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FORAGING BY SUBURBAN AUSTRALIAN MAGPIES DURING DRY CONDITIONS

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While many species of native birds have been adversely affected by urbanization, some species have benefited from suburban development. Ground-foraging species, in particular, are among the most abundant birds found in cities throughout the world (e.g. Emlen 1974). The suburban environment typically contains vast areas of lawn (Adams 1994) and the associated foraging opportunities have been an important component of the success of this and other ground-foraging species.

The Australian Magpie *Gymnorhina tibicen* is a large insectivorous ground-feeding species that has adapted well to the urban environment due, in part, to the abundance of food resources and the availability of habitat suitable for breeding territory (Jones and Thomas 1999). When foraging, Floyd and Woodland (1981) discovered that Magpies use both auditory and visual cues to detect and capture their invertebrate food items. Auditory cues were used primarily when prey was close to but beneath the surface while visual cues were used when prey was seen moving at the soil surface. The depth of prey within the soil profile is greatly influenced by extremes in the moisture level of the soil; for example, saturation brings earthworms to the surface while during extremely dry conditions most soil invertebrates remain well below the surface. Such conditions obviously have a considerable influence on the foraging behaviour of Magpies.

The present study was initially designed as an investigation of the foraging ecology of Magpies in a suburban environment during the breeding season (typically July and September) in southern Brisbane (153°03'E, 27°33'S). The advent of a three-month period of extremely dry conditions during this time — only 10 millimetres rain was received during 2000, or 7 per cent of the 135 millimetres expected for these months — provided an opportunity to assess how Magpies obtain food during drought conditions. Previous observations during normal conditions (D. Jones, unpubl. data) indicated that suburban Magpies foraged almost exclusively on lawns, although a significant number of Magpies also obtained food from backyard feeding stations (Jones and Thomas 1999). We were interested in which foraging substrates were used by Magpies, the types of food obtained, whether auditory or visual cues were used, and the success rates on different substrate types.

The foraging activities of ten Magpie pairs were observed within territories mainly situated in parks and sports fields. The male and female in each pair were observed for ten minutes weekly for 12 consecutive weeks, between dawn and about 9.00 a.m. and again late in the afternoon (from 3.00 p.m. until dusk). Two main foraging methods were recorded: pecking (when the substrate is not penetrated by the beak); and probing (when the substrate is penetrated by the beak). During probing, we attempted to determine whether the bird used auditory or visual cues to detect prey. When using auditory cues, Magpies turn the head to one side (Floyd and Woodland 1981). In contrast, when visual cues are being used the birds focus downwards and stare at one particular point on the ground directly in front. The success rates for different foraging substrate types were determined by the number of times prey items were ingested; head tossing and swallowing (Veltman and Hickson 1989) distinguishes a successful capture of prey. The foraging substrate on which the birds foraged was estimated for each territory and the birds presence on each type was recorded during each observation period. All food items injected were identified when possible. Data were usually computed as either instances per or percentage of ten-minute observation periods and means were compared using Student's T-tests.

A total of 99 separate 10 minute observations of 20 birds were completed during the study. Suburban Magpies obtained 12 different food types while foraging, the most important being (as a percentage of 740 separate items detected): minute undetermined items (65.1%); discarded potato chips (9.4%); worms (8.9%); bread (7.4%) and clover seeds (5.8%). The remainder consisted of roughly equal proportions of natural (beetle larvae, moths, ants, and skinks: 1.8%) and artificial (apple, sausage and meat: 1.3%) items. The large proportion of extremely small items appeared to have consisted of very small insects such as ants, or plant seeds. These types of foods were found in the diets of Magpies collected near Canberra (Vestjens and Carrick 1974) but were not regarded as nutritionally significant. The fact that the Magpies studied here spent a significant amount of time injesting such small items suggests that larger items were hard to obtain. By far the most important items of significant food value were earthworms, clover seeds, chips and bread, which together comprized 31.8 per cent of all items consumed. If the minute undetermined items are ignored, these four food types make up 91.6 per cent of the total, with human food waste comprising almost half of all visible items taken. It is noteworthy that beetle larvae, normally a major component of Magpie diet (Vestjens and Carrick 1974; Floyd and Woodland 1981) were only rarely consumed during this study.

Magpies (both sexes pooled) used visual cues (3.1 + 0.8 per minute) significantly more than auditory cues (0.2 + 0.4

per minute) while foraging ($t = 6.48$, d.f. = 184, $P < 0.001$). This indicates that most invertebrate food items were detected by movements at the surface rather than beneath, a result expected given the extremely dry soil conditions.

In terms of the total time spent foraging, both the males (72.5%) and females (90.3%) spent a clear majority on lawns with green pasture comprising the main other substrate used by the two sexes (12.7% and 4.5% respectively). Nonetheless, their territories were made up of an average of 19.8 ± 17.6 per cent (range: 4.6–60.5%) of substrates other than lawns and green pasture. These substrates included areas of tall dry grass, garden beds, leaf litter and footpaths, all of which could be regarded as offering poor foraging opportunities.

The mean rates (per minute) of foraging activities of lawns (male and females pooled) were: peck rate = 1.5 ± 0.2; probe rate = 2.4 ± 0.4; total items injected = 2.4 ± 0.4; and worms injected = 0.2 ± 0.1.

Males and females spent similar mean foraging times per observation period during the incubation (male: 8.5 ± 3.1 minutes; female: 9.8 ± 0.7 minutes) and nestling phases (male: 8.1 ± 4.3 minutes; female: 8.3 ± 3.9 minutes), but the female's foraging time was significantly greater than the males during the brief nest-building phases ($t = -2.57$, $df = 26$, $p < 0.01$). This result is almost certainly explained by the increased nutritional demands of egg production (Carrick 1963).

Magpies are a generalist insectivore consuming a wide variety of foods; Vestjens and Carrick (1974) list more than 50 types of invertebrates and some plant materials being consumed although beetles, weevils, spiders, earthworms, and ants were the most abundant items in the diet of Magpies from Canberra. These authors state that climatic conditions were among the most important influences on the general composition of Magpie diet, with the birds taking advantage of natural abundances as well as switching to a variety of other food types when the usual items are unavailable (Vestjens and Carrick 1974). Such a propensity appeared evident in the birds observed in the present study with birds consuming large numbers of earthworms while adding human foods to their diet.

This study provided some evidence that dry conditions can influence the foraging ecology of suburban Magpies. However, because the entire region was equally effected by these conditions it was not possible to compare directly birds foraging in moist versus dry areas. Such a study could be achieved using experimental manipulations of the moisture levels of foraging substrates and would be useful in furthering understanding of aspects of the urban ecology of this successful species.

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