breeding home range at distances greater than 150 metres from the nest. These currawongs were occasionally joined by one or both parents and stayed for only short periods (<10 minutes) before moving on. I concluded that they were transient non-breeding currawongs.

Post-fledging care

The fledged young from nests 2 and 7 remained within the defended territory for the first 10 days and were totally dependent on the parents for the provision of food during that time. They then moved much further away but stayed within the breeding home range for at least a further 45 days (nest 2) and 41 days (nest 7) respectively. They were still receiving substantial quantities of food from the parents when last seen in the home range. I found one of the temporarily colour-marked juveniles from nest 7 at Mangerton 88 days after fledging and two of these juveniles at the same location 7 days later. They were with their parents in a flock of about 25 currawongs. The family had moved 850 metres from their nest at Coniston West. These juveniles picked and ate ripe peppercorns *Schinus molle* and gleaned insects but they also occasionally followed a parent and begged for food. Before this study

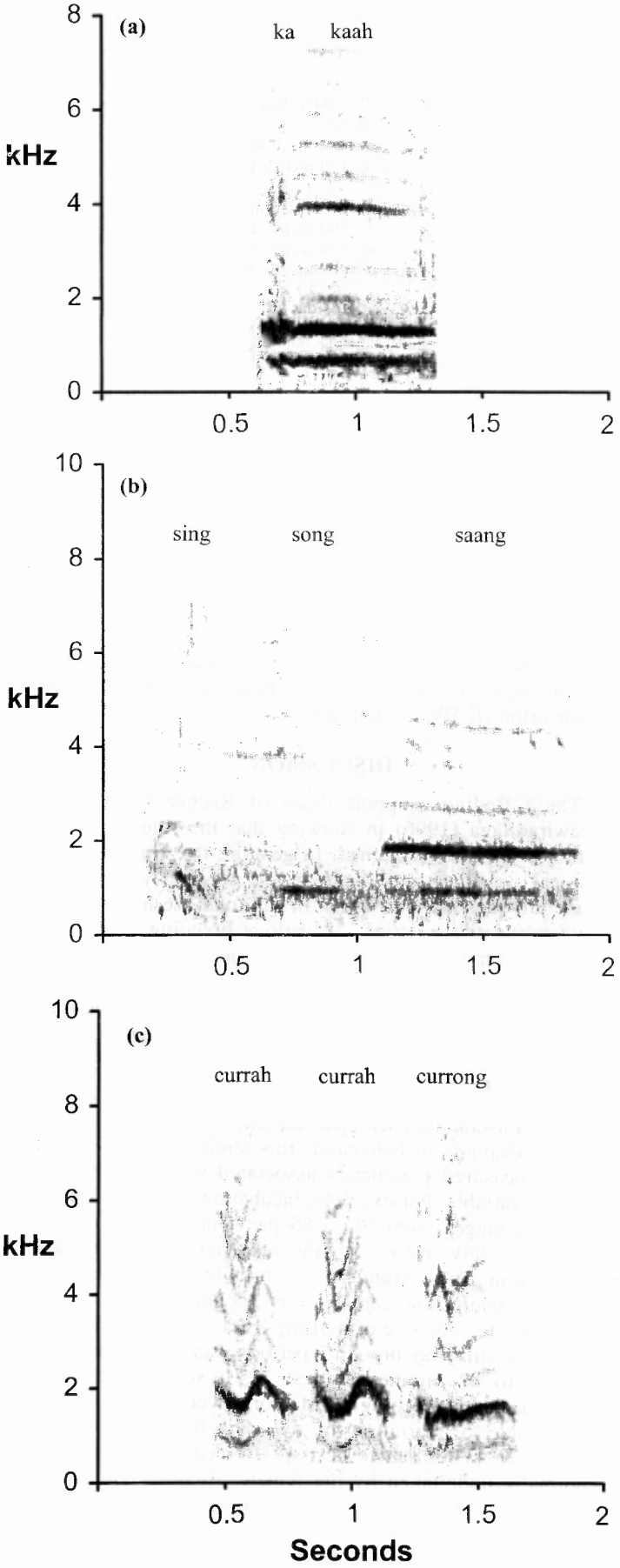


Figure 3. *Sonograms of three distinctive calls of breeding Pied Currawongs at Wollongong, New South Wales.*

TABLE 6

Number of territorial calls (*currah-currah-currong*) given by parent and other Pied Currawongs at nest 3 (Mt Keira) on 3 November 1994 (d19). Approximate distances and compass directions are relative to the nest.

Period	1	2	3	4
From/to	First call at 0432 hours to 0700 hours*	0844 hours to 1044 hours	1308 hours to 1522 hours	1700 hours to last call at 1850 hours*
Duration	2 hours 28 minutes	2 hours	2 hours 14 minutes	1 hour 50 minutes
Male	2 @ 130 metres E	0	1 @ 100 metres E 3 @ 120 metres E	1 @ 150 metres E 1 @ 180 metres N
Female	6 while incubating	0	1 @ 270 metres N	1 while incubating
Other Pied Currawongs	6 @ 300 metres E 2 @ 350 metres NE 1 @ 400 metres S	8 @ 450 metres S	1 @ 450 metres NE 1 @ 300 metres E	27 @ 350 metres N 13 @ 350 metres NE 6 @ 350 metres E 9 @ 350 metres S 1 @ 300 metres W
Male or other Pied Currawongs	45 @ 300 metres N 25 @ 250 metres N	0 36 @ 200 metres NE 61 @ 250 metres NE 9 @ 300 metres NE	0	17 @ 200 metres N 3 @ 250 metres N 6 @ 300 metres N
Total	87	8	7	191
Calls per hour (all currawongs)	35	4	3	104

*Civil twilight: 0426 hours to 1852 hours.

commenced, dependent juveniles with parents and other currawongs in flocks of 10–15 birds were recorded at Mangerton (KAW, unpubl. data).

DISCUSSION

These findings support those of Recher (1976) and Prawiradilaga (1996) in showing that the role of parent currawongs is well defined. In general, the female builds the nest, incubates the eggs and broods the young. The male provides her with much of the food she needs while performing these duties. As various breeding stages are entered, some behaviours abruptly cease. For example, solicitation displays are common during the nest-building stage but somewhat rare after incubation commences. Courtship-feeding is frequent during nest building and incubation but ceases almost immediately after the young are hatched.

Notwithstanding such clear distinctions in sex roles and abrupt changes in behaviour, this study also shows that some measured parameters associated with breeding are widely variable. For example, incubation constancy during watches ranged from 45 to 85 per cent. Behaviours that varied widely were: female rest periods during the incubation phase (range 1–36 minutes); male absence periods while the female was incubating (max. 120 minutes); feeding rate of nestlings (2.4 –11.1 visits/hr) and longest continuous brooding periods (range 16 minutes at nest 7 to 82 minutes at nest 2). It seems likely that biological and ecological factors were affecting the magnitude of variation in most of these parameters. Moreover, males at two nests performed duties that were normally undertaken by the female. At nest 4, the male made four construction visits, and at nest 3, the male performed one incubation bout. Indeed, it seems likely that individual birds may sometimes display atypical behaviour. Some form of non-stereotypic behaviour was evident at some time in most of the individuals that were observed.

Perhaps the most important difference between the results of this and previous studies is the size of territory and the manner in which it is used. Whereas at Wollongong the breeding home range was 12–16 hectares and the defended territory was about half a hectare (40 m radius), Recher (1976) found at Dangar Island, that the breeding pair confined all activities to a defended area of approximately 100 metres by 70 metres (0.7 ha). The defended territory at Canberra was much larger than at Wollongong and Dangar Island, varying from 4.5 to 11.5 hectares (mean = 7.9 ha, n = 6) (Prawiradilaga 1996). At Canberra, no mention was made of currawongs moving outside the defended territory. In tall open eucalypt forest at Moruya, currawong nests were 500–600 metres apart, providing a breeding home range of 20–28 hectares (Marchant 1992). At Turramurra, a Sydney suburb, nests were about 250 metres apart (Larkins 1994), providing a breeding home range of about 5 hectares. More comprehensive studies are needed to determine the size and nature of currawong territories.

Because it was impracticable to regularly inspect the contents of nests by conventional means, this study did not determine precisely when each egg was laid and when each nestling hatched. Accordingly, the estimated incubation period of about 21 days should be treated with caution, even though Recher (1976) and Prawiradilaga (1996) determined the same period of time. The estimated nestling period of about 36 days should be treated even more cautiously as Recher (1976) and Prawiradilaga (1996) respectively estimated that the nestling period was 33 days and 'about one month'. A more accurate estimate of these breeding parameters provides an interesting challenge in future research.

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TWENTY-EIGHT YEAR OLD GALAH

On 25 September 2001, a wing-tagged Galah *Cacatua roseicapilla* was taken by a member of the public to the Wattle Grove Veterinary Clinic as it was unable to fly.

Veterinarian Tim Oldfield examined the bird and X-rayed the damaged wing. He found that the wound had been caused by fighting or an accident; he emphasised that there was no damage at or near the site of attachment of the wing-tags. The bird was euthanased after Tim had talked to me, since the bone had become infected.

Galah 200-05239 was captured at the CSIRO Wildlife Laboratory at Helena Valley as a brown-eyed juvenile (= in first year) on 28 June 1974. It was subsequently reported to me as an adult male seen several times around Helena Valley before moving up the Darling escarpment to Kalamunda and Gooseberry Hill, from where it was reported on October 16 1990, February 17 1997 and July 19 1999. It had moved a distance of c. 5 kilometres and 200 metres in altitude. However, it was recovered back in Helena Valley, when it was estimated to be 28 years old.

The photograph (Fig 1) shows that the stainless steel band has lasted extremely well and shows no sign of wear. The tags which were red anodised aluminium discs (see Rowley and Saunders 1980, Corella **4**, 1–7) have also worn very well and were still quite legible, 27 years after placement.

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Figure 1. *Photograph of stainless steel band 200-05239 and red anodised aluminium wing tags removed after 27 years on a Galah banded as a juvenile in June 1974 at Helena Valley, Western Australia.*