THE SUNBIRD

Volume 5 Number 4 December 1974

STUDIES OF THE APOSTLE BIRD AT INVERELL PART 1: GENERAL BEHAVIOUR

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SUMMARY

A field study of the Apostle Bird *Struthidea cinerea* was made near Inverell, in North-eastern New South Wales, from September 1962 to December 1973. A description of the bird, its habits, calls and social system is given. The social system is based on a unit of two or more breeding adults plus juvenile auxiliaries. Most auxiliaries leave in autumn or winter but one auxiliary male remains to help with nest establishment in spring then leaves. Breeding behaviour will be discussed in Part 2.

GENERAL INTRODUCTION

The Apostle Bird *Struthidea cinerea* is characteristically seen in parties of about twelve incessantly chattering individuals. It chiefly occurs in the hotter inland areas of Queensland and New South Wales which have annual average rainfall of less than about 750mm. From 1962 to 1973 I regularly observed the group near my home at Gilgai (29°53'S, 150°40'E) near Inverell, New South Wales. This group was always smaller than usual for this species: this is a characteristic of the species near the eastern limit of its range. I also made a few additional observations in similar habitat at Gwydir Park, approximately 16km west of Gilgai. I particularly investigated the structure of the social unit and the roles of auxiliaries. I was also studying group structure in the closely related White-winged Chough *Corcorax melanorhamphus*, during this period.

Summers are hot at Gilgai (mean maximum temperature in January is 30°C), while winters are cold (mean minimum temperature in June is -2°C). Annual average rainfall is 750mm fairly evenly distributed through the year; winter falls are usually light, but heavy storms

often occur in summer.

The terrain at Gilgai is slightly undulating granitic loam, rising to a boulder strewn hill on the north. Continuous dry sclerophyll woodland extends across the eastern third of the area onto the hill where there is a thick understorey of *Acacia, Leptospermum, Kunzea* and smaller shrubs. The remainder is grassland with scattered trees, chiefly red stringybark *Eucalyptus macrorrhyncha,* red gum *E. blakelyi* and rough-barked apple *Angophora floribunda* with a few apple-box *E. bridgesiana,* yellow-box *E. melliodora* and black pine *Callitris columellaris.*

An old cottage with sheds, a new house (built in 1967) and a small dwelling (removed in 1972) occupied the south-western corner of the study area. Shrubberies surrounded all buildings. A camphor laurel *Cinnamomum camphora* tree 12 m high grew between the old cottage and the new house. Water was available at each cottage and in Gilgai Creek 500 m east. A deep ditch bordering the lane on the southern boundary of the area was fed by a spring and usually held some water.

A full description and map of the district within 25 km of Inverell is given in another paper (Baldwin, 1975). A map of the Gilgai study area also appears in Baldwin (1971).

DESCRIPTION

Struthidea cinerea is about 33 cm in total length and has a stubby bill and grey-brown plumage. Non-breeding plumage is the same in both sexes. In breeding plumage the tips of the ash-grey feathers of head, throat and nape become silvery-white in the male for a short time before the post-nuptial moult but remain fuscous in females and juveniles.

Sex and age are recognizable by the colour of the iris. Females of all ages and juveniles in their first year have a brown iris, second year males have a smoky-brown iris which changes to grey at the end of the second year. Frith (1969) states that adults of both sexes have grey eyes but I observed only one bird in each unit with grey eyes: females and young had bright, brown eyes. Because of these morphological differences, and differences in behaviour, that permitted sexing no banding programme was initiated.

PREENING

Allopreening occurs throughout the year but is most frequent in summer and autumn during mid-morning and mid-afternoon. Several birds crowd together, usually on a horizontal perch, but occasionally on the ground, and preen each other with oil nibbled from their own or another bird's uropygial gland. Neck, underwings and tail are liberally treated. The birds shuffle about, change position and chatter incessantly. Loud shrieks could mean that pecks are sharp. Marked attention is paid to the preening of fledglings which press close, lift wings, and present the nape to an adult while themselves picking at breast

and abdomen. A dominant male sits between two females, nestles close to each in turn, and presents nape or throat for attention. Preening sessions last as long as fifteen minutes.

Autopreening occurs frequently in adults and has been seen in fledglings two days out of the nest. Breast, abdomen, underwings, back and tail are preened then the bird stretches out a leg and a spread wing, lifts the head high, stretches, relaxes and continues to preen.

During one unusually hot day in July several birds, each with dragging wings,spread tail and fluffed body feathers,swung about on tiptoe making swift pecks at themselves mainly under the wings and on the upper tail coverts. These birds may have been irritated by lice, because wing dragging is not normally employed in allopreening.

FEEDING

The natural foods of the Apostle Bird are insects, worms, grass seeds, blades of green grass, leaves of clover and other herbage. Offered foods such as grain sorghum, rolled oats, soaked bread and cooked meat are readily eaten.

Grain is nibbled before swallowing. Meat and stems of seeding grass are held down with the foot while being fed upon. Insects are captured by jumping, by hawking expertly about tops of trees and by searching under bark while fluttering and clawing up trees. The bill is used to turn over ground litter and sometimes to scrape it away. The foot is not used for scratching. Oat grains were collected from the wool of a pet sheep by an Apostle Bird which stood on the animal's head, pecked around its neck, then with sharp claws digging in moved backwards down the nose of the standing sheep. A large phasmid, held down with one foot, had its legs torn off and thorax nibbled but only the abdomen was eaten.

Apostle Birds were fed regularly at the new house at 07:30 and 16:00. Food was readily taken but the birds fed for a few minutes only before flying off to search for natural food. These visits were followed by absences of thirty minutes to four hours. In cold, wet weather the birds relied on food provided by man for about half of their diet. During good weather in the nesting period the birds usually consumed only natural food.

Apostle Birds frequently follow a group of White-winged Choughs to collect worms, a feeding association which could be correlated with the lengths of bill as in the Sandpiper (Thomas and Dartnall 1971). The long-billed chough digs deeply for large grubs, the stubby-billed Apostle Bird sorts the flung soil for smaller items.

MOVEMENT

When *S. cinerea* stands still the head,body and tail form a shallow

angle with the ground and the floppy tail sinks and is quickly flicked up again - also a mannerism of the Magpie Lark *Grallina cyanoleuca*. The walk is quick with tail swaying side to side just above the ground. There is no forward jerking of the head found in the Magpie Lark and, to a lesser extent, in the White-winged Chough. When a number of birds of any kind gather at food an Apostle Bird often assumes an erect posture, "Churrs" loudly, and walks in an unusual high-stepping manner away from the gathering. This same erect walk is used when passing through wet grass but then the tail is held high to avoid wetting it.

Running occurs in short, quick bursts. Hopping is unusual, but hops can be twice as long as the length of the bird. Low (under 6 m), direct flight consists of three or four quick wing beats, accompanied by a harsh "Kweer", alternating with short glides in which the tips of the primaries are raised. Longer glides from perch to ground and from tree to tree are common. The longest measured glide was 50 m.

The retrices are arranged in four different positions according to the activities of the bird. These maintenance activities require dry feathers, hence the care taken when parading through wet grass.
1. In the form of a spread fan the retrices spread to the full extent give bouyancy at take-off and in flight; spread and pressed down they give stability when perched.
2. In the form of a closed fan the tail feathers are bunched to lower wind resistance - a gust blowing against a spread fan may tip a bird over.
3. At the end of a glide the medium retrices part allowing air to pass through as the bird descends smoothly to perch. Before gaining this form of tail control young birds tip forward to the point of imbalance.
4. The four middle tail feathers usually arch above the others and control balance when turning quickly on the ground, when descending in a gusty wind and when walking along a limb in a stiff breeze.

CALLS AND POSTURES

Communication within the party is achieved by song, chatter and some less frequent calls. Three aggressive calls (the "Kreech", "Chee-ow" and "Charr" or "Churr" calls) are used interspecifically and, to a lesser degree, between members of the unit.

The territorial song of the male is a harsh "Adios-kreech" rising on the final syllable, and a pleasant "Chewa-reea"; both are given frequently in the breeding season. They are seldom heard at other times.

The "Kreech" call, the latter part of the song, is also used as the warning call of the male. In the accompanying posture the neck is arched, wings spread and drooping, tail spread, upper back feathers stiffly erect, body feathers fluffed. This call and posture are used

by the dominant male when a second year male approaches him posturing and calling in a modified way. A similar "broody-hen" display is used by the male to intimidate other species at food. A long, increasingly loud "Kreech" is given by the male to keep other species from nest or breeding unit. A soft "Kreech", increasing in volume, is given by both sexes when a person comes near a nest or the group. If the call is sharp and shrill it signifies a bird of prey; it has only been heard from the male. A soft "Kreech" is the dominant male contact call.

"Kreecha-kreecha" is the female version of the "Kreech" call. The body posture is like that of the male, and with threatening runs and frequent pecks it establishes the pecking order within the breeding unit. Both females and juveniles use this call and posture to warn other species. Its effectiveness is sometimes increased by birds with bunches of grass in their bills advancing as a group. Should other species attack, the male Apostle joins in with a piercing "Kreech". The young male appears to use this call as his first song.

The "Chee-ow" call is a loud and harsh call used by all members of the unit when an intruder comes near nest, young or food. However only a whisper-soft "Chee-ow-eer" is used at the time of hatching. An exchanging of birds at the nest is announced by a harsh "Chee-ow" by the arriving bird. "Chee-ow" is used in border disputes by all birds in both parties.

The "Charr" (male) and "Churr" (female) calls are less aggressive than "Kreecha-kreecha", and are accompanied by a fluffed feather and tail fanning posture by the female to correct greedy juveniles at sources of food. A sustained "Churr" from the female keeps other species away from the fledglings. At the age of six months a young male begins to posture with drooping wings and spread tail before the head bird who "Charrs" harshly, crouches close and pecks the juvenile.

Apostle Birds are seldom silent, they chatter noisily between themselves and to other species in a medley of notes in which one can distinguish the three calls. Several other calls can be distinguished. Adults keep in touch when flying or searching for food with a harsh "Kweer". The adult to fledgling "Chuck" is soft. A short pipe is repeated when a bird wishes to be relieved from sitting on the nest. This same note is used by the male when perched beside a brooding female. At dawn Apostle Birds give a similar call that is louder and longer. One loud pipe is the alarm call of the male and is obeyed instantly by all birds which take cover or freeze for a predator is close by. Rarely, and always in autumn after nesting is completed, a musical "Chock" similar to a note of the Grey-crowned Babbler *Pomatostomus temporalis* is heard. The first food-begging call by fledglings is "Kair". Later it develops into "Keersh", which in turn develops into "Kreecha".

DISPLAY

Struthidea is not a timid bird, immatures and unattached transients will follow close to a human's feet, chatter and even respond in louder tones if encouraged. The birds with a territory at Gilgai were very tame, as were those at Gwydir Park. Juveniles are friendly, though cautious, and this wariness increases with maturation. Food may be taken from the hand but the least movement makes the bird jump away. If a person remains motionless a hungry bird will solicit food by pecking an arm or empty hand. Yet, despite the bold approach, there is a minimum distance which man can usually approach before birds flee.

Clustering occurs in the hotter part of the day from noon to mid-afternoon during the incubation time and when fledglings are semi-independent. Prior to clustering, chattering Apostle Birds drive other species from the selected tree, then crowd together on a horizontal limb in the shade, mostly facing the same direction. There is much changing of places and chatter before the birds become quiet, crouch down, close their eyes and appear to sleep. I have approached within touching distance before the birds woke and scattered. Allopreening may occur but this normally happens before and after clustering. During the breeding season (October-March) maximum day temperatures are $25^{o}C$ - $30^{o}C$, thus crowding cannot be for warmth. But warmth may be important when birds huddle together on the ground in sunny sheltered places in winter.

A drop in temperature, or showers in summer and warmth in winter triggers play. This behaviour seems to have some value in teaching juveniles aggression, *e.g.* when small branches are pulled to the ground, held by bill and claw then tugged and twisted until they break, the birds adopt similar postures to those of fighting males. Leaves may be stripped off and flowers picked to pieces. But amusement would appear to be the only motivation when birds hop quickly up a ladder, glide down, then repeat the performance many times. Follow-the-leader around trees appears aggressive but physically harmless. Each bird crouches low and tries to nip the tail of the bird in front; they dart away and return while giving the calls of "Kreech" and "Chee-ow". They strike out with claws and endeavour to turn another bird on its back and, as the play increases in intensity, sharp pecks are exchanged. The dominant male may voluntarily turn over, relax his claws, and let other birds peck his abdomen for a while, then jump clear and lead the chase around the tree again.

Several birds may cling together, roll over, claw, peck and call "Kreech" and "Chee-ow". Two may lie on their sides with claws locked and flutter their wings - as much as possible in that position - making a depression in the soil. After a few minutes both jump up and move off.

These are common autumn displays in which adults and first-of-the

season young join, but fledglings hop up to a sheltered branch. When the adults tire they often join the fledglings in the tree for preening.

A young male may challenge a dominant male by running about with a leaf held high in the bill. A tug-o-war may then result in fragmentation of the leaf as smaller and yet smaller pieces are offered by either bird. The dominant male does not attempt to claw or peck; the post-breeding period and age (under six months) of the juvenile, could be inhibiting factors.

SOCIAL SYSTEM AND TERRITORY

The social system of the Apostle Bird consists of a breeding unit plus young-of-theyear, termed auxiliaries after Parry (1973). The composition of, and the change within, a group (breeding unit and auxiliaries) studied at Gilgai from 1968 to 1971 inclusive, is shown in Table I. Throughout this study individual birds were kept track of by watching colour changes of plumage and irides and by noting typical sexual behaviour. Tracking was comparatively easy because this territory appeared isolated from other territories. The breeding unit is dominated by a male and has two or three females. One male and three females were present at Nests A to G; one male and two females at Nests H to M. Four of the birds which arrived at Gilgai in September 1962 were already banded. Three (females or young for they had brown eyes) left during the next two years, but the banded male stayed with the unit until his disappearance in autumn 1966. A male with a deformed foot, hatched on 5 February 1969 (Nest D), replaced the dominant male after a fight on 15 October 1970 (Nest I) and remained head of the group until February 1974. These observations suggest that males are dominant for several years at least.

One auxiliary male from the last successful brood stays over winter with the unit to assist with the first nest of the season. Building is underway and in some cases sitting has commenced before this auxiliary is forced to leave by means of the "Kreech" call and physical combat. When Nest A was not finished because of cold, frosty weather, the auxiliary male waited to help with Nest B. An auxiliary male present at Nests E and F left for a few days when sitting commenced (Nest F) but returned when a hailstorm destroyed the eggs. This same auxiliary helped with Nests G and H before replacing the dominant male of Nest I. I was able to keep track of this auxiliary male because it had a deformed foot.

Juveniles from the first brood of the season help to build the second nest, then leave the unit but remain close to the territory. They return to feed the newly fledged chicks. Auxiliaries from Nest B left on the day the chicks hatched in Nest D and returned the day they fledged to help feed them. A male and a female auxiliary which arrived six days after the chicks hatched (Nest I) may have been young from Nest D hatched twenty-one months previously (inter-

mediate nests were unsuccessful):the male had smoky-brown eyes and was therefore in his second year. When the three fledglings were four days out of the nest and safely in the care of three females (two unit, one auxiliary) the primary male drove the auxiliary male away. Auxiliaries from Nest I left when sitting commenced at Nest J and returned three days before the chicks fledged, which was four days later than usual in wet weather.

TABLE I

Nesting activities and alterations to the breeding unit during the four years from 1968 to 1971. * M = male; F = female; J = juvenile under six months.

Date	Nest	Nest status	No.M*	No.F*	No.J*	Remarks
1968						
15 Feb			1	3	2	1 J leaves 29 Feb.
Oct	A	Not finished	2	3	-	1 J leaves 4 Nov.
12 Nov	B	Sitting	1	3	-	3 J hatched on 30 Nov.
1969						
Jan	C	Not finished	1	3	3	1 J lost on 12 Jan.
Jan	D		1	3	2	3 J hatched,2 leave on 5 Feb,2 return 18 Feb 1 chick lost 21 Feb.
Nov	E	Abandoned	2	6	-	1 F leaves.
1970						
30 Dec	F	Sitting				Abandoned after hail-storm on 1 Jan.
8 Jan	G	Not finished	2	5	-	2 F leave, 1 F leaves on 2 Feb.
Sep	H	Abandoned				
15 Oct	I	Sitting	2	2	-	1 M leaves,3 hatch on 28 Oct,2 auxiliaries join in 3 Nov,1 M leaves 14 Nov,1 F in 21 Dec.
28 Dec	J	Sitting	1	2	2	2 J leave,3 hatch on 12 Jan,2 J return on 26 Jan.
1971						
Feb	K	Abandoned(this was nest G finished)	2	3	3	1 F leaves in May,2 J leave in Aug,1 M and 1 F leave 17 Sep.
3 Oct	L	Sitting (nest J re-used)	1	2	-	2 hatch 18 Oct.
19 Oct	M	Abandoned				

In autumn and winter one auxiliary male stays with the unit but the other auxiliaries come and go and may band together with transient young. In the three breeding seasons from 1968 to 1971 there were four, none and five surviving progeny, but eight (all brown eyed and probably young-of-the-season) came frequently to the territory. These were tolerated by the unit until spring when they were evicted from the territory by the "Kreech" and "Charr" calls of both sexes and physical combat between males.

It is thought that young females may replace older females in spring but this must be verified by banding. I agree with Frith (1969) who stated that during the non-breeding season "some interchange of juveniles occurs". Despite frequent aggression by older females, two young females stayed on at Nest E but subsequent friction between the five females may have contributed to nest failure.

The unit wanders over a home range from late summer to winter. The first absence is a few hours, then a few days and finally as long as a month in the winter. Over the years availability of food offered by humans has limited these extra territorial wanderings.

Autumn flocks of eight to eighteen birds (approximately two to four units, determined by eye as each unit maintained its identity when feeding) are usual, but in the drought of 1965 on 21 April and 24 May groups of 25 to 48 birds were seen moving south from Gwydir Park homestead. These autumn groups are tolerated by the territorial unit and may mingle for a day or two. It is at this time that interchange of members could occur, but it is essential to note that, apart from accountable dispersion of auxiliaries, numbers, sex and age classes of this territorial unit (determined by colour change) did not appear to change throughout winter periods.

Spring flocks of five to eighteen were common and seemed to consist of young of the previous season plus a few adults. One such flock of eighteen had only one adult male and two second-year males in contrast to an autumn flock of similar number which had four adult males. Some of the brown-eyed birds attempted to join the territorial unit by approaching in submissive posture, crouching and calling as young, but they were driven off with the "Kreech" and "Charr" calls. After a few days the flock tended to split into possible breeding parties but aggression ("Kreech" and "Charr"calls) by unit males drove the flock away.

Flock activity peaked in May and September. All autumn flocks moved south or south-west, some spring flocks moved north but others were not recorded.

The territory of the Apostle Bird at Gilgai is roughly a circle of about 350 m in diameter. The west-south boundary is common to a territory of the White-winged Chough, but this extends further north-east into a fledgling area (Baldwin, 1972).

Food gathering during nesting is restricted to the territory, which the Apostle Birds cover by moving abreast or by concentrating in one place at the same time each day until the supply is exhausted. A party of eight Apostle Birds first arrived in the study area on 2 September 1962. One male had a plain leg band, and three of the others had coloured rings. They visited the house with two young ones in August 1963. In June 1964 fourteen established the present territory. Intraspecific aggression ("Kreech" call) in which both sexes participated, together with clawing, pecking and with males turned on their backs, resulted in the departure of nine birds, and the formation of a nesting unit of four unmarked birds and the banded male.

The first nest was built in October 1964. Nesting occurred within the same territory for nine years and is continuing. In the breeding season, maintenance of borders was achieved by aggressive behaviour but actual physical contact was rare. The dominant male, giving loud "Kreech's" and "Ker-eech's", flew straight to the trespassing conspecifics followed by the rest of the unit all calling "Chee-ow". In both parties, each bird erected the upper-back feathers; fluffed the feathers of nape, head and underparts; fanned the tail and ran forward. The defenders picked up grass, soil or small stones, but the intruders were not seen to do so. After a short encounter the intruders left, pursued by the unit screaming "Chee-ow". Border disputes are noisy and obviously meant as warnings, but within the territory disputes may culminate in bill and claw fighting. Predatory animals, such as hawks or goannas, are challenged by the whole flock. This challenge is characterised by posture and calls, like those used in border maintenance, but grass gathering is not employed. If the predator is in a tree the birds will surround it, chatter aggressively, dart down, peck and return to perch. They are often joined by the Magpie-lark, Pied Butcherbird *Cracticus nigrogularis* and Black-backed Magpie *Gymnorhina tibicen* which attack by dive bombing. Nest robbers are attacked by fluffed out balls of fury, clawing, pecking and screaching. The predator is often brought to the ground and subjected to vicious pecks. A Pied Currawong *Strepera graculina* trailed an injured wing after one such attack, and thereafter it became the victim of frequent unprovoked attacks.

Although intraspecific and interspecific challenges are met in much the same way there is an element of mischief in the treatment by Apostle Birds of some interspecifics (Black-backed Magpie, Pied Currawong, White-winged Chough, Laughing Kookaburra *Dacelo gigas*) at the food table. These birds are pursued by the persistent following and loud calls of Apostle Birds, or have their attention diverted by a displaying group while one Apostle Bird gives them premeditated pecks on back and tail.

DISCUSSION

Peters (1962), subdivides Grallinidae into two sub-families, the

Gralllininae (Magpie-larks) and *Corcoraciae* (White-winged Chough and Apostle Bird). On a behavioural basis it seems that a definite relationship exists between *Struthidea* and *Corcorax* for both genera have a social system based on a breeding unit plus juvenile auxiliaries, whereas *Grallina* is pair-bonded and has no auxiliaries. Frith (1969) details other similarities in behaviour which support these observations.

In *Struthidea* one auxiliary male stays with the breeding unit throughout winter but leaves when nesting is established in spring. The male auxiliary counterpart in *Corcorax* remains until the younger male auxiliary is three months old. Rowley (1965) states that the "loss of the dominant male *(Corcorax)* usually results in the break-up of the group". I have not found this so: the auxiliary male replaces the lost dominant male.

The statement by Harrison (1969) "that the flock is the unit and the first birds to become sexually active become the dominant pair" is not true of *Corcorax* or *Struthidea*. Older birds still in their prime continue to dominate for several years until they are replaced by a younger bird. After an auxiliary male Chough of ten months copulated with an adult female one month before the dominant male, the youngster later appeared to be sexually suppressed by physical attack which left him lamed. Sexual behaviour in the young of *Struthidea* is also probably checked by fighting. The "Kreech" call and posture of the dominant male is directed towards young males from three months of age. From six months, fighting (bill and claws) occurs. Restraints imposed by the peck order arrest mature behaviour in young females.

Rowley's statement that he has not "in many hours observation..... seen actual physical combat between choughs" is different from my own experience which was that unit males fight even to the extent of broken legs and wings, bleeding caudal stumps and death, during the post-breeding period when one adult male is displaced by another.

At this time the primary male is in post-nuptial moult and may be deposed by a full-feathered young male.

Territorial behaviour, nesting and post-breeding movements of *Struthidea* and *Corcorax* are similar. Each genus has permanent colour change of the irides of the male with age and temporary colour change of the iris with anger.

An association of benefit to both genera begins when a party of White-winged Choughs is welcomed by chattering Apostle Birds which tag after for discarded food. The Choughs build their first nest in July, and this almost appears to be supervised by Apostle Birds which nest in October. The Apostle Birds sit beside or in the nest adjusting material; they may be present when Choughs copulate (Baldwin 1972); they watch beside a

sitting bird; they warn of danger and attack predators; they fly to assist when Choughs call a warning. Both species may wander together in autumn and winter. Rain brings both back to drain the nests of either genus, but neither has drained the nest of *Grallina*. Both nests have cores of grass *(Struthidea)* or bark *(Corcorax)* arranged in tiers and plastered with mud and have a drainage pad (Baldwin 1972) at the base. The nest of *Grallina* has neither core nor drainage pad but is made of balls of mud mixed with short fibres pressed together and smoothed over. Despite the doubt expressed by Mayr (1963) the method of nest construction may be a valuable clue to genetic relationships.

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NESTING OF THE LETTER-WINGED KITE IN WESTERN QUEENSLAND

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In many parts of south west Queensland, above average rainfall for the last three years has resulted in a prolific growth of vegetation. During the same period there has been a rapid increase in the population of the Longhaired or Plague Rat, *Rattus vilosissimus*. By late 1974, over a wide area, wherever the ground was soft enough for digging, it was difficult to step between occupied burrows.

A watch was kept to determine the effect, if possible, on the population density of the Letter-winged Kite *Elanus scriptus*. Previous writers have drawn attention to its relationship with rats and, sometimes, mice; notably Hall (1969), Rabig (1970) and Beruldsen (1971). Predictably, the kite population became large, and widespread breeding occurred.

With my son Christopher I visited three breeding colonies between 18 and 25 September 1974, and saw indications of another that could not be investigated. We believe many more nesting colonies than those visited existed at the time in south west Queensland.

On 21 September, in company with Mr. Jim Dwyer, manager of Glenormiston Station, we inspected a breeding colony 33 km south of the homestead (23°12'S,138°45'E). The treeless plain surrounding this colony was riddled with rat burrows. The time was 17:00 and the evening hunting had not commenced. About twelve nests were built in stunted Coolibahs *Eucalyptus microtheca* fringing the banks of a billabong. Many young had left the nests, one had eggs, and several were under construction. These latter nests and the number of adult birds, indicated that they may at least be double brooded. I have noted previously that other species in Central Australia appear to keep on nesting as long as conditions are suitable, quite irrespective of the season.

On 23 September another breeding colony was found 97 km east of Cluny Station, on the Monkira road (24°44'S,140°05'E). About fifty adult birds were present, with twenty nests spread out in the trees (mostly Coolibah) for 1 km along the banks of a small watercourse. At 18:15 some hunting had commenced. West of the creek the plain held a heavy concentration of rat burrows. A few adult and juvenile kites were already on the wing, some hunting. Again, nests were in all stages from scarcely completed to recently vacated. One tree, in addition to an occupied Letter-winged Kite nest in the lower branches, had an occupied nest of

Australian Crow *Corvus orru* higher up. No interaction between the two species was evident.

Between sundown and full dark the hunting tempo increased, both in numbers of hunters and the number of kills. Noises from occupied nests, invisible after dark, indicated that nestlings were being fed until we left at 21:00.

On 25 September we revisited a site on Morney (25°16'S,141°40'E), west of Windorah, where we had seen kites hunting after sundown a week before. It was now mid-morning and no kites were visible. The nesting colony was located along an almost dry channel of Morney Creek, 2 km north of the Windorah road, again adjacent to an extensive rat colony. We investigated this kite colony for 3 km along the creek, without reaching its limits in either direction. More than fifty nests were inspected, mostly in Coolibahs, though other trees were used occasionally. Again, nests were in all stages, from partly built to recently vacated. One fledgling left the nest as we approached, and wobbled its way out across the plain. A Fork-tailed Kite *Milvus migrans* followed it for a while, above and just behind, then left. The young Letter-winged Kite continued for 1 km, improving its technique rapidly, and finally made a competent landing in a dead tree. No parents were in evidence.

In this colony, as in those on Glenormiston and Cluny, all nests were made of sticks, sometimes mixed with dry stems of Roly Poly *(Bassia* sp.). The material in nests under construction or newly completed was light yellow to brown; in older nests almost black. Some were in old nests of Fork-tailed Kite or Whistling Eagle *Haliastur sphenurus*. This is in contrast to the situation reported by Beruldsen (1971) in South Australia, where Letter-winged Kites usually occupied old nests of the Australian Raven *Corvus coronoides*. We suspect that disused nests of suitable size and type may be appropriated by the Letter-winged Kite from time to time, and renovated. Lining was mostly rat fur, possibly broken down pellets, as noted by Beruldsen, but cattle dung was often used as well, and sometimes green leaves of Coolibah or Beefwood, *Grevillea striata*. The presence in some of a few kite feathers was probably fortuitous. In 1972 Allan Ey (pers. comm) recorded nests of green herbage, lined with rat fur, on Springvale Station (23°33'S,40°42'E).

New nests were clean, but increasing amounts of droppings appeared on the nest, the foliage below and the ground beneath the tree, as the age of nestlings advanced. Height above ground varied from 2-10 m, usually the maximum available to give a firm foundation. Most nesting trees had one nest, some had two and one had three. More than three nests were never found in one tree. Some nest trees were adjacent, others as much as two hundred metres apart. Many had a perching point above and close to the nest as described by Beruldsen (1971); it was often occupied by

adults when not brooding. In addition to an occupied nest one tree had a feeding platform, a disused Fork-tailed Kite nest, which held the remains of many rats, and was covered with red ants.

For the seven nests measured, external diameter averaged 504 mm, (381-736 mm), external depth 344 mm, (288-584), egg cavities 195 mm across (152-254) by 97 mm deep (51-127). Nine clutch sizes ranged from 2-5, averaging 3.3, though the smaller clutches may have been incomplete. In one egg found in a nest with four well grown chicks, incubation had proceeded about half way before it had failed. Egg colour was fairly uniform; white to buff ground colour, spotted, blotched or smeared with reddish or brownish markings in varying amounts, mostly covering about 75% of the shell. Some markings were superficial, and could be removed with a damp cloth. Some 60% of eggs were marked predominantly towards the larger end, 30% at the smaller end, while on the remainder markings were evenly distributed. Three were smeared with a white chalky material over the markings. One had a distinct, unbroken dark band towards the larger end. The twenty eight eggs measured averaged 43.9 mm (41.4 - 48) by 33.0 mm (31.5-33.3) (Fig. 1).

Nestlings when hatched were covered with whitish down, the iris was dark brown, bills and feet black and cere blue grey (Fig. 2). Shortly before fledging, young Letter-winged Kites closely resembled young Fork-tailed Kites at the same stage, the dark brown plumage plentifully spotted and mottled with buff. After fledging the plumage approximated to adult markings, except that the back and secondaries were still partly mottled, and there was a distinct rusty wash over the pale grey on crown, back, wings and breast. As the face turned white the very large, dark eye gave the head a characteristic owl like appearance (Fig. 3).

A notable feature of the colonies examined was the large degree of inter species tolerance. One nest with eggs (Fig. 4) was less than two metres away from that of a Black-faced Woodswallow *Artamus cinereus* also with eggs, while a Fork-tailed Kite and a Willie Wagtail *Rhipidura leucophrys* had working nests in the next tree. Many Letter-winged Kite nests had nests of Zebra Finch *Peophila guttata* built into their bases. Others being used in close proximity were Wedge-tailed Eagle *Aquila audax*, Black Falcon *Falco subniger*, Nankeen Kestrel *Falco cenchroides*, Magpie Lark *Grallina cyanoleuca* and Australian Crow. We could detect no interference or aggression among them.

Hunting and feeding of all Letter-winged Kites studied were closely geared to the activity of the rats, which are nocturnal. Even with the rat population at such a very high level, daytime sightings of rats were unusual. The birds perched around the breeding colony by day. Towards dusk they commenced to fly over

their feeding ground, which in our experience was the rat colony nearest to them. They flew in flat circles up to about 50 m above ground, usually hovering before making an attack. Rabig's (1970) observations on feeding were made over a small, localised rat colony, which may account for the lower height (9-15 m) at which his birds flew. This preliminary reconnaissance started before sunset. As the light faded and rats began to appear above ground, the hunting tempo increased. Hunting continued for some hours, we believe all night. By daylight, activity began to diminish, and by sunrise most birds were back at their daytime roosts.

One atypical feeding occurrence was noted. On 19 September 1974 at Breadalbane, just north of Bedourie, (23°50'S,139°34'E) we travelled through a swarm of Spur-throated Locusts *Austracris guttolosa* that extended at least 16 km north south and from 0-50 m altitude. In many places the swarm was so dense that the horizon was invisible. At 15:00 a few Letter-winged Kites were catching and eating locusts on the wing. Many other birds, including a flock of Plumed Tree-ducks *Dendrocygna eytoni* were also feeding on locusts. All seemed lethargic, sometimes taking a locust within reach, but not pursuing individuals. The kites later drifted away towards the east, where a channel of the Hamilton River was just visible, possibly to a nesting colony. Our other observations on hunting support those of Rabig.

As far as we could ascertain the kites were feeding almost entirely on rats. Other nocturnal native animals were seen, but no identifiable remains other than rats were found at nests or feeding platforms. Hall's (1969) observations were similar. At the time of Beruldsen's observations there was no rat plague in South Australia, but the area was heavily infested with mice, on which he speculated the kites were feeding.

The observed descent from hover to kill is unusual and spectacular. During the hover, wings were approximately horizontal, both wing and body movements being so controlled that the head remained stationary while searching the ground below. As with the Nankeen Kestrel, windless conditions required rapid wingbeats. When the air mass is moving, both kestrels and Letter-winged Kites can remain stationary and virtually motionless, supported by air for several seconds.

To lose altitude, the kites increased the wing dihedral by raising the wings, thus decreasing lift while allowing the head and body attitude to remain unchanged. During a very rapid descent, wing tips almost met above the back. This method seems very efficient for maintaining a close scrutiny of terrestrial prey, especially in darkness.

Like Rabig (1970) we were impressed by the size of the eyes of this species. This feature is discounted by Beruldsen (1971)

Figure 1. Nest and eggs of Letter-winged Kite in a small Coolibah tree. Photo: Christopher Cameron

Figure 2. Nestling Letter-winged Kites. Photo: Christopher Cameron

Figure 3. Juvenile Letter-winged Kite just after leaving nest. Most notable features include the large dark eyes, black wing and rufous wash on crown, inner wing and breast. Photo: Christopher Cameron.

Figure 4. Typical tree used for nesting (small Coolibah) surrounded by treeless plain. Nest at author's right hand and a nest of a Black-faced Wood-swallow at left hand. Photo: Christopher Cameron.

in observations made in South Australia. "None of the birds that I observed" he says, "appeared to have eyes any larger than those of the Black-shouldered Kite, .." To us, eye size was one of the most striking diagnostic features for identifying the two species. Black-shouldered Kites *E. notatus* were present in small numbers right across the area studied.

In summary then, in 1974 we found a high incidence of nesting Letter-winged Kites in south west Queensland, coinciding with a dense rat population. Hunting and feeding were almost entirely nocturnal. There was some crepuscular activity but during the day the Letter-winged Kites were roosting. Concentration of nests in a given area was determined by the presence of suitable nesting trees close to a rat colony. Such trees occurred only along watercourses, where Coolibah was the dominant species. The Letter-winged Kites appeared to tolerate the presence of other species, including other raptores, in the breeding colony. Observations suggest the probability of two or more consecutive broods, in quick succession, by at least some breeding pairs.

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OBSERVATIONS ON THE BEHAVIOUR OF THE YELLOW-BREASTED BOWER-BIRD

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In July and August of 1963 and 1967 I was able to observe 8 to 10 bowers of the Yellow-breasted Bower-bird *Chlamydera lauterbachi* in the Waghi Valley region of New Guinea. Two exceptionally well built bowers were closely examined and photographed. One, between two fast running streams which dampened the noise of the camera motor, was used for photographing and observing. The other, on the higher bank of the creek, was used only for observation as the bird was too sensitive to any strange noise in the vicinity of its bower.

The bowers (Fig. 1) have a "W" shape, as described by Marshall (1954) and Gilliard (1969), with the wings oriented approximately

in a north-south direction. Some bowers were substantially constructed of fine dry twigs, others were less massive. I suspect that the ones with greater numbers of twigs were bowers of the previous years used again after "repairs" and addition of more twigs, and the lightly built ones were newly built by young males in their first season or by an old bird not able to use the previous year's bower.

All bowers were decorated with many river pebbles, some grey-blue fruits, and one or more bright red berries, in the way described by Gilliard (1969). One bower included a bright red toy figurine: the male appeared to give this special attention, re-positioning it daily. Red berries were not replaced often and some were very shrunken after five days. Blue, hard cored, fruit remained even longer: however, as soon as the male found replacements the oldest ones were taken away. Fresh pebbles were added daily to the north saddle and those that rolled off were also heaped up in the saddle. The red berries were often shifted to a new position to display them to the best advantage.

The bowers were watched from 07:00 to 15:00 for five weeks. The male arrived at the bower from his perch on a nearby tree within ten minutes of my entering a hide placed 3 m away from the bower. On his early morning visits he landed at the south saddle with his beak full of some substance which he proceeded to apply gently to the tops of the twigs of the inner chamber, placing the beak 10-15 cm from the top of the twig and moving his head up till the end of the twig passed through his beak, rather like the way a duck preens its wing or tail feathers. I was not able to discover any deposits on the twigs "painted" in this way, nor do I know what the substance was.

The male revisited the bower every hour, sometimes for as little as 30 seconds, but at other times for up to 25 to 30 minutes. He entered the central chamber with cobweb-like growth from the surrounding vegetation and proceeded to apply this and re-arrange all the twigs, replacing coarser ones with finer ones where possible. He went over the chamber four times on most visits. He was unable to turn around in the chamber, so to change direction, he hopped out into a saddle and back again in two jumps. When he completed the re-arranging of the chamber he moved some pebbles, blue fruit or red berries in his beak to display them more effectively around the bower. Less often he attended to the East and West slopes of the bower and even more infrequently he went under the South or North wings of the bower to inspect there. Between visits to his bower he perched on a tree by the river bank awaiting the female's arrival.

I believe more than one female visited the observed bowers, although I am unable to be sure. They looked very similar but slight variation in sizes led me to suspect that more than one female was visiting. The female landed close to the bower,

Figure 1. The bower of the Yellow-breasted Bower-bird, showing the female entering the central avenue from the south. The male has just landed on the eastern slope, adjacent to the pebbles, blue and red berries.

sometimes out of my sight line. Sometimes she made a few inquisitive landings around it and then left. At other times, after satisfying herself that everything was to her liking, she landed at the south saddle. This entrance was the male's entrance, the one free of pebbles, where the male bird especially attended in the early mornings. The male landed immediately afterwards and placed himself on the eastern slope of the bower to display. One display lasted 28 minutes.

After some six minutes inspecting the situation on the west side of the bower, the visiting female landed at the south saddle and entered the chamber (as in Fig. 1). She remained in the chamber for 28 minutes without noticeable movement. Throughout this time the male hopped around, mostly on the east slope, performing various antics. He twisted his body to left

and right, moving his slightly spread tail towards his beak, made squeaking sounds, and picked up stones, twigs or berries in his beak and either showed them to the female or looked away from her. The red berries were used most prominently. They were held in his beak and shown to the female from every angle. At other times he sat in a twisted position and opened and closed his beak to display his red tongue to the female, occasionally opening and shaking his wings or twisting his neck around. After 28 minutes he jumped onto a branch overhanging the bower and jumped from this to land on top of the female, still motionless within the chamber. She appeared to shake him off violently because he flew out like a stone and landed in front of the bower. The female shook her whole body and beat her wings in the chamber for some 30 seconds before relaxing and flying off to land on a branch above my hide. The male remained on the ground trying to attract her down with calls and more body twisting, but after a while she flew off. He flew after her, and returned again 20 minutes later to examine his bower, shift a red berry and a few stones and fruits, before flying off again.

The male usually returned again at about 14:30 hours and did a little rearranging inside and outside the bower.

Once I saw the male land at the bower and commence twisting and calling two hours after a display, but I did not see the female who was right above my hide, nor do I know whether she was the same female who had visited earlier.

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MOVEMENTS OF AUSTRALIAN GANNETS PAST CALOUNDRA

KATHLEEN McARTHUR

Australian Gannets *Morus serrator* from rookeries in New Zealand are known to migrate across the Tasman Sea in their first year (Wodzicki and Stein, 1958). These birds apparently migrate via a route having its landfall on the central and southern Queensland coast. Here the birds are quite common from late April to early October and are seen as far north as approximately the Capricorn Coast (Storr, 1973). I have observed birds passing southwards off Caloundra (26°18'S) during winter. These observations were made irregularly in spare time only and thus do not give a complete picture. The following notes have been extracted from my diary.

1968

In the late afternoon of 10 June 1968 a resident of nearby Shelly Beach telephoned to ask what were the large birds that had been seen flying south offshore both that day and the previous. Through our binocculars we could see a broken 'streamer' of Australian Gannets, both mature and immature, flying low over the sea close to Bray Reef, which is a rocky reef off Caloundra Headland, marked on some maps as Wickham Point. Using a telescope, Robin Elks began counting gannets and Hugh McArthur kept the tally. In the one hour left of light, a total of 1,250 birds was counted. No further observations were made in that year.

1971

In 1971 the following observations were made.
19 May - afternoon - gannets flying south.
18 June - more gannets noticed 10 minutes before dark.
19 June - hundreds more gannets same time as previous day.
20 June - only two streamers of gannets seen.
21 June - none!

1973

The first movement of gannets was reported to me by John Sutton of Shelly Beach on 25 May. A greater effort was made this season.
26 May - checked every 5 minutes from 15:30 to 17:00. Birds seen moving south in pairs and small flocks of up to eight birds.
27 & 28 May - no gannets seen.
29 May - 13:30 3 gannets followed by 4.
14:15 2 gannets
15:30 over a period of 20 minutes - 86 gannets.
15:50 over a period of 20 minutes - 121 gannets.
16:10 over a period of 20 minutes - 209 gannets.
16:30 over a period of 20 minutes - 103 gannets.
30 May - 15:55 over a period of 30 minutes - 98 gannets.
16:30 over a period of 30 minutes - 184 gannets.

After this time a very shimmering light on the sea made observation very difficult and counting impossible.
17:15 large flocks of up to 30 birds in each flock were seen but could not be counted as it was only when they rose above the horizon that they were seen.

31 May - spot checking between 15:15 and 16:15.
15:15 - 6 birds
15:40 - 10 birds
16:00 - 20 birds
16:12 - 7 birds
16:15 - 22 birds
16:30 - over a period of 45 minutes - 464 birds.
17:20 - greater numbers than earlier but light on sea prevented counting.

1 June - 16:55 - over 5 minutes - 113 birds.
17:05 - 21 birds
17:10 - 23 birds
17:15 - 8 birds

2 June - 13:45 - spot check revealed no gannets.
14:40 - flock of approximately 20 gannets fishing around Bray Reef.
15:20 - 7 gannets sitting on the sea Bray Reef area.
No migration this evening.

3 June - 16:10 - 14 gannets moving south.

No further migration was seen.

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EDITOR'S NOTE

Addendum to Griffin's note (p.54) on the Lovely Wren *Malurus amabilis*.

In a note 'Lovely Wren near Townsville' (Griffin, A.C.M. (1974), Sunbird 5(2): 54) Andrée Griffin recorded this species at Saunders Beach north-west of Townsville. As the area was subjected to extensive cyclone and fire damage in 1972 and an extensive search for the birds in 1973 had been unsuccessful, she suggested that this population may have succumbed. In a recent letter, Andrée advises that a pair of Lovely Wrens was seen again in the area in 1974.