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Pied Currawongs and the decline of native birds

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Abstract. Predation pressure by Pied Currawongs, *Strepera graculina*, has been implicated as a principal factor in the decline of native bush bird populations. We review the available literature, analyse the types of avian species reported as being preyed on by currawongs, and examine whether this evidence suggests that increased currawong predation is limiting bird populations. Virtually all species reported as prey could be classified as 'introduced/common' and 'native/common'. The results suggest that predation is greatest on introduced/common species, and less than expected on native/common species and native/rare species. Currawongs seem to be generalist predators and do not appear to target any particular size or age range of avian prey. Nonetheless, it is not clear that currawongs are primarily responsible for predation on both nests and adults in all populations of small native birds, nor are the possible compensatory effects of density-dependent population growth rates in small Australian passerines well understood. It is also difficult to separate the effects of predation (increased mortality, possible reduced recruitment) from the effects of gross habitat change (degradation, fragmentation, changes in species composition and/or abundance). We discuss the limitations of some previous studies on currawong predation, and suggest possible directions for future research.

Introduction

Pied Currawongs, *Strepera graculina* (hereafter referred to as currawongs), are large (41–51 cm) conspicuous birds found in a wide variety of habitats (forest, woodland, scrub, agricultural, urban) in the eastern states of Australia. They are omnivorous and feed on invertebrates, reptiles, small birds, mammals, fruits, seeds and carrion (Simpson and Day 1999). Currawongs have been implicated as a principal factor in the decline of native bush bird populations, and in spreading weed species such as privet (*Ligustrum* spp.). While there is convincing evidence that currawongs are involved in the spread of weeds (Buchanan 1989; Bass 1995), evidence for their role in the decline of native bush birds in both urban and rural areas is less clear.

In our experience, the debate on currawong control is a highly political issue. Here we review the available literature and analyse the types of avian species reported as being preyed on by currawongs. We then examine whether this evidence alone suggests that increased currawong predation is limiting bird populations. This paper is not intended to suggest that Pied Currawong populations should not be controlled, but rather to suggest that additional research is required to properly understand the problem.

Methods

We searched *Streamline* and *BIOSIS* and reviewed the literature on the foraging and predation habits of currawongs published before January 2000. We also obtained studies on the breeding success of Australian birds published in major journals between January 1970 and December 1999. We then compiled a list of all the avian species reported as currawong prey ('prey' group). We counted the number of sympatric species not reported as prey ('not prey' group). 'Sympatric' is defined as 'residing within the currawongs' range and within at least one of the currawongs' habitat types' (Simpson and Day 1999). Species in both groups were classified as native, introduced or domestic, and further as common or rare (following Australian Government 1992; Simpson and Day 1999). The category 'rare' includes uncommon, endangered and vulnerable species.

To avoid unduly inflating the figures for the 'non-prey' group, we excluded domestic species (e.g. chickens, *Gallus gallus*) and certain free-flying species from the analysis. Cuckoos were excluded because nest predation rates on these birds would be dependent on the nest predation rates of their hosts. Although one island-breeding seabird was reported as currawong prey, we excluded seabirds because determining whether currawongs were found on the breeding islands of most species was beyond the scope of this paper.

We investigated whether there were any differences between nest predation (nestlings, fledglings and eggs) and adult/juvenile predation reported for the 'prey' categories. Further analyses focussed on two subsets of species: (1) passerines, pigeons and doves, and (2) all possible prey species. Species in Subset 1 most closely matched the

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genera in the 'prey' group whereas Subset 2 contains some genera that have never been reported as currawong prey.

We used contingency table analysis to gain some insight into observed patterns of predation. Residual analysis determines where, and in what direction, the observed data deviates from the expected values (Haberman 1978).

For the 'prey' group, we also noted each species' preferred habitat and adult size (average length from bill tip along back to tail tip). Finally, we examined the evidence for a clear causal relationship between the presence of currawongs and a decline in populations of small birds.

Results

Of the species listed in the literature (Table 1), the only avian species that had been clearly identified as being significantly limited by currawong predation was an endangered island-nesting seabird (Priddel and Carlile 1995); this was not included in the statistical analysis. Reports by other authors on birds taken by currawongs are mostly anecdotal and consist of either unspecified numbers of predation events or a single observation. In many cases, it is typically unclear whether currawongs killed the species listed or merely scavenged the remains (e.g. Cooper and Cooper 1981; Prawiradilaga 1994; Wood 1998).

Virtually all species reported as prey were classified as 'introduced/common' and 'native/common' (Table 2). Most (62%) native/common and introduced/common species recorded were found in urban environments. Currawongs preyed on free-flying birds as well as on nests (Table 3).

For the most conservatively matched subset of species (passerines and doves), predation was greater on introduced/common species and less on native/rare species than expected (Table 2). This is based on the null hypothesis of no difference between observed and expected frequencies of predation for these categories. There are no reports of predation in either of the 'rare' categories, possibly because the probabilities of observing these events are extremely low.

We also compared the frequencies of predation for pairs of categories using contingency table analysis. Predation on introduced/common and native/common species differed more than expected (Fisher's Exact $P = 0.003$). Introduced/common species were preyed on more than expected (adjusted residual 3.3), while native/common species were preyed on less then expected (adjusted residual –3.3). Similar results were found with Subset 2 (Fisher's Exact $P = 0.001$).

Adult and juvenile prey were 8–45 cm in length (mean 21.5 cm), with 40.7% of prey species larger than 21.5 cm.

Discussion

Currawongs appear to be generalist avian predators and do not appear to target any particular size or age range of avian prey. Although they prey on similar numbers of nests and adults in both the native/common and introduced/common categories, predation pressure appears to be greater on introduced/common species than native/common species. This may result from a bias toward fewer introduced species occurring in greater abundance in areas where many observers live, or greater susceptibility to currawong predation in introduced birds.

'Common' species may still be in decline (Recher 1999), and given currawongs' predatory abilities, it is possible that they may have some deleterious effects on populations of small birds in certain areas. Ford *et al.* (2001) have published a comprehensive review of the reasons why small birds have declined in rural areas of southern Australia, and suggest a number of hypotheses to guide further research. Below, we discuss the limitations of some previous studies on currawong predation, and suggest possible directions for future research.

Are currawongs primarily responsible for predation on both nests and adults?

Small birds and their nests are preyed upon by a range of avian (see Major *et al.* 1996) and non-avian predators (e.g. reptiles: Prawiradilaga 1996; Green and Cockburn 1999; Zanette and Jenkins 2000). Most reports of predation, and notably currawong predation, on adult birds are anecdotal. Determining which predator preyed on a nest is usually based on how often a predator species is observed in the study area (natural nests), and on beak or claw imprints in dummy eggs (artificial nests). The use of artificial nests in nest predation studies can overestimate the rate of predation or the relative importance of different predators (Taylor and Ford 1998).

For example, a substantial recent study on nest predation recruited members of the public to collect data through a multi-media advertising campaign (Major *et al.* 1996). Large birds were identified as the predominant predators, based on the number of large beak imprints on dummy eggs (48.5% of total predation), but it was not possible to ascertain which species made each imprint. In a very small number of opportunistically observed cases (for 11.8% of all preyed-upon nests), currawongs were seen to prey on about half the nests (6.1% of all preyed-upon nests). This trend was assumed to underlie all the data and currawongs were subsequently identified as the dominant nest predator.

While the study of Major *et al.*(1996) clearly identified birds as important nest predators in urban areas, the identification of currawongs as the dominant nest predator is not convincing. We suggest that systematic observational studies are needed to identify nest predators conclusively.

In areas where currawong populations have increased, has overall nest predation pressure also increased to the extent that it significantly affects recruitment?

Figures for nesting failure in Australian birds show enormous variability among species (39–92.2%, $n = 22$ species: Robinson 1990) and within species in the same locality (e.g.

Table 1. Age range, abundance and habitat type of native, introduced and domestic prey species reported taken by Pied Currawongs
Age range categories: E = egg, NF = nestling/fledgling, J = juvenile, A = adult, JA = juvenile or adult. Abundance categories: A = abundant, LA = locally abundant, C = common, MC = moderately common, LC = locally common, LUC = locally uncommon, R = rare (after Simpson and Day 1999). Habitat-type categories: Ur = urban, human habitation, gardens, parkland; Ag = agricultural, farmland, orchard; Ru = rural, country; Fo = forest, woodland; Du = prefers availability of dense undergrowth, In = inland; Si = sea and island, He = heath (after Flegg and Madge 1995; Simpson and Day 1999). References: 1 = Allison (1993); 2 = Ashby (1927); 3 = Bell (1985); 4 = Bridges (1994); 5 = Butterfield (1988); 6 = Chittick (1990); 7 = Cooper and Cooper (1981); 8 = Crowe (1978); 9 = Emery (1988); 10 = Ford (1999); 11 = Hoskin *et al.* (1991); 12 = Hunt and Hunt (1995); 13 = Lenz (1990); 14 = Lepschi (1993); 15 = Manuel (1992); 16 = McFarland (1978); 17 = Metcalf (1988); 18 = Miller and Naisbitt (1994); 19 = Morris and Burton (1994); 20 = Portbury (1992); 21 = Prawiradilaga (1994); 22 = Prawiradilaga (1996); 23 = Priddel and Carlile (1995); 24 = Recher and Schulz (1983); 25 = Roberts (1942); 26 = Robinson (1990); 27 = S. G. Pruett-Jones in Langmore and Mulder (1992); 28 = S. Debus in Cooper and Cooper (1981); 29 = Sefton (1988); 30 = Taylor (1986); 31 = Tibicen (1978); 32 = Vellenga (1980); 33 = Vestjens and Vestjens (1970); 34 = Wood (1998); 35 = Wood (1995); 36 = Wood (1997), 37 = W. Rolland in Miller and Naisbitt (1994)

Category	Common name	Scientific name	Age range	Abundance	Habitat type	References
Native, common	Australian Magpie	*Gymnorhina tibicen*	NF, J	C–LA	Ur, Ag, Fo	1, 7, 8
	Black-faced Cuckoo Shrike	*Coracina novaehollandiae*	E, NF	MC–C	Ur, Fo	15, 29
	Brown Thornbill	*Acanthiza pusilla*	JA	LUC–C	Fo, Du	17
	Flame Robin	*Petroica phoenicia*	NF	C	Ur, Ag, Fo, Du	26
	Jacky Winter	*Microeca fascinans*	NF	LC–MC	Ag	11
	Little (Brush) Wattlebird	*Anthochaera chrysoptera*	NF	C	Ur, Fo, He	29
	Magpie Lark	*Grallina cyanoleuca*	NF	C	Ur, Ag, In	29
	New Holland Honeyeater	*Phylidonyris novaehollandiae*	NF	C	Fo, He	16
	Noisy Friarbird	*Philemon corniculatus*	NF	C–LA	Fo	10
	Pardalote	*Pardalotus* spp.	JA	MC–C	Fo	20
	Red Wattlebird	*Anthochaera carunculata*	NF, A	C	Ur, Fo	7, 19, 20, 21
	Red-browed Finch	*Neochmia temporalis*	NF	C	Ur, Fo, Du	1
	Rufous Whistler	*Pachycephala rufiventris*	NF	C	Fo	4
	Silvereye	*Zosterops lateralis*	NF, JA	C	Ur, Ag	1, 14, 17, 28
	Spotted Pardalote	*Pardalotus punctatus*	J	MC–C	Fo	35
	Superb Fairy-wren	*Malurus splendens*	E, NF, JA	C	Ur, Fo, Du	21, 22, 27
	Thornbill	*Acanthiza* spp.	E, NF, JA	C	Fo	3, 20
	Welcome Swallow	*Hirundo neoxena*	JA	C	Ur, Ag, Fo, In	6
	White-bellied Cuckoo-shrike	*Coracina papuensis*	E	MC–C	Fo	12
	White-browed Scrub-wren	*Sericornis frontalis*	E, NF, JA	C	Ur, He, Du	22
	White-browed Woodswallow	*Artamus superciliosis*	E	MC– LA	In	24
	White-naped Honeyeater	*Melithreptus lunatus*	A	C	Fo	32
	White-winged Chough	*Corcorax melanorhampos*	NF	C	Fo	21
	Willie Wagtail	*Rhipidura leucophrys*	NF	C–A	Ur, Ag, Fo, In	29
	Yellow-faced Honeyeater	*Lichenostomus chrysops*	A	C	Fo	32
	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	NF	C	Ur, Fo, Ag	1
Native, rare	Gould's Petrel	*Pterodroma leucoptera*	JA	R	Si	23
Introduced, common	Common Blackbird	*Turdus merula*	E, NF, J, A	LC–C	Ur, Ru	1, 6, 8, 17, 20, 21, 31, 32, 33
	Common Myna	*Acridotheres tristis*	NF, JA	C–LA	Ur	1, 28
	Common Starling	*Sturnus vulgaris*	E, NF, J, A	C–A	Ur, Ru	1, 5, 8, 13, 17, 21, 30, 32
	European Goldfinch	*Carduelis carduelis*	J	LC	Ag	31
	House Sparrow	*Passer domesticus*	E, NF, J, A	C	Ur, Ag	1, 8, 13, 14, 17, 28, 30, 32
	Red-whiskered Bulbul	*Pycnonotus jocosus*	NF	LC–C	Ur	9, 29, 34
	Spotted Turtle-dove	*Sreptopelia senegalensis*	E, A, JA	A	Ur, Ag	7, 18, 20, 36
Domestic	Budgerigar	*Melopsitticus undulatus*	A	LC	Ur	37
	Canary	*Serinius canarius*	A	UC	Ur	28
	Chicken	*Gallus gallus*	E, J	LC	Ur, Ag	2, 25
	Turkey	*Meleagris gallopavo*	J	LC	Ur, Ag	25

Table 2. Passerine and dove prey of Pied Currawongs
$\chi^2 = 17.74$, $P = 0.001$

	Prey	Not prey
Native / common	26	92
Native / rare[A]	0	16
Introduced / common[B]	7	3
Introduced / rare	0	1

[A]Adjusted residual = –2.3
[B]Adjusted residual = 3.7

Table 3. Types of predation by Pied Currawongs
$\chi^2 = 0.396$, $P = 0.651$

	No. of reports for	
	Native / common	Introduced / common
Nest predation	27	23
Adult / juvenile predation	15	17

45.8–70.0% for Regent Honeyeaters, *Xanthomyza phrygia*: Geering and French 1998), in different localities (e.g. 52–84% for Brown Thornbills, *Acanthia pusilla*: Bell 1985; Green and Cockburn 1999) and between years (e.g. 58–89% for White-browed Scrubwrens, *Sericornis frontalis*: Prawiradilaga 1996). The most important cause of nest failure is high predation (around 50–60% of all nests), but as most studies have been carried out in fragmented habitats it is difficult to know whether these predation rates are truly characteristic of Australian birds (Ford *et al.* 2001). However, there is some evidence that Australian birds' breeding biology has been shaped by high rates of predation (Robinson 1990; Rowley and Russell 1991), and the mean success rates of nests does not differ between those studies carried out in fragmented habitat and those in continuous habitat (Ford *et al.* 2001).

While there have been a number of important studies on nest predation by currawongs (Wood 1995, 1998; Prawiradilaga 1996), these studies have failed to show any population decline in the prey species. Predation on eggs and chicks is less likely to affect subsequent breeding numbers than predation on adults because of greater opportunities for improved recruitment of surviving young into the breeding population (Newton 1998). Therefore, high nest predation rates may not be detrimental to long-term population viability if overall rates are within an historically normal range. We suggest that, to fully understand the effects of nest predation on limiting populations, studies must document later density-dependent population growth rates and determine whether these are compensatory.

Are there factors other than predation contributing to bush bird decline?

Clearing of native vegetation, grazing pressure, inappropriate fire regimes, over-abundance of certain feral and native animals, water quality and flow, and lack of appropriate reserve systems are known to contribute to decline in Australian wildlife (Recher 1999).

Human-induced habitat change tends to favour large or aggressive birds over small native insectivorous birds (Recher 1972) and over-abundance of species is a poorly acknowledged result of habitat change (Recher 1999). For example, Noisy Miners, *Manorina melanocephala*, are often found in great abundance in altered or degraded habitats (Ford *et al.* 2001) and are extremely effective in excluding other bird species (Dow 1977; Loyn 1985). Recent experimental reduction of Noisy Miner numbers in woodland remnants in Victoria resulted in increased populations of small native birds (Grey *et al.* 1997, 1998).

Many native bush birds require substantial understorey (Green and Catterall 1998) or forest remnants (Sewell and Catterall 1998) to thrive. Ironically, introduced weeds such as lantana can provide this type of shelter in developed areas. Removal of these plants in some areas may have unwittingly left bush bird populations vulnerable to both predation and aggressive encounters with competitors.

We suggest that factors other than predation should also be seriously considered when designing experiments to ascertain the cause of bush bird decline. For example, removal of currawongs in areas denuded of habitat suitable for small birds is unlikely to result in recolonisation of the area by small birds, but may be appropriate where suitable habitat still exists.

Are currawongs controlling populations of introduced species?

Populations of introduced species such as House Sparrows, *Passer domesticus*, Common Starlings, *Sturnus vulgaris*, and Common Mynas, *Acridotheres tristus*, have doubled over the past 50 years (Blakers *et al.* 1984) and appear to be targeted by currawongs in urban areas (Taylor 1986; Metcalf 1988; Lenz 1990). It is possible that currawongs exert some control over these populations, both by competing for food (Bass 1995) and by predation on adults and nests. Although sparrows and mynas are cavity nesters, there are reports of nest predation on these species (Table 1). The published data that we have collated suggests strongly that there is significant predation pressure on introduced species, although this needs to be confirmed by more detailed studies. Currawongs may be an important predator of these species in urban areas, and control measures may be counterproductive in these localities.

Is controlling currawong populations an effective method for dealing with currawong predation on sensitive species?

Controlling currawong populations proved successful in protecting Gould's Petrel, *Pterodroma leucoptera* (Priddel and Carlile 1995). On the mainland, similar control programs may be effective in increasing bird populations at small scales (Grey *et al.* 1998), or protecting endangered or vulnerable species, and currawong-removal programs may prove to be necessary conservation measures in such cases.

However, control measures are a short-term solution (Newton 1998). Population control by poisoning is likely to select for behavioural modification (Garnett 1998; Temby 1998) or genetically resistant individuals (e.g. Warfarin resistance in rats), and may affect non-target species (Garnett 1998). In addition, there are no currently approved avicides in Australia, and shooting is ineffective for large numbers of birds (Garnett 1998). Finally, killing birds may not have much impact on population size and populations may easily recover (Feare 1991), or simply move elsewhere, transferring the problem to another site (Bosch *et al.* 2000). For long-term control, altered habitats must be made less suitable for currawongs, and more suitable for small bush birds (Ford *et al.* 2001).

Conclusion

An objective examination of the evidence suggests that the decline in bush birds is the result of an interaction between many factors, rather than the result of currawong predation alone. Nevertheless, this does not preclude the possibility that predation pressure by currawongs is the primary cause of bush bird decline in some areas. Scientifically based policy can only be made on the available data, and we strongly support the call for more detailed studies. We suggest that population-reduction measures should be the outcome of carefully controlled, peer-reviewed experimental and observational evidence, rather than based on anecdote or emotion. Assessing the effectiveness and viability of currawong control will require well designed currawong-removal experiments, and population monitoring in a variety of habitats. However, following Ford *et al.* (2001) and Recher (1999), we caution that reversing the decline of native bush birds will be achieved sustainably only through substantial habitat restoration.

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