CORELLA

Journal of the Australian Bird Study Association

VOLUME 8 DECEMBER, 1984 NUMBER 4

The Breeding Biology of the Willie Wagtail *Rhipidura leucophrys* in a Suburban Woodlot

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Over a two-year period Willie Wagtails were studied in a suburban woodlot in Beverly Hills, Sydney. Observations revealed that territories were held year round with intra- and interspecific aggression greatest when breeding, that there was a possible courtship display and that a distraction display was used against potential predators. Overall 51.6% of all eggs laid survived to an independent juvenile stage, with success being greater when the breeding timetable was uninterrupted. While an interrupted breeding schedule resulted in an increase in the period of parental care, there was no increase in reproductive success.

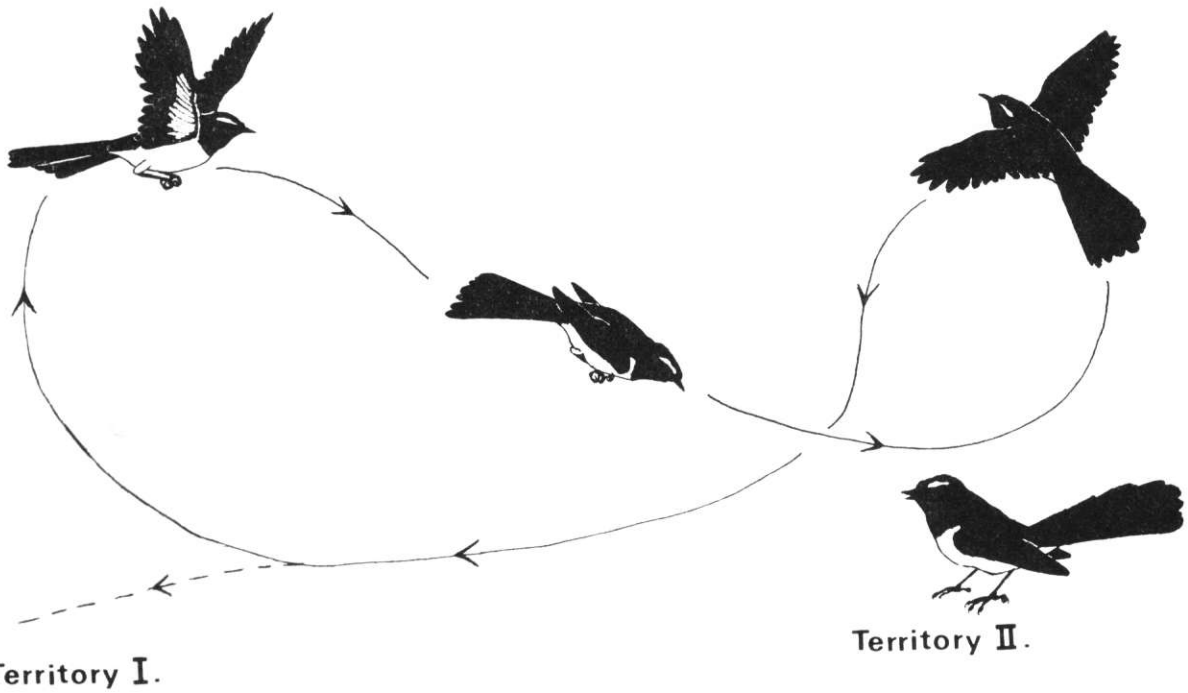
With the exception of Marchant's (1974) detailed analysis of nesting records, little information has been published about the reproductive biology of the Willie Wagtail *Rhipidura leucophrys*. The aim of this paper is to describe behaviours associated with breeding and to report on timetabling of the breeding activity of Willie Wagtails.

Two pairs of wagtails were studied in a three hectare woodlot and adjacent urban areas. The woodlot was composed of *Eucalyptus* and *Leptospermum* species. No understorey was present and the wood was bordered on two sides by buildings and on the other two sides by open, grass fields. Observations were made regularly (about three times per month) between 9 December 1977 and 5 March 1980. Although none of the birds were colour-banded, individuals could be recognised by the amount and distribution of white flecking on the throat and lower cheek.

Territoriality

Willie Wagtails are intensely territorial during the breeding season (Hill 1975; Frith 1976), that is from September until January (Marchant 1974). However the maintenance of an almost exclusive feeding and breeding area is not restricted to the reproductive period.

In nearly all months of the year, the reported territorial call, characterised as "pretty-little-creature", was heard (Table 1). Intra-specific aggression in the form of chasing and ritualised fighting was also recorded throughout the year (Table 1). Chasings occurred whenever a wagtail was found intruding on another pair's territory or when adults were expelling immature birds. The ritualised combat, in this case a diving display (Fig. 1), was restricted to interactions between pairs at the common boundary. The display involved only one member of each pair at any one time. Both participants would expand their white eyebrows and utter both territorial



• Figure 1. *Diving display of Willie Wagtail. Bird from pair 1 attacking a bird from pair 2.*

and alarm (rattle call) calls throughout the display. The aerial looping by one bird would be repeated a number of times and, once finished, the roles were sometimes reversed. In all the interactions observed (n=13) physical contact was never seen.

Since no other pairs occupied territories around these two, it was difficult to determine complete territorial boundaries. From records of where birds were seen, the home range of each pair was estimated at two hectares.

Interspecific aggression was confined almost solely to the breeding season (24 of 29 records, Table 1). Wagtails attacked any bird, regardless of size, that was detected in the vicinity of the nest. Together or singly the wagtails would arc above and peck at intruders such as Australian Magpies *Gymnorhina tibicen*, Laughing Kookaburras *Dacelo novaeguineae* and Black-faced Cuckoo-shrikes *Coracina novaehollandiae*. Other intruders such as Red Wattlebirds *Anthochaera carunculata* and White-plumed Honeyeaters *Lichenostomus penicillatus* were chased. The fact that Willie Wagtails can be strongly aggressive

TABLE 1

Intra- and interspecific interactions and behaviours of Willie Wagtails during the year. (• sign indicates that the behaviour was recorded in that month. All years were combined. Abbreviations: WPH — White-plumed Honeyeater, RW — Red Wattlebird, BFCS — Black-faced Cuckoo-shrike, AM — Australian Magpie, LK — Laughing Kookaburra, AR — Australian Raven.)

	Months J F M A M J J A S O N D
Intraspecific Behaviours	
Diving Display	• • • • • • • • • •
Chase	• • • • • • • • • •
Territorial Call	• • • • • • • • • •
Alarm Call	• • • • • • • • • •
Courtship Display	• • • • •
Nests and Eggs	• • • • •
Interspecific Behaviours	
(Species attacked)	
WPH	• • • • •
RW	• • • • •
BFCS	• • •
AM	• • • • •
LK	• • •
AR	•

against even harmless species such as Silvereyes *Zosterops lateralis* and thornbills *Acanthiza* spp. (Serventy & Whittell 1976), may explain the attacks on the two honeyeater species. Although a pair of Australian Magpie-larks *Grallina cyanoleuca* also resided in the woodlot no aggressive interactions with the wagtails were ever observed. With the exception of the kookaburras and the Australian Raven *Corvus coronoides*, all the species mentioned above and in Table 1 were present in the study area all year. The kookaburras and ravens were occasional visitors during the year.

Courtship

Hough (1969) described a possible courtship display between a pair of adult wagtails. He reported that during October a male, with eyebrows expanded, was seen leaping around a female as she perched on a horizontal branch. During the display the male gave a rattling call.

Over the two years I observed a similar behaviour nine times involving both pairs. Initially the pair would settle on the same horizontal branch perching 10 to 15 cm apart. The male (presumed from Hough 1969) would begin bobbing toward the female while she crouched side on to the male. Unlike Hough's description, the eyebrows of the male were hardly visible whereas those of the female were fluffed out. As the male jumped toward and around the female he gave both territorial and rattle calls. During the display the female moved only to maintain a 10 to 15 cm distance from the male. On four occasions the display ended with the male chasing the female for a short distance and on the other five the pair resumed feeding on the ground.

This behaviour was noted only in the two months prior to breeding and in the first three months of breeding (Table 1). Since the display was never seen to culminate in copulation or even attempted mounting, it remains unclear whether it was a courtship activity. It may merely be an interactive behaviour aimed at either strengthening the pair bond prior to breeding, or at stimulating a breeding response in the female.

Nesting

Of the eight nests built over the study period, seven were in eucalypts and one in teatree. All were on horizontal branches between 2.5 and 4.0 m above the ground. The ultimate fates of the nests were: one abandoned, two destroyed by storms, two destroyed by ravens (ravens present and nests found torn apart), and three were removed by humans (once observed, the rest assumed by disappearance of entire nest and contents).

The degree to which a single nest was successfully used varied considerably. One pair used the same nest for three consecutive broods while the other pair at one time built three nests, all of which were destroyed before a brood could be raised. The use of the same nest for consecutive broods is not an unusual occurrence amongst wagtails (Marchant 1974; Frith 1976).

Once a site was selected, nest construction took five to seven days. Firstly a circle of spider's web was laid down on the branch surface forming a hollow saddle. Within this a platform of dead fine grass, hair and bark strips was built up. Once this was established, more web and lining was added alternately until the familiar cup shape was obtained. Additions of web and lining were made by the bird sitting on the platform thus acting as a mould around which the materials were arranged. The large amounts of web used in the nest were carried stuck to the bird's beak and forehead. Once in the nest the bird then smeared the web around the outside of the nest, moving around the circumference of the cup until all the web was used.

Both adults participate in the construction of the first and all subsequent new nests. Repairs made to a nest in preparation for another brood appear to be made by the female alone although Marchant (1974) suggests that the male will assist unless otherwise engaged, e.g. caring for juveniles.

Brood Raising and Protection

The clutch size of the Willie Wagtails studied varied from two to four eggs (Table 2). Each egg is laid at 24 hr intervals with incubation taking approximately 14 days from the laying of the last egg and the nestling period another 15 days (Marchant 1974). Both male and female incubate the eggs but I suspect the female occupies the nest most, at least during the daylight hours. Once the young have hatched both parents share in the feeding duties.

TABLE 2

Frequency of clutch size in Willie Wagtail in Beverly Hills.

	Number of eggs		
	2	3	4
Pair 1	1	5	—
Pair 2	1	1	1
Total	2	6	1

Soon after the first brood was hatched one bird of each pair (assumed to be the female from the courtship display) began to exhibit unusual behaviour around the nest site, previously noted but not described by Bourke (1955). The activity resembles the 'rodent-run' behaviour described by Chisholm (1950). When an intruder approached the nest the female wagtail would land on the ground under the nest. Here she fluffed up her breast and belly feathers in such a way that the legs were almost totally obscured. Initially the bird would waddle around beneath the nest before moving away, occasionally stopping and jumping up onto the sides of tree trunks. These actions would be repeated until the intruder was drawn up to 40 m from the nest at which time contact was broken and the wagtail returned to the nest. If the male was near the nest when the intruder appeared he would dive and call loudly while the female performed the 'rodent-run'.

The 'rodent-run' behaviour was recorded up until after the chicks had fledged and again as soon as eggs were present in the nest. On all 20 occasions that the display was seen, the intruder involved was a mammal (dog = 2, cat = 1, human = 17). Chases or physical attacks were employed against conspecifics and other avian intruders.

Post-fledging Behaviour

When the breeding cycle was uninterrupted, juvenile birds remained in the parents' territory for at least 26 days after leaving the nest. For the first 12 days the young were still fed by the adults but after this time the amount of self-feeding progressively increased. While the adults may respond to begging juveniles (intensive calling and wing wavering) up to the 17th day after fledging, no adult feeding was observed after this date.

Submissive gestures by juveniles (crouching low, eyebrow hidden, flank exposed) were noted four times (9th, 15th, 16th and 19th days after fledging) and were associated either with begging, or attacks by parents. Such attacks or chases by the adult wagtails were recorded five times (19th, 20th, 23rd, 28th and 30th days after fledging).

Breeding Success

The breeding data of the two wagtail pairs, as well as the percentage survival at various stages, are shown in Table 3. Overall an average of 51.6% of all eggs laid survived to an independent juvenile stage. The difference in the success of each pair was probably greater than the results indicate since pair 2 had three nests destroyed in 1979-80. Although no remains of eggs or young were found in the debris, one cannot ignore the possibility the reproductive effort (i.e. the number of eggs laid) was greater than that actually found for this pair.

Using the data from pair 1 it was found that when breeding was uninterrupted, 78% of the fledgelings survived to independence while only 50% survived in an interrupted season.

Breeding Timetable

From the laying of the first eggs in early September, there followed a set pattern of events and behaviours which climaxed in the expulsion of immature birds from the territory (Fig. 2). The pattern was repeated upwards of three times during a single breeding season by a single pair, Overlap between the broods was approximately 13 days with the new clutch hatching about four days after the surviving juveniles from the previous brood were expelled from the territory.

When breeding was uninterrupted, the mean length of time a brood was present in a territory, i.e. from the first egg laid to the last time that juveniles were seen in the territory, was 58.3 $\pm$ 9.6 days (mean $\pm$ standard deviation; n = 6). Should the cycle be interrupted with the loss of the new nest while juveniles were being cared for, the period of residence was considerably extended to 86.5 $\pm$ 7.8 days (n = 2). The longer stay was due to the parents being unable to spare enough time to build a new nest. The presence of dependent juveniles meant a new nest could not be built for 18-28 days. However if no juveniles were present it was only 1-2 days before a new nest was under construction.

TABLE 3

Breeding success of Willie Wagtails in Beverly Hills.

	Nests	Eggs		Young		Juveniles		Total
		Laid (L)	Hatched (H)	% H/L	Fledged (F)	% F/H	No. (I)	% I/F	% I/L
Pair 1	3	17	13	77	12	92	10	83	58.8
Pair 2	5	9	9	100	6	67	4	67	44.4
$\bar{x}$ %				88		80		75	51.6

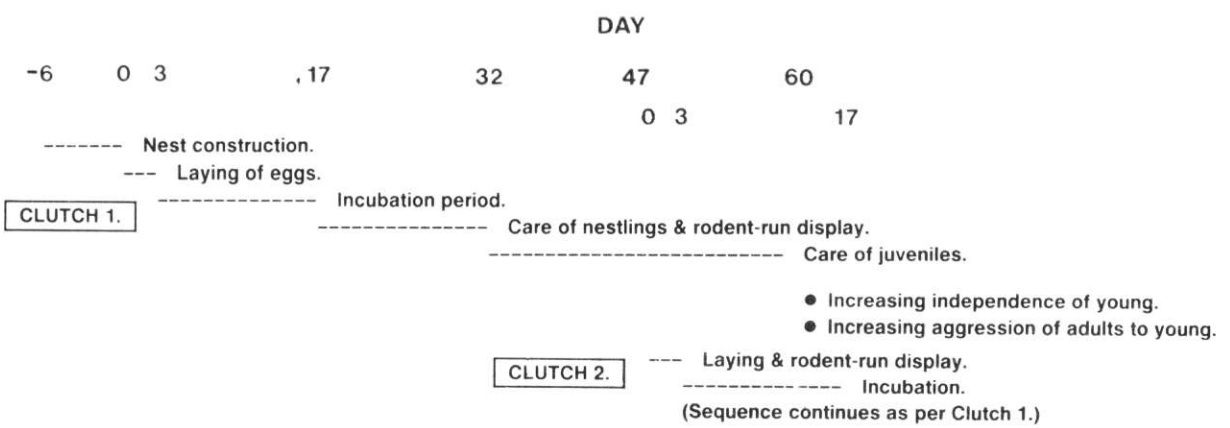
Nesting Association with Australian Magpie-larks

The incidence of Willie Wagtails building their nests close to those of Australian Magpie-larks has been reported numerous times (Cayley 1959; Readers Digest 1976; Pizzey 1980). However little factual evidence has been given to support anything other than what may be a chance association brought about by limited nesting sites.

Of the eight wagtail nests found in this study, four (50%) were in the same or adjacent (<5m) trees containing a magpie-lark's nest. Two of the remaining nests could not be in close proximity because the magpie-larks were, at the time, nesting in the other wagtail's territory. The other two nests were built before the magpie-larks began breeding. If one views this relationship differently, of the four magpie-lark nests built in different trees between late 1977 and early 1980, three (75%) had an active Willie Magtail nest in the same or adjacent tree. In all cases of association, the magpie-larks nested before the wagtails. It may be coincidental but it is interesting to note that the siting of the magpie-lark nests alternated between the two wagtail territories over the years (1977 and 1979 — pair 1 territory; 1978 and 1980 — pair 2 territory).

Discussion

The information presented in this paper is limited to two pairs of birds. The lack of large sample sizes meant that general descriptions of behaviour and events in the Willie Wagtail breeding cycle had to be derived from a combination of observations over the two-year period.



• Figure 2. *Generalised timetable of the breeding cycle of Willie Wagtails in Beverly Hills Park.*

In terms of overall hatching of fledglings, the results obtained in this study are similar to those calculated by Marchant (1974) using nest record cards for the period 1964 to 1972.

The differences in breeding success between the two pairs of wagtails could be due to a number of factors including constancy of breeding, experience and territory quality.

I have shown that should breeding be disrupted by nest destruction while juveniles are present, the period of parental supervision is extended. One might think that such increased protection time would increase the chances of the young surviving to independence. This however is not the case. Uninterrupted breeding had a much higher success rate than an interrupted season. This could be exaplained by the increased mortality in the late juvenile stage which was observed in the young that had a prolonged stay in the territory due to an interruption to the adult's breeding cycle. It may be that juveniles of this age are more active and dispersed in the territory thereby making it harder for the adults to effectively guard them against predators, especially cats. Increased activity, plus a lack of experience, may have also made the young more susceptible to death from hazards, e.g. motor vehicles. Young that are expelled at the usual time probably suffer the same mortality rate as retained birds but because it occurred outside the territory it was not noted. The difference may also have been simply an artifact of the small sample size.

Experience may also be important in determining breeding success. The pair with the higher success rate (pair 1) was established in the woodlot prior to 1977 while pair 2 did not appear until February 1978. Combining all years, the success rate for pair 1 was 59% and for pair 2 it was 44%. By virture of being established longer it is probable that pair 1 had time in which to select the better part of the woodlot (more nesting sites, greater food availability) thereby increasing their chances of breeding successfully in the future.

One of the aims of this paper was to provide baseline data about the breeding biology of a common Australian bird in the hope that a more intensive study will be carried out in the future. A much closer examination of breeding success with larger sample sizes and a more quantified analysis of behaviours, such as the courtship and distraction display, is needed. Although the wagtail's distraction display differs from the usual feigning an injured wing, there is no doubt that by performing conspicuous behaviours, the parents attract the attention of a potential predator and draw it away from the eggs or young. The nesting association between Willie Wagtails and Australian Magpie-larks also requires further study. It appears that Willie Wagtails prefer to nest near magpie-lark's nests whenever their territories overlap. The obvious benefit of the association is the enhanced protection given to the eggs and young of both species by the attention of two sets of aggressive parents. Nevertheless more quantified data are required to test this relationship.

Too much of our knowledge about our birds, even the most common ones, is based on limited anecdotal evidence. It is time these observations were built upon to create a sounder and more detailed knowledge of Australia's avifauna.

Acknowledgements

My thanks must go to the two anonymous referees and G. Cam for their helpful criticisms on the earlier draft of this paper.

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