Diet of Breeding Willie Wagtails *Rhipidura leucophrys* in Suburban Western Australia

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The insectivorous Willie Wagtail *Rhipidura leucophrys* is common throughout Australia, except in very wet forests, and also occurs in New Guinea and neighbouring islands (Blakers et al. 1984). It is often abundant in open grassland habitats with a sparse tree layer (Cameron 1985), and so it is a well-known sight in urban parkland, suburban gardens and agricultural areas. Barker & Vestjens (1991) summarised the literature on Willie Wagtail diets available from stomach samples, noting that arthropods from 29 families representing nine orders were included, and that there was a single report of seeds being taken. In an Australian woodland population Cameron (1985) estimated the mean size of prey taken as 7-8 mm, although some very small insects and some over 20 mm long were eaten. Dyrcz & Flinks (1995) reported that in New Guinea *c.* 95% prey taken were less than 10 mm long, although some prey over 30 mm long were taken. Overall, most dietary information comes from birds in woodland or agricultural areas and very little is known of the diets of Willie Wagtails living in suburbia, although this might explain their success in an altered environment. This study presents dietary data collected from a suburban breeding pair

Table 1 Number (% in parentheses) of prey identified from Willie Wagtail droppings between December 1992 and March 1993. Note that Lepidoptera wing scales were present in all samples but the number of these prey eaten could not be quantified.

	1992					1993		
Prey taxon	9 Dec	11 Dec	14 Dec	18 Dec	21 Dec	6 Jan	4 Mar	Total diet
Hymenoptera (wasps)	6 (11.1)	30 (49.2)	28 (32.6)	10 (8.6)	19 (22.1)	10 (12.5)	10 (6.8)	113 (18.0)
Formicidae (ants)	4 (7.4)	2 (3.3)	4 (3.3)	25 (21.5)	8 (9.3)	18 (22.5)	42 (28.8)	103 (16.4)
Diptera (flies)	8 (14.8)	9 (14.7)	13 (15.1)	17 (14.6)	18 (20.9)	1 (1.3)	10 (6.8)	76 (12.1)
Coleoptera (beetles)	5 (9.3)	7 (11.5)	11 (12.8)	13 (11.2)	15 (17.5)	14 (17.5)	35 (24.0)	100 (15.9)
Araneae (spiders)	15 (27.8)	0 (0.0)	3 (3.5)	9 (7.8)	2 (2.3)	18 (22.5)	11 (7.5)	58 (9.2)
Hemiptera (bugs)	0 (0.0)	5 (8.2)	11 (12.8)	22 (19.0)	0 (0.0)	3 (3.7)	2 (1.4)	43 (6.8)
Odonata (dragonflies)	0 (0.0)	1 (1.6)	1 (1.2)	0 (0.0)	1 (1.2)	2 (2.5)	1 (0.7)	6 (0.9)
Unknown	16 (29.6)	7 (11.5)	15 (17.4)	20 (17.3)	23 (26.7)	14 (17.5)	35 (24.0)	130 (20.7)
Total prey items	54	61	86	116	86	80	146	629
No. of droppings	Not known	55	108	84	50	Not known	106	—

and compares the results to those known for other populations.

Materials and methods

The study site was a grassed courtyard of 2700 m^2 with a sparse overstorey of *Eucalyptus* spp. in the grounds of Murdoch University in Perth, Western Australia. A pair of Willie Wagtails nested in a tree in one corner of the courtyard and, between prey chases, often perched on the lids of 80 cm high rubbish bins at the edge of the courtyard. Such use of a 'lookout perch' is common in other populations (Cameron 1985). Ravens *Corvus coronoides* were the only other birds seen to perch on these lids, and their large droppings were never observed. More than 400 droppings were collected from these lids on seven occasions between December 1992 and March 1993. The birds had an unknown number of young in the nest during the December and January samples and were accompanied by at least one juvenile at the time of the March sample.

Droppings were stored without preservative until analysis, when they were moistened with a weak detergent solution and teased apart under a microscope. Recognisable fragments, such as heads, legs, mandibles, wings, elytra, and antennae, were removed. A careful check was made for wing scales from lepidopterans since, although these could not be quantified, they did confirm that these insects had been eaten. Fragments were identified to the level of order (and family in the case of ants) and quantified using the guides in Calver & Wooller (1982) and Ralph et al. (1985); the remainder were classed as 'unidentified'. Intact heads and forewings were measured to the nearest 0.1 mm using a microscope and their dimensions used to estimate the length of the insect eaten using the equations in Calver & Wooller (1982) and Myatt (1992).

Table 2 Mean lengths of prey (mm) recovered from Willie Wagtail droppings over the period December 1992 to March 1993, as estimated from heads and wings recovered. Means are given ± standard errors and sample sizes are in parentheses. Note that some prey taxa could not be sized and that sample sizes do not match those in Table 1 since not all remains retrieved could be sized.

Date	Prey type	Estimates from heads	Estimates from wings
9 Dec 92	Hymenoptera	2.73 ± 0.21 (6)	11.42 ± 0.0 (1)
	Diptera	10.32 ± 1.9 (2)	5.90 ± 1.6 (3)
	Formicidae	2.00 ± 0.1 (4)	—
	Coleoptera	—	3.02 ± 0.0 (6)
	Hemiptera	—	—
11 Dec 92	Hymenoptera	2.25 ± 0.14 (26)	8.20 ± 0.55 (9)
	Diptera	—	—
	Formicidae	2.10 ± 0.0 (1)	—
	Coleoptera	—	3.02 ± 0.00 (7)
	Hemiptera	7.32 ± 0.13 (5)	—
14 Dec 92	Hymenoptera	3.49 ± 0.30 (28)	8.78 ± 0.27 (6)
	Diptera	8.45 ± 0.74 (6)	6.20 ± 0.23 (11)
	Formicidae	2.10 ± 0.00 (2)	—
	Coleoptera	12.78 ± 1.11 (3)	3.89 ± 0.58 (8)
	Hemiptera	7.34 ± 0.12 (7)	—
18 Dec 92	Hymenoptera	3.12 ± 0.22 (9)	8.26 ± 0.00 (1)
	Diptera	—	6.40 ± 0.14 (4)
	Formicidae	1.97 ± 0.05 (16)	—
	Coleoptera	—	3.48 ± 0.20 (12)
	Hemiptera	7.91 ± 1.50 (13)	—
21 Dec 92	Hymenoptera	3.48 ± 0.25 (17)	6.40 ± 0.58 (2)
	Diptera	—	6.47 ± 0.00 (1)
	Formicidae	2.20 ± 0.10 (4)	—
	Coleoptera	—	3.00 ± 0.01 (14)
	Hemiptera	9.17 ± 0.00 (1)	—
6 Jan 93	Hymenoptera	1.48 ± 0.43 (10)	6.68 ± 0.46 (8)
	Diptera	—	—
	Formicidae	2.15 ± 0.05 (8)	—
	Coleoptera	—	3.06 ± 0.1 (16)
	Hemiptera	7.69 ± 0.16 (2)	
4 Mar 93	Hymenoptera	3.77 ± 0.79 (9)	7.81 ± 0.00 (1)
	Diptera	8.15 ± 0.22 (5)	6.32 ± 0.30 (2)
	Formicidae	2.00 ± 0.04 (31)	—
	Coleoptera	8.84 ± 0.68 (4)	3.00 ± 0.01 (53)
	Hemiptera	—	—

Results

The proportions of each taxon in the diet varied greatly across sampling occasions with no obvious pattern (Table 1). For example, Formicidae (ants) made up only 3.3% of prey recovered in the 11 December sample, yet they comprised 28.8% of the prey recovered in the 4 March sample, while hemipterans (bugs) ranged from none on 9 December and 21 December to 22% in the 18 December sample. These results suggest that the birds were feeding opportunistically rather than preferentially selecting one taxon over others. Lepidopteran scales were present in all samples but, since they could not be quantified, the importance of this group as food cannot be compared readily to the other taxa. The high proportions of unknown prey at all sampling dates reflected the number of jaws recovered that we could not ascribe with surety to any prey taxon, although we are confident that they most likely came from the head capsules of the ants, wasps and beetles recovered.

Eighty per cent of the 499 prey individuals identified could be sized (Table 2). Estimated prey sizes ranged from less than 1 mm for a hymenopteran (wasp) to 14.6 mm for a coleopteran (beetle). Interestingly, estimates of prey length based on wings and heads from the same prey taxon in the same sample were sometimes markedly different. For example, in the 14 December sample, hymenopteran lengths based on head measurements were estimated at approximately half those based on wing measurements. However, measurements of both the heads and wings of dipterans (flies) from the same sample agreed well in their estimates of the length of dipterans eaten. Overall, the mean prey length of 3.9 mm estimated from heads was not significantly different (t_{382} = 1.79, $P > 0.05$) to that from wings (4.31 mm).

Discussion

The diet of these suburban Willie Wagtails was similar in composition to that described from elsewhere. Cameron (1985) reported that wasps, bees and ants made up about 40% of the diet in birds from open woodland in New South Wales, followed by flies (about 20%), beetles (about 15%), grasshoppers and crickets (about 10%), bugs (about 5%), spiders (about 2%) and dragonflies and damselflies (about 1%). Dyrcz & Flinks (1995) found that ants were the most abundant prey type in their New Guinea study, followed by other hymenopterans, beetles, flies, spiders, lepidopterans, orthopterans (grasshoppers and crickets), and a single lizard. These results are very similar to ours, with the exception that grasshoppers and crickets were not represented in our samples. This is almost certainly a function of availability, since we were never aware of grasshoppers at our site and they are conspicuous insects. Cameron (1985) found prey lengths averaged about 8 mm (range 1-23 mm). rather larger than our mean prey size of 4.1 mm (range 1-14.6 mm). However, she worked from stomach contents which are less fragmented than the remains in droppings; we could not size the dragonflies in our samples, which were the largest prey in her collections, and this could account for the disparity in prey sizes estimated. Dyrcz & Flinks (1995) found that about 95% of adult Willie Wagtail prey were less than 10mm long with about 55% less than 5 mm long, although insects up to 30 mm long were taken. These data are in general agreement with ours.

Differences between mean size estimated from head measurements and that based on wing measurements in some prey taxa have also been reported in studies of another insectivorous bird (Calver et al. 1987), and attributed to differential digestion and ingestion of body parts. Larger heads and wings retrieved from droppings may be identifiable while too damaged to be measured, and this loss is not equal across all sizes and types of prey. Overall this probably underestimates the prey sizes taken, although if large prey are taken infrequently this bias is unlikely to be great. The mode may therefore be a better statistic than the mean to summarise prey size distributions produced from estimates based on fragmented prey remains in droppings, since it will not be influenced by the absence of a few outlying large values as would both the mean and the median. For example, the modal prey size class for adult Willie Wagtails in the data of Dyrcz & Flinks (1995) is 0-5 mm, yet the presence of some prey up to 30 mm long would raise the mean outside this interval. It is also important to consider size estimates based on both wings and heads in determining the sizes of prey taken; it may be best to estimate separate prey size distributions for these values.

Overall, our findings agree with published descriptions of the Willie Wagtail as an opportunistic feeder with a broad arthropod diet. This lack of specialised dietary requirements probably contributes to its success in suburban gardens.

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Presumptive Renesting of Red-tailed Black-Cockatoos in South-eastern Australia

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A study on the endangered subspecies of the Red-tailed Black-Cockatoo *Calyptorhynchus banksii graptogyne* in south-eastern Australia has been under way since late in 1988. To understand the conservation needs of this cockatoo we aim to determine nest and food requirements, population size, movements and range. Early results indicate that this cockatoo usually lays during October and November in south-eastern Australia; most young fledge during February and March but a few fledge as late as April (Joseph et al. 1991). Before this study, the latest date that an active nest (either eggs or young present) had been recorded for this population was 24 April (Attiwill 1960).

It does not appear that this population breeds successfully twice a year as does *C. b. samueli* in the wheatbelt of Western Australia (Saunders 1977). However, in this paper we report on the apparent renesting of several pairs of Red-tailed Black-Cockatoos in southeastern Australia during the 1992–93 nesting season.

Methods

The Red-tailed Black-Cockatoo in south-eastern Australia has a restricted distribution centred in the Brown Stringybark *Eucalyptus baxteri* forests of south-western Victoria and, to a lesser extent, in the south-east of South Australia. These forests often have a heathy understorey and usually occur in discrete blocks of varying sizes, surrounded by crop and pasture land. The surrounding agricultural land sometimes has scattered River Red Gum *E. camaldulensis*, Yellow Gum *E. leucoxylon* or Buloke *Allocasuarina luehmannii* still remaining, as well as some large dead gums which often contain deep hollows. Details of nest trees, roosts, population size and food are given in Joseph et al. (1991) and Emison & Joseph (1992).

Field work was conducted in south-western Victoria from December 1988 to July 1993. Early in the study (1988–89), the work was confined mainly to the spring and summer months. Searches conducted during the first two seasons (1988–89 and 1989–90) found three main nesting areas of the Red-tailed Black-Cockatoo. After 1989, we made monthly visits to each of these breeding areas to determine if nesting was occurring.

A typical visit to a nesting area involved arriving two or three hours before nightfall at a position where several known nests could be observed. The behaviour of the Red-tailed Black-Cockatoos around the nests was watched until dark and an assessment made as to whether breeding was occurring. In most cases there was little reason for the cockatoos to be in these areas other than for nesting purposes. The main difficulty was distinguishing between the activity associated with pre-nesting and that associated with having an egg or young in the nest; uncertainties were clarified by follow-up