

Notes on the parasitic ecology of newly-fledged Fan-tailed Cuckoos *Cacomantis flabelliformis* and their White-browed Scrubwren *Sericornis frontalis* hosts in south-east Queensland

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Abstract

Despite brood parasitic cuckoos being the subject of much scientific attention, in large part due to the study of the adaptation-counter adaptation evolutionary “arms-races” that they have with their hosts, there is surprisingly little literature on the natural habits of newly-fledged cuckoos. Generally, it is believed that after depositing their egg in their host’s nest, adult cuckoos provide no parental care and care is only provided by the foster parents. However, intriguing records of adult cuckoos feeding newly-fledged cuckoos and provisioning by adult birds other than the cuckoo’s host parents exist. Fledged-but-dependent Fan-tailed Cuckoos *Cacomantis flabelliformis* have been recorded to be fed by both adult conspecifics and a variety of non-foster parent adult birds, making it an interesting species to begin investigating why these phenomena exist. Here, we followed seven fledged but dependent Fan-tailed Cuckoos over the course of three months (August – October 2017) at Lake Samsonvale in south-east Queensland, Australia, to investigate their feeding ecology and record interactions between them and other species. Female White-browed Scrubwren *Sericornis frontalis* hosts provisioned fledged cuckoos at a significantly higher rate than males, and while newly-fledged cuckoos directed begging at individuals from species other than their foster parents (including one butterfly), we did not record any evidence of provisioning by non-hosts (i.e. auxiliary feeds, Sealy & Lorenzana 1997), in our 1207 provisioning observations. Our observations provide new insights into the ecology of newly-fledged Fan-tailed Cuckoos, including interactions with their foster parents and other species.

Introduction

The Fan-tailed Cuckoo *Cacomantis flabelliformis* is a species of Old World brood-parasitic cuckoo (Tribe: Cuculini) that is found throughout the south-west Pacific region. It is an obligate brood parasite, laying its eggs in the nests of other (host) species (Feeney *et al.* 2014). Seventeen species have been identified as biological hosts, the most commonly parasitised species being the White-browed Scrubwren *Sericornis frontalis*, Brown Thornbill *Acanthiza pusilla* and Inland Thornbill *A. apicalis* (Brooker & Brooker 1989; Guppy *et al.* 2017; Feeney *et al.* 2018). Raising a cuckoo represents a substantial cost to the host since post-fledging care of juvenile Fan-tailed Cuckoos is reported to last three to four weeks (Higgins 1999).

Fledgling Fan-tailed Cuckoos have been reported to be fed by adult Fan-tailed Cuckoos and species other than their hosts (Brooker & Brooker 1989; Sealy & Lorenzana 1997; Lorenzana & Sealy 1998; Higgins 1999). These behaviours may be a result of adult cuckoos providing more parental care than traditionally assumed or fledgling cuckoos having evolved behaviours or traits that take advantage of the sensory predispositions of parental behaviours e.g. supernormal signalling; Holen *et al.* 2001. Either way, these reports highlight that the natural habits of brood parasites, such as cuckoos, are sorely understudied

(reviewed by Feeney & Riehl 2019). In this study, we followed seven fledgling Fan-tailed Cuckoos to investigate interactions between them and other species in order to gain new insights into the fledgling ecology of this species, as well as why other species contribute to provisioning them.

Methods

Study Site

The study was conducted in an area west of Lake Samsonvale (27°16'S, 152°51'E) in south-east Queensland. The site contains a mix of vegetation with remnant rainforest and dry sclerophyll forest interspersed between grassland with planted *Eucalyptus* spp. The dominant habitat at the site is grassland where *Eucalyptus* spp have been planted. The dominant plant species of the understory is the invasive *Lantana camara*. Areas of remnant rainforest are found in a few gullies at the site.

Behavioural Observations

We observed seven fledged-but-dependent Fan-tailed Cuckoos for almost 80 h (4721 min) between August and October 2017. Each fledgling was watched for a single period each day (mean observation duration, 53.64 +/- 2.10 [SE] min; median, 59 min), with 91% of observations (n=88) starting between 10:00 and 12:30 hrs. Unfortunately, these birds had fledged prior to our field season starting so all observations were conducted on fledged cuckoos of unknown age. Our previous research (Feeney *et al.* 2018) showed that nestling Fan-tailed Cuckoos stay in White-browed Scrubwren nests for approximately 17 days after hatching so all cuckoos observed in this study were at least 17 days old.

During each observation period, each observer recorded the number of feeds and the species, sex and colour bands, if applicable, of the provisioning bird. Observers also recorded any interactions between the fledgling cuckoo and other species, as well as general feeding behaviours. Individual cuckoos were identified by association with the host parents' colour bands and home range. The sex of each White-browed Scrubwren host was determined through a combination of colour-band combinations and plumage characters (Magrath *et al.* 2000; Higgins & Peter 2002). All White-browed Scrubwrens observed in this study bred in pairs, rather than groups.



Figure 1. A fledged Fan-tailed Cuckoo being fed by an adult female White-browed Scrubwren (colour combination: BLYS) at the Samsonvale study site, Queensland, Australia. (Cameryn Brock).

Statistics

Statistical analyses were conducted in R (R Core Team 2015) and Generalised Linear Mixed Models (GLMMs) were conducted using the lme4 package (Bates & Maechler 2009). We used a GLMM to investigate whether males and females differed in their provisioning rates of the fledged Cuckoos. The full and final model had 'host parent sex' as a fixed effect, and 'observation event' and 'cuckoo ID' as random effects.

Results

Overall 1207 provisioning events were observed. Of these, the female fed the cuckoo on 358 occasions, the male on 226 occasions. The observers were unable to confidently identify the provisioner's sex on 584 occasions, so these data were excluded from statistical analysis. Our analysis suggests that female scrubwrens provisioned cuckoo fledglings at a significantly higher rate than male scrubwrens ($\chi^2_4 = 30.09$, $P < 0.001$, Fig. 2).

Six of the observed fledglings displayed aggressive begging behaviour, following their hosts through vegetation while making begging calls. Three of the fledglings were observed pecking and nipping at their host parents' backs and tails. All fledglings displaying this behaviour were capable of foraging - one fledgling captured 23 insects during an observation period but received only 14 food items from the hosts. Five of the seven cuckoo fledglings received more feedings from their female host parent than from their male host parent (Fig.2).

Fledged-but-dependent cuckoos interacted with a variety of other species (Table 1). Most non-host species showed no interest in the fledglings, with only a brief examination before moving on. On four occasions the fledglings were chased by a non-host adult, after actively begging from it, namely a Rufous Whistler *Pachycephala rufiventris*, Willie Wagtail *Rhipidura leucophrys*, and two unidentified honeyeaters.

Adult Fan-tailed Cuckoos were observed at the study site throughout the duration of this study and showed interest in the fledged cuckoos on two occasions. During both interactions, the adult cuckoo approached and watched the fledgling within 7 m, but no contact was made.

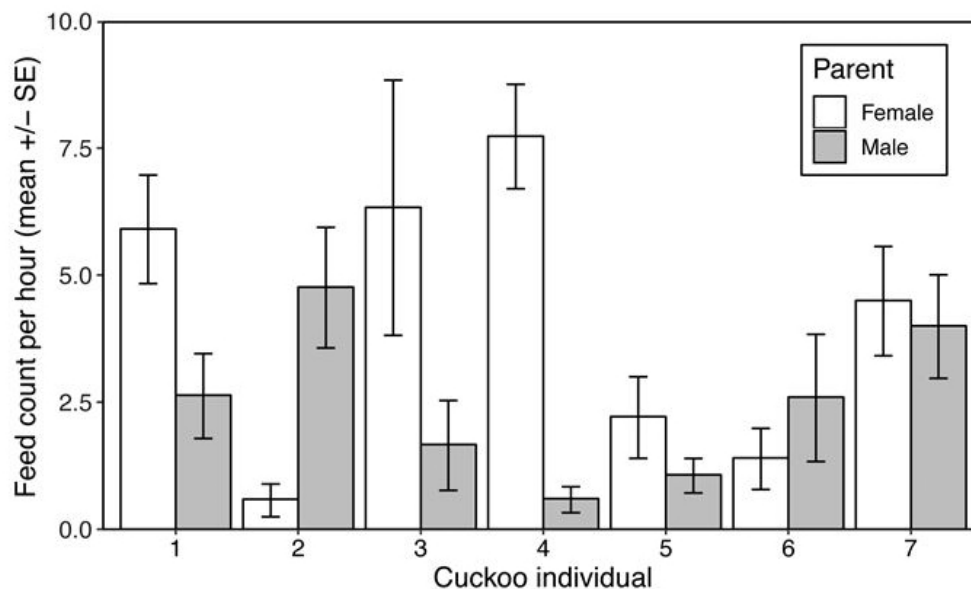


Figure 2. Mean provisioning rate of female and male White-browed Scrubwren *Sericornis frontalis* hosts to each of the fledged-but-dependent Fan-tailed Cuckoos *Cacomantis flabelliformis* observed in this study. Error bars denote standard error (SE).

Discussion

During the three months of observations we observed 1207 feeding events for seven Fan-tailed Cuckoo fledglings and saw no incidence of auxiliary feedings. We expected that male White-browed Scrubwrens would provide more feedings to the cuckoo fledglings than the females, as Magrath & Yezerinac (1997) found this to be the case when Scrubwrens in Canberra provisioned their own nestlings. While our study was conducted on fledgling, rather than nest-bound offspring, we found that the female provided significantly more feedings to the fledgling cuckoo. We do not know why this difference exists between the two studies, although one possibility is that provisioning rates change post-fledging. We suggest future work should consider feeding rates of cuckoos and biological offspring by scrubwren hosts from nestlings to independence post-fledging to fully understand these trends.

While we did not observe auxiliary feedings during our observations of Fan-tailed Cuckoo fledglings, we saw fledglings beg at a number of species other than their host parents, including one butterfly. In Sealy & Lorezana's (1997) review, all observed auxiliary feedings of fledgling brood parasites "were stimulated by vocalizing young". During our observations, all attempts by fledgling cuckoos to solicit food from non-hosts failed, the fledglings being chased off their perch in three cases (Table 1). In one case, a fledgling begged from an unidentified honeyeater and was chased twice during a single observation period. While this may seem like a poor strategy, fledgling Pallid Cuckoos *Heteroscenes pallidus* have been reported successfully soliciting food from attackers (Sharland 1929; Kikkawa & Dwyer 1962). Thus, our observations support the idea that incessant begging vocalizations by fledgling Fan-tailed Cuckoos may represent a supernormal stimulus (Holen *et al.* 2001) that can play on the sensory predispositions of parental birds to secure provisioning. The relentless begging by fledged cuckoos was such that it continued in the face of bird predators including a Lace Monitor *Varanus varius* and Carpet Python *Morelia spilota* (Table 1). We agree with Sealy & Lorezana (1997) that a study of vocalizations and vocal mimicry during the fledgling stage of development would be beneficial to further understanding of cuckoo behaviour.

There is a general lack of information on the ecology and behaviour of brood parasites. A push in recent years to understand Australian cuckoos has resulted in several studies which broaden our knowledge of non-European cuckoos, such as the Pallid Cuckoo (Kennerley *et al.* 2019) and the Pacific Koel (Abernathy & Langmore 2016). This push, however, is focused mostly on the ecology and evolution of adult cuckoos and not fledglings, which remain largely understudied. A broader study of all cuckoo fledglings from time of fledging to when they reach independence is needed to fully understand the significance of this period in their development.

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Table 1. Summary of interactions between fledgling Fan-tailed Cuckoos and non-host individuals observed during this study.

Species	Interaction					Description
	Alarm Vocalization	Chased	Ignored	Inspected	Scolding Vocalization	
Brown Honeyeater <i>Lichmera indistincta</i>				X		Brown Honeyeater investigated a fledgling
Eastern Yellow Robin <i>Eopsaltria australis</i>		X				Robin chased a fledgling from its perch
Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i>				X		Fan-tailed adult flew up to and then watched a fledgling
Grey Fantail <i>Rhipidura fuliginosa</i>			X			Fantail ignored a begging fledgling
			X			Fantail ignored a begging fledgling
Honeyeater spp. <i>Meliphagidae sp</i>		X				Honeyeater chased a begging fledgling from branch
		X				Honeyeater chased a begging fledgling from branch
Mistletoebird <i>Dicaeum hirundinaceum</i>				X		Female Mistletoebird flew up to and inspected a fledgling
Red-backed Fairywren <i>Malurus melanocephalus</i>					X	A fledgling was scolded by a group of Red-backed Fairywrens when it landed near them

	<i>Alarm Vocalization</i>	<i>Chased</i>	<i>Ignored</i>	<i>Inspected</i>	<i>Scolding Vocalization</i>
Rufous Fantail <i>Rhipidura rufifrons</i>				X	Rufous fantail inspected a begging fledgling
Rufous Whistler <i>Pachycephala rufiventris</i>		X			Whistler chased a fledgling from its perch
			X		Rufous whistler ignored a begging fledgling
Superb Fairywren <i>Malurus cyaneus</i>			X		A singing Superb Fairywren ignored a begging fledgling
	X				Superb Fairywrens alarm called when a fledgling landed near them
Yellow-faced Honeyeater <i>Caligavis chrysops</i>		X			Yellow-faced Honeyeater chased a begging fledgling off a branch
				X	Yellow-faced Honeyeater investigated a fledgling but flew away after the fledgling lunged at the honeyeater
White-browed Scrubwren <i>Sericornis frontalis</i>	X				Scrubwrens alarm called when a fledgling landed near them
			X		A foraging scrubwren ignored a begging fledgling
Willie Wagtail <i>Rhipidura leucophrys</i>		X			A fledgling was chased by Willie Wagtail after the fledgling vocalized towards Willie Wagtail
			X		Willie Wagtail ignored a begging fledgling
			X		Willie Wagtail ignored a begging fledgling
Non-Avian Species					
Butterfly (unidentified)					A fledgling begged towards butterfly as the butterfly flew past
Carpet Python <i>Varanus varius</i>					A fledgling was begging loudly and pursuing its host parents through the undergrowth when they came across a carpet python. Host parents went quite but the cuckoo kept begging
Lace Monitor <i>Morelia spilota</i>					A Lace Monitor was moving through undergrowth towards the fledgling and host parents. Fledgling continued begging as other birds in the area alarm called at the monitor