The Foraging Behaviour of the Willie Wagtail *Rhipidura leucophrys*: Why Does it Wag its Tail?

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The Willie Wagtail *Rhipidura leucophrys* (hereafter referred to as Wagtail), commonly found in urban parklands and suburbs, is a ground-feeding insectivore that prefers open habitats with little or no canopy (Cameron 1979; Harrison 1976). This species derives its name from its well-known tail-wagging behaviour, in which the bird rapidly moves its tail side-to-side in the horizontal plane. The Wagtail is a pursuit predator that chases aerial insects, and the tail is wagged at variable rates while it is foraging on the ground. The function of tail-wagging is not known: it may assist the balance of foraging birds, provide either an intra- or inter-specific signal function, or may flush cryptic insects from the ground (Goodwin 1967; Harrison 1976; Cameron 1979; 1985). The latter function has been most widely proposed by ornithologists (e.g. Pizzey 1980; Slater *et al.* 1986), although there is no supporting evidence. Insects may be flushed by tail-wagging because the moving tail causes rapid changes in light intensity, thereby startling the insect. The probability that an insect is flushed from the ground may depend on both the contrast in light intensity that results from casting a shadow above the surface of the ground, and the frequency with which these changes occur. In other words, a Wagtail may be more likely to flush an insect if it wags its tail in bright sunlight, or does so more frequently.

If tail-wagging serves mainly to flush insects, Wagtails should adjust their tail-wagging rate if they are to maintain constant food intake rates under different conditions of light intensity. In particular, tail-wagging rates may be lower in bright sunny conditions and higher in dull overcast conditions. Futhermore, there should be no difference in tail-wagging rates of birds foraging on overcast days or in shaded areas on sunny days. This variation in tail-wagging is unlikely to be evident if tail-wagging is not associated with flushing insects. We examined this idea by observing the tail-wagging behaviour of free-living Wagtails foraging under conditions of different light intensity.

Study area and methods

Wagtails were observed between 0630 and 1930 h from January through March 1992, at three suburban parks (Royal Park South, Parkville; Carlton Cricket Ground, Carlton; and Fleming Park, Brunswick East) in central Melbourne. Each location contained at least two resident pairs of birds. Only adult birds were observed because the foraging behaviour of younger birds appeared to be less consistent and not as well developed; their inclusion may have introduced additional variation in the recorded behaviour. Two data sets were obtained: one compares the behaviour of Wagtails that were observed on the ground, apparently foraging, with those observed on a perch. The other data set includes the behaviour of Wagtails foraging on the ground under conditions that reflected higher and lower light intensity. Thus, birds were observed foraging in the sunlight on sunny days; in the shade on sunny days; and in both areas on overcast days in which no shadows were cast.

Birds were selected randomly and observations of their behaviour were recorded onto a continuously running tape-recorder. Each bird was observed until either it flew away or about five minutes had elapsed, after which another individual was selected. The following behaviours were recorded. A 'tail-wag' was defined as the movement of the tail in one direction along the horizontal plane and then back to its original position. Thus, the movement of the tail from the centre to one side and then to the other side and back to the centre is two wags. A 'wing-flash' was defined as a single, fast opening and closing of the wings while the bird remained on the ground. A 'flutter' was a series of wing-flashes executed when the bird leaped into the air but was not actually flying. Fluttering was frequently associated with catching low-flying insects, although it was not possible to obtain records of the frequency of success. A 'run' was defined as a short dash across the ground of up to 30 cm. In addition, data on the turning movements (through 180 degrees) of birds perching on

park seats or railings (760 mm and 860 mm. high respectively) were also recorded. Data were transferred from the tape-recordings onto computer file using a tailor-made event-recording program, and subsequently analysed statistically using Analysis of Covariance and *t*-tests with SYSTAT™ 5.2 for the Apple Macintosh (Wilkinson 1992).

Results and discussion

Wagtails neither wing-flashed nor fluttered while they were on perch (Table 1). The turn rate was not recorded when the birds were on the ground. Tail-wagging and running rates were significantly higher for Wagtails on the ground compared with those on a perch (Table 1). Cameron (1985) suggested that Wagtails commonly use perches as vantage points when scanning the environment for flying insects; the observed frequency of turning in this study is consistent with this idea. Comparison of the behaviour of perching birds with those on the ground indicate that perching birds, although possibly scanning for prey, were not actively foraging by hunting and catching prey.

The behaviour of Wagtails foraging on the ground varied according to whether they were foraging in bright sunlight or in the shade (Table 2). In particular, Wagtails foraging in the sunlight wagged their tails at less than half the rate of birds foraging in the shade on a sunny day or on overcast days. However, the other foraging behaviours were not significantly different between these three conditions (Table 2).

These data are consistent with the idea that tail-wagging is a mechanism by which Wagtails flush out ground-dwelling insects. The similarity of tail-wagging rates of birds foraging on overcast days and those foraging in the shade on sunny days suggests that light intensity, rather than whether the day is sunny or overcast, is the important factor influencing their tail-wagging rate. Tails are wagged less frequently under conditions of high light intensity, presumably because the insects are more easily startled by the bird's shadow. The jerky movement associated with tail-wagging may be detected by an insect, causing it to take flight or move to a safer refuge, thereby alerting the Wagtail to its presence. It is worthy of note that Wagtails seemed to prefer to forage in the sunlight rather than the shade on sunny days, which is reflected by the variation in the number of observations made under these different conditions.

The flutter rate of Wagtails, a behaviour that is apparently associated with capturing flying insects, did not differ between the three conditions (Table 2). If a Wagtail's flutter rate reflects its prey capture rate then these data suggest that Wagtails adjust their tail-wagging behaviour according to differences in light intensity, in order to maintain constant levels of food intake. Clearly, accurate data on prey capture rates are required to test this possibility.

These data are unable to demonstrate that tail-wagging does not have functions other than those associated with foraging. However, it is not clear why the

Table 1 Comparison of Willie Wagtail *Rhipidura leucophrys* behaviour while perching or on the ground.

	Location of bird		
Behaviour[1]	Ground	Perch	*t*-test
No. of observations	107	16	
Tail-wags	16.04 (0.81)	0.33 (2.10)	17.11 *
Runs	5.68 (0.41)	0.49 (1.05)	9.52 *
Wing-flashes	7.37 (0.52)	0.00 —	
Flutters	3.26 (0.27)	0.00 —	
Turns	0.00 —	2.56 (0.28)	

[1] Values are mean rates per minute with *s.e.* in parentheses; see text for detailed description. * $P < 0.001$.

Table 2 Variation in the behaviour of Willie Wagtails *Rhipidura leucophrys* under different environmental conditions.

	Environmental condition			
Behaviour[1]	Sunny and open	Sunny and shade	Cloudy (shade)	*F*
No. of observations	45	26	36	
Tail-wags	9.88 (1.09)	20.42 (1.43)	20.58 (1.22)	27.58*
Wing-flashes	8.12 (0.86)	6.54 (1.17)	7.02 (0.96)	0.72
Flutters	2.88 (0.43)	2.60 (0.56)	4.21 (0.48)	3.04
Runs	6.89 (0.65)	4.52 (0.89)	5.01 (0.73)	3.06

[1] Values are mean rates per minute with *s.e.* in parentheses; see text for detailed description. * $P < 0.001$.

rate of tail-wagging should change with different light conditions if this behaviour is associated with either signalling behaviour, such as territorial defence, or providing balance while foraging. It is also possible that the birds are simply responding to changes in insect abundance or activity that are associated with different light conditions. For example, insect activity may be higher on sunny days than dull days, resulting in less time spent tail-wagging and more time in other foraging activities on sunny days. Such differences in insect abundance would most likely be reflected in differences in the flutter-rate, which is thought to be associated with capturing flying prey. However, the flutter-rate did not change under these different light conditions.

Further data are required to establish that the rate of tail-wagging by Wagtails is directly correlated with the probability of flushing insects and prey capture rates. Nevertheless, comparative information on the tail-wagging behaviour of congenerics provides some additional insight. All species within the genus *Rhipidura* fan or wag their tails, although apparently at different rates: the Rufous Fantail *R. rufifrons* and Grey Fantail *R. fuliginosa* both actively fan their tails, while the Northern Fantail *R. rufiventris* only occasionally fans its tail (Simpson & Day 1986). Is this inter-specific variation in tail-fanning rate associated with differences in foraging behaviours or preferred habitats? For example, the Rufous and Grey Fantail live in forests while the Northern Fantail lives on the edges of rainforests and mangroves (Cameron 1985; Simpson & Day 1986; Boles 1988). Perhaps the Rufous and Grey Fantails fan their tails more frequently than the Northern Fantail because they forage in shadier places and therefore must fan their tails more rapidly in order to flush insects. Alternatively, these different tail-fanning rates may reflect differences in diet: the Northern Fantail characteristically flies from a perch directly to a flying insect, while the Rufous and Grey Fantails both glean insects from trees and hawk flying insects that are disturbed (see Boles 1988). Detailed comparative data on habitat use, foraging behaviour and tail-wagging rates across species of *Rhipidura* are required to adequately address these questions.

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