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SPRING DIET OF PIED CURRAWONGS AT IMBOTA NATURE RESERVE, ARMIDALE, NEW SOUTH WALES

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The diet of Pied Currawongs *Strepera graculina* in eucalypt woodland near Armidale, New South Wales, was studied by analysis of stomach contents of 21 birds collected in October–December 2002. Adult pairs, and replacement currawongs in those territories, were collected before they had active nests. The currawongs' diet consisted predominantly of arthropods (97% by number): mainly beetles (36% by number, 95% of stomachs), large ants (48% by number, 62% of stomachs) and dragonflies (7% by number, 14% of stomachs), with lesser quantities of other arthropods and some fruit and leaf material (n = 188 food items). No vertebrates or bird eggshell were found in the stomachs. Incidental observations were made of currawongs feeding on a small free-flying bird, a microchiropteran bat, and a tree-frog.

INTRODUCTION

The diet of the Pied Currawong *Strepera graculina* is well known, having been the subject of quantitative analyses in New South Wales including the New England Tablelands (Buchanan 1989; Bass 1995; Wood 1998, 2000; Rose 1999; Bayly and Blumstein 2001; Fulton and Ford 2001a). The currawong eats invertebrates, but also exotic fruits especially in winter, and particularly when breeding it takes vertebrates, including adult, nestling or fledgling birds. It is thought to be a major nest predator, accounting for a high proportion of predation-related nest failures in small passerines (Major *et al.* 1996; Zanette and Jenkins 2000; Fulton and Ford 2001b). However, caution is required in interpreting the often anecdotal evidence, or experimental evidence based on artificial nests (Bayly and Blumstein 2001; Zanette 2002; Berry and Lill 2003). As part of an investigation into the impact of currawongs on passerine nesting success (Debus, unpubl. data), free-flying currawongs were collected during the local passerine breeding season to determine whether they had eaten birds or eggs. This paper reports on the stomach contents of those currawongs.

STUDY AREA AND METHODS

The study site was Imbota Nature Reserve (formerly Eastwood State Forest), ten kilometres southeast of Armidale (30°30'S, 151°40'E) on the New England Tablelands of New South Wales. This woodland patch of about 270 hectares, including contiguous intact woodland on private land, has been described by Ford *et al.* (1986), NPWS (2002) and Hunter (2003). Twenty-one currawongs were collected from one half of the reserve in October to December 2002: five adult pairs in the third week of October, before they had laid eggs; five birds that replaced them in those territories in the following week; then a further four birds in November and two in December from the same areas.

Currawongs were culled by mist-netting and live-trapping (in cage traps), with humane euthanasia, and by luring onto neighbouring private land by call playback and a stuffed currawong specimen, then shooting. Collected birds were chilled in the field, stored frozen, then dissected, sexed, and aged by plumage and condition of the oviduct (curled = adult, i.e. had bred in previous years; straight = had not bred, presumed subadult). Contents of their digestive tracts were examined, microscopically as necessary, and identified with the aid of a manual (CSIRO 1970) and a reference collection of insects.

The sample consisted of eight male and 13 female currawongs: ten adults (five males and five females) in mid-October; a yearling female (in immature plumage) and four older subadult (straight oviduct) females later in October; three males and one subadult female in November; and one adult and one subadult female in December. By February–March 2003 currawongs were repopulating the cull area (Debus, pers. obs.).

By the time of the initial currawong cull, ten pairs of the subject passerines (robins *Petroica* and *Eopsaltria*) in the cull area had already laid up to three (usually two) unsuccessful clutches each over the period late August to mid-October, most clutches or broods having been lost to predation (Debus, unpubl. data). Subsequent robin nests (n = 13) and new fledglings (n = 3) in the cull area were also preyed upon or failed through the cull period, so that freshly eaten birds or eggs might have been expected in stomach samples if currawongs were the predators.

RESULTS

The currawongs in this study were almost entirely insectivorous (Table 1); no stomachs contained vertebrates or eggshell, although several currawongs had eaten fruit, leaves or human food scraps as well as invertebrates. The predominant foods of these pre-breeding currawongs were beetles and large venomous ants, and to a lesser extent dragonflies. In five cases there were 10–17 bull-ants *Myrmecia* per stomach, and in four cases 6–10 beetles per stomach. Two currawongs appeared to target dragonflies, having five and eight in their stomachs respectively.

No age or sex bias was evident in the diet of individual currawongs, as all age and sex classes contained examples of most of the recorded food types. The only seasonal effect was the lack of Christmas beetles in stomach samples until December, when two currawongs had eaten a total of seven such beetles.

Incidental observations revealed that adult currawongs at Imbota ate some vertebrates. In mid-October, several days before it was collected, one of the adult male currawongs carried and cached a bird carcass resembling an adult Fuscous Honeyeater *Lichenostomus fuscus*. In late spring

TABLE 1

Stomach contents of Pied Currawongs (n = 21) from a 270 hectare woodland fragment near Armidale, New South Wales, October–December 2002. Adult and subadult currawongs of both sexes are represented. Items identified to lowest possible taxon; n = minimum number of individual items per stomach.

Food type	n (%)	n stomachs (%)
Centipede (Chilopoda)	1 (<1)	1 (5)
Spider (Araneae)	1 (<1)	1 (5)
Dragonfly (Anisoptera)	14 (7)	3 (14)
Grasshopper (Orthoptera)	2 (1)	2 (10)
Ground-beetle (Carabidae)	1 (<1)	
Dung-beetle *Onthophagus* sp.	1 (<1)	
Christmas beetle: *Anoplognathus viriditarsus*	4 (2)	
A. porosus	2 (1)	
Anoplognathus sp.	1 (<1)	
Leaf-beetle (Chrysomelidae)	25 (13)	
Weevil (Curculionidae)	4 (2)	
Unidentified beetle (Coleoptera)	30[a] (16)	
Total beetles	68 (36)	20 (95)
Lepidoptera: adult	1 (<1)	
larva	2 (1)	
Total	3 (2)	3 (14)
Spider-hunter wasp (Pepsinae)	2 (1)	1 (5)
Bull-ant: *Myrmecia tarsata*	72 (38)	
M. gulosa	17 (9)	
Unidentified ant (Formicidae)	2 (1)	
Total ants	91 (48)	13 (62)
Apple *Malus domestica*	1 (<1)	1 (5)
Pear *Pyrus communis*	2 (1)	2 (10)
Leaf	2 (1)	1 (5)
Bread	1 (<1)	1 (5)
Total items	188 (100)	

[a]24, plus many fragments in a further stomach estimated to represent another six individuals.

of the previous year, a breeding adult currawong from one of the target territories ate a small bat (Microchiroptera), which it dismembered by wedging it into the crevice of a dead branch and stripping flesh off with its bill. In Imbota in a previous year, H. Ford (pers. comm.) observed a currawong take a large frog (apparently Peron's Tree-Frog, *Litoria peronii*) from the bark 'ribbon' of a Manna Gum *Eucalyptus viminalis*. The currawong beat the frog, which was giving loud distress calls, against a branch then carried its prey away.

DISCUSSION

Currawong prey items may differ in size and digestibility. For instance, easily digestible material such as vertebrate flesh may have a low probability of detection in stomachs, compared with indigestible matter such as insect exoskeletons. Nevertheless, vertebrate remains such as flesh, feathers, bones and eggshell are detectable in currawong stomachs or regurgitated pellets (Barker and Vestjens 1991; Prawiradilaga 1996; Wood 1998; Rose 1999; Fulton and Ford 2001a).

The results of this study are consistent with those of previous studies of Pied Currawong diet in spring (Wood 1998, 2000; Prawiradilaga 1996; Rose 1999; Fulton and Ford 2001a), with the exception of the lack of vertebrate prey in the present stomach samples. The difference may be explained at least partly by the fact that previous studies were of currawongs feeding their own nestlings, often on vertebrate prey, whereas the present study sought to remove currawongs before they bred. The currawongs collected at Imbota did not have active nests, and had eaten mostly arthropods. This result supports the view that the currawong takes mostly animal food (primarily insects) during its own breeding season, but preys on vertebrates mainly when feeding its own nestlings (Cooper and Cooper 1981; Prawiradilaga 1996; Wood 1998, 2000; Fulton and Ford 2001a).

The few novel prey items found in this study (dragonflies, predatory wasp, tree-frog, bat), as compared with items listed by Wood (1998, 2000), Prawiradilaga (1996), Rose (1999), Lepschi (1993, 1997), Barker and Vestjens (1991) and Fulton and Ford (2001a), probably reflect the incremental dietary dataset, regional variation, and identification of prey to different taxonomic levels. Bekker (1985) observed a currawong eating a Cane Toad *Bufo marinus*, but it was unclear whether it was obtained by predation or scavenging. The dragonflies at Armidale were taken in October–November, suggesting that the currawongs had found them, perhaps in clusters, roosting on cold mornings. The appearance of Christmas beetles in the diet reflects their seasonal availability, December being when the adult beetles emerge *en masse* (Debus, pers. obs.). Locally, currawongs deposit pellets containing many Christmas beetle remains in December–January (H. Ford, pers. comm.).

The currawongs in this study took large numbers of leaf-beetles and bull-ants, suggesting that in some circumstances currawongs may be major predators of these species. Bull-ants and leaf-beetles are common prey items in spring elsewhere, and some are toxic (Prawiradilaga 1996), suggesting that currawongs might have the physiological means to deal with ingested insect toxins. Predation on bull-ants and predatory wasps would necessitate disabling their stinging apparatus, a process yet to be described for currawongs although probably similar to that described by Griffiths and Holyoak (1993) and Bray and Davey (2002) for Australian Magpies *Gymnorhina tibicen* dealing with venomous bees and wasps. A recent record of paper-nest wasps *Polistes*, which have a painful sting, as currawong prey reported the bird as simply crushing the semi-torpid wasps in its beak before swallowing them (Holliday 2004).

The finding of human food scraps (bread, orchard fruit) in several stomachs is consistent with the incidental observation that, earlier in spring, several of the target currawongs sometimes left their woodland breeding territories and foraged on private land outside the reserve. This result also accords with the conclusion that the agricultural matrix sustains nest predators in fragments, thereby contributing to the high levels of nest predation in fragments (Chalfoun *et al.* 2002; Piper *et al.* 2002). The apple eaten at Imbota may have been from a farm tree, although the date was early for local ripening.

The observations of bird, tree-frog and bat prey, prey-handling and caching behaviour are consistent with previous descriptions (Cooper and Cooper 1981; Prawiradilaga 1994, 1996; Wood 2000) of currawong foraging behaviour. For instance, currawongs can capture free-flying birds, and their arboreal gleaning techniques would enable them to find roosting bats and tree-frogs in crevices of trees. It is likely that juvenile ringtail possums *Pseudocheirus*, recorded as prey by Cooper and Cooper (1981), were taken from their dreys in shrubs.

Although the currawong is a known predator of birds and the contents of their nests, the present study found no direct evidence that pre-breeding currawongs had eaten passerine eggs or nestlings. However, there was observational and strong circumstantial evidence, deriving from predator-exclusion cages around robin nests in 2001 and reduced predation pressure after the currawong cull in 2002, that breeding currawongs in the study site did rob robin nests (Debus, unpubl. data). Furthermore, in a previous spring at Imbota, the stomachs of parent currawongs and their young contained bird and other vertebrate remains (Fulton and Ford 2001a).

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