

Observations on the behaviour and ecology of the Pallid Cuckoo *Heteroscenes pallidus* in south-eastern Queensland

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Abstract. The Pallid Cuckoo *Heteroscenes pallidus* is a species of Old World brood-parasitic cuckoo (Tribe: Cuculini) that has received relatively little research attention, resulting in a lack of information on several aspects of its natural history. Over the course of c. 16 weeks (between September 2017 and January 2018), we recorded daily observations of at least six individuals present at the study site at Lake Samsonvale, Queensland. Here we present a summary of our observations including details on habitat preferences, plumages, vocalisations, social behaviour and interactions between Pallid Cuckoos and their potential hosts. We discuss these observations and suggest potential avenues for future research.

Introduction

The Pallid Cuckoo *Heteroscenes pallidus* is a species of Old World brood-parasitic cuckoo (Tribe: Cuculini) that is an endemic breeding species in Australia. It occurs throughout Australia, preferring the drier interior regions of the continent but largely avoids the moist, humid region between the Great Dividing Range and the coast (Higgins 1999). Thirty-two species of passerines that construct open-cup-shaped nests are recognised as its biological hosts (Brooker & Brooker 1989; Higgins 1999) and female Pallid Cuckoos lay eggs that mimic those of several common hosts, indicating the presence of female host-specific races, or gentes (Starling *et al.* 2006). As with many cuckoo species, it has received limited research attention and there is a paucity of information concerning several aspects of its natural history (Feeney & Riehl 2019). Through daily observations, we aimed to document the behaviour and ecology of the Pallid Cuckoo from a location in south-eastern Queensland, a region where this species occurs sporadically.

Methods

Observations were conducted at a study site on the western side of Lake Samsonvale (27°16'S, 152°51'E), Queensland. The habitat is varied, with large areas of grassland planted with *Eucalyptus* spp., <5 m in height, remnant dry sclerophyll forest dominated by Myrtaceae species particularly of the genus *Eucalyptus*, and secondary regrowth dry sclerophyll forest. Some gullies also support remnant rainforest communities. In each habitat, the understorey is usually dominated by the introduced and invasive *Lantana camara*.

Observations were made between sunrise and 6 hours thereafter, with observations of Pallid Cuckoos being more frequent during the earlier part of the morning. We documented behaviour with field notebooks, eBird (ebird.org), photographs and sound recordings, which have been uploaded to the Macaulay Library at the Cornell Lab of Ornithology (ML; macaulaylibrary.org). The following photographs and sound recordings from the ML were used: 68916861, 75747131, 102512161, 102512501, 143526231, 143526311, 143526961 and 143526971. Each was collected by JAK. Spectrograms were produced from sound recordings using Raven Lite (ravensoundsoftware.com).

Using Google Earth Pro (www.google.com/earth/ versions/#earth-pro), territory and home-range sizes were calculated retrospectively by drawing a minimum convex polygon encompassing all locations where an individual Pallid Cuckoo was observed, a method analogous to that used for calculating a species' extent of occurrence (IUCN 2012). Individual Pallid Cuckoos were identified on the basis of plumage markings and repeated observations of Cuckoos in specific locations; however, not all individuals (particularly males) were uniquely identifiable.

Observations

We first observed Pallid Cuckoos at the study site on 12 September 2017. Thereafter, a further 84 observations involving at least one individual were made until 5 January 2018, when the field season ended. The number of Cuckoos increased as the season progressed, with a daily high count of five birds being observed on 14 October 2017. In total, we identified six individual Cuckoos, although more individuals might have been present. Here we refer to the six individually identified Cuckoos as Males A, B and

D, and Females A, B and C. We considered Male A and Female A, and Male B and Female B to be pairs.

Habitat, territories and home-ranges

Males ($n = 3$) held territories that encompassed areas of bushland of varying maturity, and their territories appeared to comprise disjunct areas of suitable habitat separated by unsuitable habitat such as grassland and open water (Figure 1). We estimated the territory for Male A to be 15 ha. The territories of two other males (Males B and D) encompassed areas of the study site plus inaccessible areas (east of the study site), to which we observed them fly. Although we were unable to accurately calculate the size of the territories of Males B and D, because of the expanse of lake that fell within each of their territories, we estimate that both territories were at least 25 ha. Females also showed fidelity to particular areas and we describe these areas as home-ranges. Over a period of several weeks, Females A and C occupied home-ranges of 3 and 5 ha, respectively (Figure 1), separated by an area of grassland that extended for 100 m at its narrowest point. We did not observe any interactions between Females A and C.

For one pair of Cuckoos, Male A held a territory that wholly encompassed the home-range of Female A (Figure 1) and was an order of magnitude larger than the home-range of Female A (Male A, 15 ha; Female A, 3 ha). Pallid Cuckoos were almost exclusively observed in areas of remnant dry sclerophyll forest except for a vocalising pair (Male B and Female B) in the largest remaining area of remnant rainforest, where they frequented a large fruiting Moreton Bay Fig *Ficus macrophylla*.

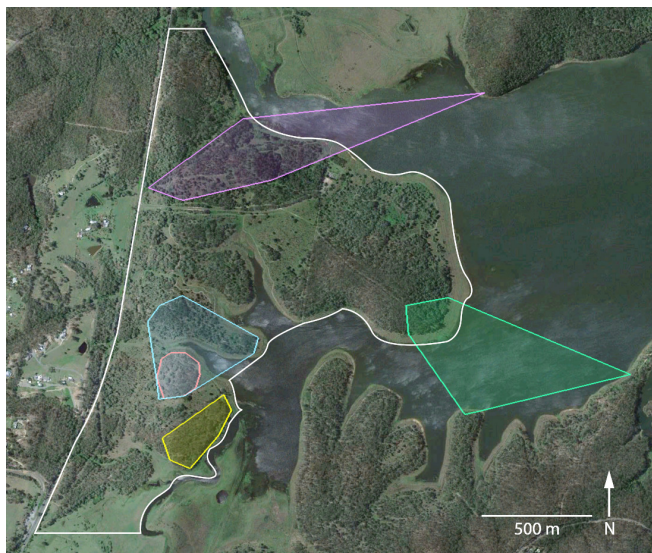


Figure 1. Minimum convex polygons depicting territories and home-ranges for individually identified Pallid Cuckoos at Samsonvale, Queensland: territories of Male A (blue), Male B (purple) and Male D (green), and home-ranges for Female A (pink) and Female C (yellow). Polygons are overlaid on a satellite image of the study site, which is delimited by a white outline. Polygon vertices outside the study site represent the projected location of an individual based on hearing a bird vocalising across the lake whilst the observer was at the study site. Satellite imagery was taken during the study period on 27 October 2017. Imagery: Google, map data: Google.

Plumage

All males were light-grey morph ($n = 3$, Table 1) (Figure 2), as described in Higgins (1999). Females were more variable than males to the extent that we could differentiate and recognise some individual females by plumage characters, including Female A, which was a dark-rufous morph (*sensu* Higgins 1999; Figure 3), and Female C, which showed plumage characters of both pale-rufous and dark-rufous morphs, including grey-brown head, lacking rufous tones; grey-brown upperparts admixed with rufous, buff and white spotting to the upperparts and uppertail; and no gorget across the lower

Table 1. Plumage morphs for the six individually identified Pallid Cuckoos observed at Samsonvale. Plumage morphs follow Higgins (1999). We also list the intermediate-rufous, female plumage morph, which was not described in Higgins (1999). The plumage morph for one female was not determined and is thus listed as unknown.

Plumage morph	Sex	No. of individuals
Light grey	Male	3
Dark grey	Male	0
Light rufous	Female	0
Intermediate rufous	Female	1
Dark rufous	Female	1
Unknown	Female	1



Figure 2. Light-grey-morph male Pallid Cuckoo (Male D) at Samsonvale, Queensland. Note head, nape and mantle are pale grey and lacking brown tones and rufous nape-patch characteristic of dark-grey-morph male. Photographs in the Macaulay Library: ML 143526311 (top), ML 143526231 (bottom). Photos: James A. Kennerley



Figure 3. Dark-rufous-morph female Pallid Cuckoo (Female A), Samsonvale, Queensland. Note forehead, crown and nape streaked dark brown and rufous. Upperparts including mantle, secondary coverts and tertials, dark brown, coarsely chequered rufous with a few whiter tips to some secondary coverts and scapulars. Note also the poorly defined white supercilium with poorly defined dark eye-stripe below that merges into dark-brown and rufous striations to side of neck and also the poorly defined gorget to lower throat. ML 143526961. Photo: James A. Kennerley

neck. We hereafter term the plumage of birds showing characters of both pale-rufous and dark-rufous morphs as intermediate-rufous morph. We made further observations of light-grey-morph males and intermediate-rufous-morph females outside the mapped territories and home-ranges of the recognised individuals in this study but, because of the infrequency of these sightings, we cannot be sure how

many individuals were involved so these birds have been excluded from our totals.

Vocalisations

We recorded Pallid Cuckoos making two of the six vocalisations described by Higgins (1999) (Table 2). Of these, the scale call (Figures 4a–b; ML 68916861, ML 75747131) was the vocalisation most frequently encountered. Based on the minimum projected distance across the lake separating observer and Cuckoo, the scale call was audible over distances of at least 1 km, enabling the presence of Cuckoos to be noted when not recorded visually; the majority of our records involved birds that were heard but not seen. Based on plumage characters, those individuals seen producing the scale call were always males. We also heard the scale call before dawn when the Pallid Cuckoo was noted to be the only bird species vocalising. If males giving the scale call were seen, they were usually on a high perch (up to 30 m above the ground in a Forest Red Gum *Eucalyptus tereticornis*), and never close to another calling male. On at least two occasions, however, we observed Male A giving the scale call from lower perches (c. 5 m above the ground) when close to Female A (within ~20 m). The scale call was also given by males in flight, most notably by Male A, which regularly flew over an inlet between two areas of regenerated bushland that comprised parts of his territory. On one occasion, an unsexed individual was heard giving a contracted scale call, where only the initial 4–5 short notes were given, but repeatedly and in quick succession (Figure 4c; ML 102512501). The same unsexed individual also gave a three-note call comprising three monosyllabic piping calls (Figure 4d; ML 102512161). Finally, a hoarse call, as described in Higgins (1999), was heard on numerous occasions throughout the study period (Figure 4e; ML 75747131). We heard females give this call both when in the company of males and when solitary, and males gave this call during pauses between scale calls.

Table 2. Vocalisations by male and female Pallid Cuckoos, from Higgins (1999) and the present study. X denotes whether a vocalisation has been documented in Higgins (1999) for males, females, or if the sex is unknown. The minimum number of individuals producing each vocalisation at Samsonvale is listed, including for the contracted scale and piping calls, which were not described by Higgins (1999). Vocalisations were heard from a minimum of six individuals, and some individuals were heard to give more than one type of vocalisation.

Vocalisation	Male		Female		Sex unknown	
	Higgins (1999)	This study	Higgins (1999)	This study	Higgins (1999)	This study
Cluck		0		0	X	0
Contracted scale call		0		0		1
Hoarse call	X	3	X	3		0
Piping call		0		0		1
Repeated <i>peep</i>	X	0		0		0
Scale call	X	3		0		0
Shriek		0		0	X	0
Three-note call		0		0	X	0

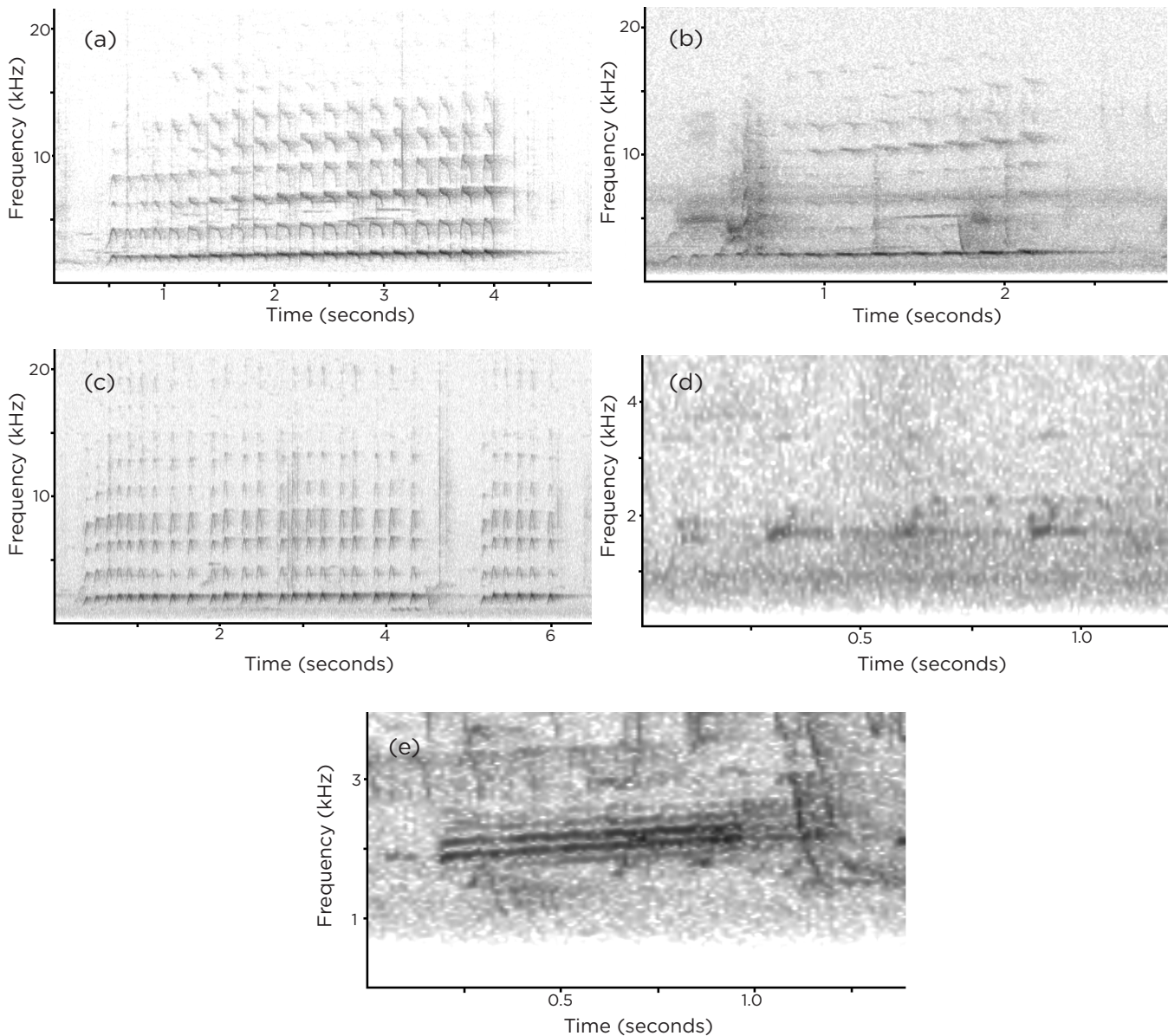


Figure 4. Spectrograms depicting Pallid Cuckoo vocalisations at Samsonvale, Queensland: scale call produced by Male C (a) and an unknown male (b); contracted scale call produced by an unsexed individual (c); piping call produced by an unsexed individual (d); and hoarse call produced by a female (e). Spectrograms were generated using the following recordings catalogued in the Macaulay Library: ML 68916861 (a), ML 75747131 (b and e), ML 102512501 (c) and ML 102512161 (d). Recordings: James A. Kennerley

Social behaviour and intraspecific interactions

On at least two occasions, we observed male–female interactions between Pallid Cuckoos where Male A appeared to be courting Female A. These interactions involved both the male and female landing on low perches (<5 m above the ground), the female remaining silent and the male calling the scale call, seemingly targeted toward the female. Each time, the female then flew to another low perch in her home-range and the male followed. If the female only flew a short distance, the male landed where the female had previously perched and continued to vocalise. Alternatively, the male attempted to land on the same branch as the female, at which point the female gave the hoarse call before flying to a different perch, again within her home-range.

Interspecific interactions

Both male and female Pallid Cuckoos were observed being mobbed by potential host species, although males more frequently so. On several occasions, a male gave the scale call in flight whilst being pursued by a potential host species. Species observed mobbing Cuckoos included Lewin's Honeyeater *Meliphaga lewinii*, Rufous Whistler *Pachycephala rufiventris* (Figure 5), Olive-backed Oriole *Oriolus sagittatus*, Willie Wagtail *Rhipidura leucophrys*, Grey Fantail *Rhipidura fuliginosa*, Leaden Flycatcher *Myiagra rubecula* and Eastern Yellow Robin *Eopsaltria australis*. We also observed two Noisy Friarbirds *Philemon corniculatus* perching next to a male Pallid Cuckoo and looking closely at him but not mobbing him on 12 September 2017. On 30 January 2018, after our field season had closed, there was a report of a juvenile Pallid Cuckoo being provisioned by a Lewin's Honeyeater at Golds Scrub Lane, Lake Samsonvale (Armstrong 2018).



Figure 5. Dark-rufous-morph female Pallid Cuckoo (Female A), Samsonvale, Queensland, being mobbed by a male Rufous Whistler. ML 143526971. Photo: James A. Kennerley

Discussion

From 12 September 2017 to 5 January 2018, we recorded Pallid Cuckoos at Samsonvale almost daily. By comparison, daily observations with equal effort from August 2014 to January 2015, and from August 2015 to January 2016, failed to produce any sightings of this species at the study site. We suggest that weather conditions in eastern Australia were the principal reason for this disparity. Although spring and summer in 2014–2015 and 2015–2016 received close to average rainfall (Bureau of Meteorology 2016, 2017a), during spring and summer in 2017–2018, inland regions of Queensland and New South Wales experienced unusually hot and dry weather (Bureau of Meteorology 2017b–f, 2018). These widespread drought conditions coincided with many typically inland bird species, such as the Pallid Cuckoo, moving to coastal areas, as has been reported in the popular media (e.g. Virtue 2017).

Habitat, territories and home-ranges

Male Pallid Cuckoos held territories an order of magnitude larger than a female's home-range. Moreover, at least one male's (Male A) territory wholly encompassed a female's (Female A) home-range such that the two birds shared an area of bushland. If a male's territory is larger than a female's home-range, this suggests that males may have the capacity to hold a territory that encompasses home-ranges of multiple females. Both male and female Cuckoos showed a preference for remnant dry sclerophyll forest, which is concordant with previous observations (Conole 1981; Bridges 1994). We made similar observations for another pair of Cuckoos (Male B and Female B). However, observations within marginal rainforest habitat are not unprecedented (Higgins 1999).

As our calculations for territory and home-range sizes are based solely on observational data, these represent a minimum size, as individual Pallid Cuckoos might have occupied areas where we did not observe them. Future studies on habitat preferences, territories and home-ranges could benefit from using telemetry to gain a more comprehensive understanding of habitat usage (e.g. Honza *et al.* 2002).

Plumage

Of the 58 species of brood-parasitic cuckoos found globally, 13 (22%) show plumage polymorphism (Payne 2005; Erritzøe *et al.* 2012), a trait that has evolved to thwart detection by hosts in at least some species (e.g. Thorogood & Davies 2012). Among parasitic cuckoos, the Pallid Cuckoo is unique in displaying pronounced intra- and intersexual plumage polymorphism leading to four described plumages, two for each sex (Higgins 1999; Erritzøe *et al.* 2012). In addition to observing individual males and females fitting the descriptions of described morphs (Table 1), we also observed a female (Female B) that showed characters of both dark-rufous and pale-rufous morphs, a plumage we term intermediate-rufous-morph. Our observations support the supposition that the plumage of both sexes of Pallid Cuckoo varies between the described morphs, which represent the extremes in variation (Higgins 1999; Payne 2005; Erritzøe *et al.* 2012).

Vocalisations

The scale call was the vocalisation most frequently heard in the present study, and we never observed two males giving the scale call when near each other. This suggests that, during the breeding season, the scale call may be given by males as a means of territory defence to avoid physical confrontations with conspecifics (de Kort *et al.* 2009). Furthermore, males giving the scale call were often observed sitting on a high perch (up to 30 m above the ground), behaviour typically associated with bird 'song' (Gil & Gahr 2002). We also heard the scale call before dawn, as documented by Higgins (1999). When a male gave the scale call from a low perch whilst in close proximity to a female, the vocalisations appeared to be targeted toward the female and the male would follow the female whilst giving the scale call. It is likely, therefore, that the scale call also acts as a means of mate attraction.

Although there were minor variations in the structure and duration of the scale call over several months of observations, we were unable to identify whether this was because of individual plasticity or variation between individuals. The most extreme example of variation in the scale call was noted on 12 September 2017 and we termed this undescribed variant the contracted scale call. It comprises elements present in the typical scale call. The piping call has also not been described previously, although it could be the repeated *peep* call (Higgins 1999) or a variation of it. Both of these undescribed vocalisations were given by the same (unsexed) individual and both were recorded only on the first day that we observed Pallid Cuckoos at the study site. Based on our observations, the hoarse call is the only vocalisation given by females, although it was also given by males during pauses between scale calls, indicating that it may function in territory defence, as suggested by Higgins (1999) but *contra* Payne (2018), who remarked that the hoarse call is only given by females. Following this, we recommend that descriptions of vocalisations should be accompanied by sound recordings and appropriate metadata in online repositories such as the Macaulay Library or xeno-canto (www.xeno-canto.org). With comprehensive documentation, many of the difficulties that we found in matching a sound recording to a written phonetic description could be avoided.

Social behaviour and intraspecific interactions

We observed that at least one male (Male A) and one female (Female A) were exclusively sharing an area of bushland, a behaviour that has been previously documented in the Pallid Cuckoo (Higgins 1999). This suggests that Pallid Cuckoos may form socially monogamous pairs and defend a breeding area, a behaviour which has been reported as the primary mating system for several species of brood-parasitic cuckoo, including Horsfield's Bronze-Cuckoo *Chalcites basalis* (Langmore *et al.* 2007), Common Cuckoo *Cuculus canorus* (Marchetti *et al.* 1998) and Great Spotted Cuckoo *Clamator glandarius* (Martinez *et al.* 1998), as well as the brood-parasitic Brown-headed Cowbird *Molothrus ater* (Woolfenden *et al.* 2002; Strausberger & Ashley 2003). Additionally, given that male territories are large enough to encompass the home-ranges of multiple spatially separated females, males may switch from monogamy to polygyny when females are present in sufficiently high densities. This would be in line with other species of avian brood-parasite (Marchetti *et al.* 1998; Martinez *et al.* 1998; Woolfenden *et al.* 2002; Strausberger & Ashley 2003), although not all (Langmore *et al.* 2007).

We observed courtship behaviour between Male A and Female A on two occasions, which would be infrequent for a socially monogamous pair (Black 1996). These observations appear to be among few recorded notes on the courtship behaviours of this species (Feeney & Riehl 2019). We suggest that the apparent infrequency of pair-bonding behaviour may be related to the need for secretive behaviour by cuckoos, especially females, in order to remain undetected by their host species, an important strategy for limiting information of cuckoo presence which could affect nest finding by female cuckoos, and egg or chick rejection behaviour by host species (Feeney *et al.* 2014; Thorogood & Davies 2016).

We did not record interactions between male Pallid Cuckoos, such as direct competition for females, which we frequently observed in other cuckoo species at the study site, including the communal display of the Shining Bronze-Cuckoo *Chalcites lucidus* (see Higgins 1999) and up to two male Horsfield's Bronze-Cuckoos chasing a single female. Male–male competition for females is also known from other more closely related cuckoo species, including the Common Cuckoo (Cramp 1985) and Eastern Koel *Eudynamys orientalis* (Abernathy & Langmore 2016).

Interspecific interactions

Male Pallid Cuckoos were more frequently observed to be mobbed by potential hosts than were females, most likely because of their greater conspicuousness in performing loud vocalisations from prominent perches. We also observed males producing the scale call in flight whilst being pursued by potential host species. Similar behaviour was also noted in Channel-billed Cuckoos *Scythrops novaehollandiae* at the study site (pers. obs.) and has been documented in other species of Old World brood-parasitic cuckoos (Cramp 1985; Abernathy & Langmore 2016). Our observation of two Noisy Friarbirds investigating but not mobbing a male Pallid Cuckoo is particularly noteworthy, as the Pallid Cuckoo has been recorded to parasitise

Noisy Friarbirds (Brooker & Brooker 1989), and suggests that these individuals might have been naïve to the Pallid Cuckoo as a potential brood-parasite, a phenomenon that has been documented in Superb Fairy-wrens *Malurus cyaneus*, a common host species of Horsfield's Bronze-Cuckoo (Langmore *et al.* 2012; Feeney & Langmore 2013).

The report of a juvenile Pallid Cuckoo being provisioned by a Lewin's Honeyeater (Armstrong 2018) represents the only documented breeding record of the Pallid Cuckoo from Samsonvale and indicates successful parasitism of a Lewin's Honeyeater nest, a previously recorded host species (Brooker & Brooker 1989). As fledgling Pallid Cuckoos have been recorded to be provisioned by individuals not of their host-parent species (Sealy & Lorenzana 1997), however, the host species cannot be confirmed with the available information.

Conclusion

This paper provides information in support of major works on the natural history of the Pallid Cuckoo (Higgins 1999; Payne 2005; Erritzøe *et al.* 2012) and contributes details from a region where this species has not been studied. We also provide new insight into aspects of this species' natural history and its hosts and we hope that this encourages future study. Future research building upon these observations should clarify questions of host preference in the Pallid Cuckoo, including geographic variation in parasitism, egg mimicry, and host-specific defences.

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