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Multiple individuals incubating and nest building, and winter breeding, in the Black-chinned Honeyeater *Melithreptus gularis*

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Abstract. The role of the male and female in the incubation of eggs is unknown in 30 of the 70 species of Australian honeyeaters, but in most of the remainder, only the female is thought to incubate. Nevertheless, incubation by both male and female is known to occur in six species, including the Brown-headed Honeyeater *Melithreptus brevirostris*. I observed and video-recorded activities at two nests of one group of four Black-chinned Honeyeaters *M. gularis gularis* in south-eastern Queensland. Nest attentiveness (incubation constancy) averaged 88% over three sample days. At least two birds participated in incubation, as evidenced by numerous change-overs, strongly suggesting that both male and female were involved. Incubation bouts averaged 7.2 minutes, but varied significantly over the 3 days, and off-bouts averaged 1.3 minutes but did not vary significantly. Nestling provisioning rates varied from 7.5 to 14.4 feeds h^{-1} on the fourth and thirteenth days after the estimated hatching day. Although cooperative breeding could not be confirmed, up to three birds were seen at this nest during the nestling stage, and up to three at the second nest before incubation began. Breeding records indicate that in south-eastern Queensland laying peaks in winter, beginning in late autumn, 2 months earlier than records suggest in New South Wales.

Introduction

Incubation is a fundamental component of avian reproduction, and species differ widely in their incubation rhythm and nest attentiveness (percentage of daytime that eggs are incubated) (Conway & Martin 2000a,b; Matysioková & Remeš 2014, 2018; Austin *et al.* 2019). Honeyeaters constitute the largest family of passerines in Australia, yet incubation periods are unknown for 23 (33%) of the 70 species, excluding chats, and the role of the male and female in incubation is unknown in 30 species (43%) (data from Higgins *et al.* 2001). In most Australian honeyeaters that have been studied, only the female incubates the eggs and broods the nestlings (Higgins *et al.* 2001).

However, incubation by both male and female is known to occur in six species, five of which belong to recognised or potential monotypic genera: Striped Honeyeater *Plectorhyncha lanceolata* (Moffat *et al.* 1993; Wood & Ley 2005), Painted Honeyeater *Grantiella picta* (Eddy 1961; Whitmore & Eller 1983; Trémont & Williams 1999), Black Honeyeater *Sugomel nigrum* (Higgins *et al.* 2001; RAN pers. obs.), Pied Honeyeater *Certhionyx variegatus* (North 1907; McGilp 1932; Burgess 1947) and Grey Honeyeater *Conopophila whitei* (Wells & Wells 1977; Longmore 1991; Johnstone & Storr 2004). The Grey Honeyeater was considered a monotypic genus (*Lacustroica*) by Johnstone & Storr (2004), based on differences from its assumed congeners in nest, eggs and calls. Furthermore, using a supermatrix approach including five mitochondrial and four nuclear markers, Marki *et al*. (2017) found no support for its inclusion in the genus *Conopophila*.

The sixth known exception is the Brown-headed Honeyeater *Melithreptus brevirostris* (Noske 1983), which belongs to a genus in which at least two other members are species where only the female incubates: White-naped Honeyeater *M. lunatus* (Marchant 1986) and White-throated Honeyeater *M. albogularis* (RAN unpubl. data). Little is known of the incubation behaviour of the two Tasmanian members of the genus – Black-headed Honeyeater *M. affinis* and Strong-billed Honeyeater *M. validirostris* (Higgins *et al*. 2001; Herman 2005). The remaining species, the Black-chinned Honeyeater *M. gularis,* has been the subject of a detailed ecological study (Lollback 2007; Lollback *et al.* 2008), yet little attention has been paid to its breeding biology.

The eastern subspecies of the Black-chinned Honeyeater *M. g. gularis* is a rare resident of eucalypt woodlands of south-eastern Australia and has been classified as Near Threatened at the national level (Garnett *et al.* 2011) and Vulnerable in New South Wales (Cooper *et al.* 2020). More recently, Ford *et al*. (2021) classified it as of Least Concern in 2020 and retrospectively in 2010. Its relative rarity appears to be partly because of its specialised habitat (Priday 2015) and foraging behaviour (Lollback 2007). I quantified incubation behaviour and provisioning of nestlings, and nest-building activity, by a group of Black-chinned Honeyeaters near Brisbane, south-eastern Queensland, to determine whether one or more individuals contributed to these activities, and to compare breeding behaviour with other *Melithreptus* species.

Study site and methods

The study was carried out at Sheep Station Creek Conservation Park (27°08′S, 152°54′E), 40 km north-north-west of Brisbane's Central Business District, a well-known site for the Black-chinned Honeyeater (Priday 2015). I began searching for territories in April 2017, and on 10 June noted intense activity by a group of four Black-chinned Honeyeaters near the top of a tall eucalypt, and began video-recording 2 days later, using a Sony Handycam HDR-CX130. The chick(s) fledged from this nest on 9 July, 29 days after the nest was discovered. As incubation and nestling periods are unknown for the species, I assumed that the incubation period of the Black-chinned Honeyeater was equivalent to those of the White-naped Honeyeater (Marchant 1986; Higgins *et al.* 2001) and White-throated Honeyeater (RAN unpubl. data), and that the nestling period was close to the maximum estimate for the former species (i.e. 14 and 16 days, for incubation and nestling periods, respectively). Thus, I estimated that laying of the last egg and incubation initiation took place on 9 June, and hatching on 23 June.

I video-recorded activity at this nest on 6 days, totalling 1668 minutes (27.8 h), 3 days of which were during the incubation stage, and the other three during the nestling stage. Videos were analysed within 24 h of their recording, by describing all activities within ~1 m of the nest, and calculating their durations, using Microsoft Excel. These data were used to calculate nest attentiveness (percentage of time that birds spent on the nest), duration of incubation bouts and off-bouts (when no bird was sitting), change-over rate (when a bird left the nest and was replaced by another), provisioning rate (when adults fed nestlings), and rate of removal of faecal sacs from nest. On 4 days, ambient temperature and relative humidity were recorded every minute with a Digitech Datalogger QP-6013 placed in a shaded location near the ground below the nest. The size of prey items brought to the nest was estimated in relation to the exposed bill length (16 mm: Higgins *et al.* 2001).

In the following year (2018), I began weekly visits to the site on 4 May, and found a group of three or four Black-chinned Honeyeaters adding material to a nest on 11 June, when I recorded 3.75 h of video from 0802 to 1147 h. The nest tree was ~500 m from the 2017 nest location but, as I never found more than one group of Black-chinned Honeyeaters in this area, the 2018 group probably contained some, if not all, of the 2017 group members. When I returned on 25 June, there were no Honeyeaters in the vicinity of the nest and, after 1 h, I assumed that the nest had been abandoned. Although another nest could not be located, adults were found feeding a recently fledged juvenile ~200 m from the first nest on 2 October 2018, suggesting that a second clutch had been laid in late August.

Results

Nest sites and nest-building behaviour

The 2017 nest was built only ~2 m from the top of a tall (~36 m) Gum-topped (or Grey) Box *Eucalyptus moluccana*, which was situated near the centre of a gently sloping gully dominated by tall Gum-topped Boxes. The 2018 nest was built ~4 m from the top of a medium-sized (~30 m) Grey Ironbark *E. siderophloia*, which was located on the steep slope of a ridge co-dominated by Gum-topped Box and Grey Ironbark. Both nests were built inside dense clumps of foliage at the outer extremity of a branch, but although the outline of the first was visible only when viewed through a 60x telescope or the zoom lens of the Camcorder at some distance, the second nest could be seen more clearly from the ridge top, with ~40% visible behind the foliage, except during gusts of wind, when more was exposed.

The 2018 nest was already a deep cup when discovered but, as the birds visited the nest for only brief periods, I assumed that activities were related to nest construction rather than incubation. However, as Black-chinned Honeyeaters carrying material were noted only twice, it is possible that most visits were concerned with shaping and strengthening the nest, and monitoring its contents, rather than construction. During the 3.75-h observation period, birds made 61 visits to the nest, equating to a visit every 3.7 minutes, on average. The total time that birds spent at the nest was 45 minutes, accounting for 20% of the observation period. The duration of visits ranged from 5 seconds to 4.3 minutes, averaging 0.74 ± standard deviation 0.75 minutes, and intervals between visits ranged from 1 second to 12.9 minutes (mean 2.90 ± 3.09 min.). The visiting bird usually landed on the bare basal section of the branch above the nest 1–25 seconds (mean 3.18 ± 5.01 sec.) before descending through the foliage to the nest. Occasionally, however, it flew directly to the clump of leaves surrounding the nest from adjacent branches or leaf clumps. On at least five occasions, a bird arrived while another was still present at the nest. In two of these instances, the former flew off, and in the other three it descended to the nest as soon as the incumbent bird left. On two occasions, three birds were clearly visible within 1 m of the nest.

Incubation behaviour at 2017 nest

During the incubation period, up to four Black-chinned Honeyeaters were seen simultaneously in the vicinity of the nest (Table 1). When an individual was incubating, others often perched on the bare branch below the clump of foliage containing the nest and preened or simply rested there before proceeding to the nest or flying away. The duration of each perching event, with or without a subsequent visit to the nest, increased significantly over the six sample days (R^2 = 8.99, F = 35.7, df = 1,4; P = 0.004: Figure 1). Although no birds were colour-banded, change-overs at the nest were obvious as the sitting bird usually flew off the nest when the replacing bird landed on the nest branch and flew towards the nest. The maximum hourly change-over rate was on Day 8 (4.9 h^{-1}) and the minimum on Day 12 (1.7 h^{-1}) (Table 1). On Day 3, the incubating bird (or birds) was fed by other group members seven times on the nest, and twice off the nest. On Day 8, no incubation feeding was seen, but birds brought whitish down feathers, plant down or other objects to the nest nine times, and spent 10–35 seconds stitching the material into the nest before settling to incubate. On one occasion, two individuals arrived at the perch site with nest material, but only one went to the nest, and the other flew off. During one incubation bout of 9.1 minutes, an individual perched for 5 seconds with material in its bill before flying off and, 2.7 minutes later, the same or another individual perched with material for 20 seconds. On another occasion, the incubating bird apparently flew from the nest to huddle beside a perched bird, which then mounted the first bird twice before they both flew off.

Nest attentiveness (percentage of time sitting on nest) was uniformly high during the incubation period, but highest (93.4%) on Day 3 (post-laying), and dropping to 82.3% (Day 8), then rising to 89.9% on Day 12 (Figure 2). Although not measured on Day 3, mean ambient temperatures were significantly higher (t = 23.73, df = 516, P <0.001) on Day 8 than on Day 12 (22.84 ± 0.86°C and 20.02 ± 1.36°C, respectively). Incubation bouts over the

Table 1. Frequency of change-overs and simultaneous visits by two or more Black-chinned Honeyeaters at the 2017 nest.

	Estimated no. of days since incubation began					
	3	*8*	*12*	*18*	*24*	*27*
Video duration (h)	3.45	5.08	4.65	4.80	5.35	4.47
Change-overs						
No.	9	25	8	3	0	0
No. h^{-1}	2.6	4.9	1.7	0.6	0	0
Simultaneous visits by ≥2 birds						
Two birds at nest	12	14	31	37	21	16
Three birds at nest	2	5	4	2	0	0
Four birds at nest	0	0	1	0	0	0
Multiple birds h^{-1}	4.1	3.7	7.7	8.1	3.9	3.6

three sample days varied from <1.0 to 37.3 minutes (mean 7.19 ± 7.63 min., $n = 83$), and off-bouts varied from <1.0 to 17.2 minutes (mean 1.30 ± 2.55 min., $n = 78$). Incubation bouts were significantly longer than off-bouts on each of the three sample days, as well as for the combined sample (*t*-test with unequal variances, $t = 6.60$, df = 104, $P < 0.001$). Although there was no significant difference between the three sample days in the duration of off-bouts (ANOVA, $F = 0.111$, df = 2, 65, $P > 0.05$), incubation bouts were significantly longer on Days 3 and 12 than on Day 8 (ANOVA, $F = 9.66$, df = 2, 80, $P < 0.001$: Figure 3). Four days after the estimated hatching date, nest attentiveness (brooding) decreased to 47.2%, and by 10 days was only 8.1% (Figure 2).

Provisioning of nestlings at 2017 nest

Up to three adults were recorded in the nest vicinity simultaneously during the nestling period, but the frequency of simultaneous visits by birds usually decreased with time (Table 1). However, the amount of time that individuals spent in the nest vicinity increased over time, largely because of cleaning activities. Brooding was last seen on Day 24, when the chick(s) were estimated to be 10 days old. There were no significant differences in the duration of brooding bouts or off-bouts during Days 18 and 24 (Figure 3).

The hourly food-provisioning rate roughly doubled from Day 18 (7.5 feeds h^{-1}) to Day 24 (14.4 h^{-1}), but did not increase on Day 27 (13.2 h^{-1}: Figure 4). Faecal sacs were carried from the nest in the bill, and the rate of their removal increased fivefold from Day 18 to Day 24, but had unexpectedly decreased by Day 27 (Figure 4). Of 180 food items brought to the nest during videos, 43% could not be clearly seen (Table 2). Of the visible items on the fourth day since hatching, 74% were tiny or small invertebrates (<8 mm long). On the tenth day post-hatching, visible food items were ~4–32 mm in length (mean 11.9 ± 6.28 mm, $n = 32$), composed primarily of lerps (the protective covering of psyllid nymphs: 55%) and insect larvae (33%). On the thirteenth day, two-thirds of the visible items were medium-to-large insects (Table 2), but their lengths were not estimated.

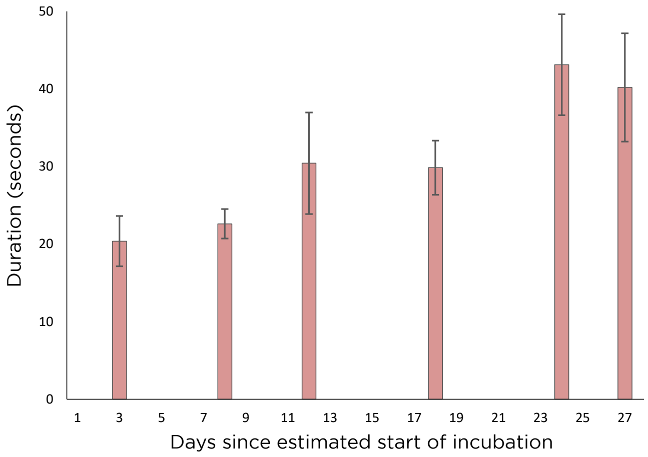

Figure 1. The duration (seconds) of perching visits by Black-chinned Honeyeaters next to the 2017 nest, regardless of whether the bird sat afterwards or not. Error bars represent 1 standard error either side of mean.

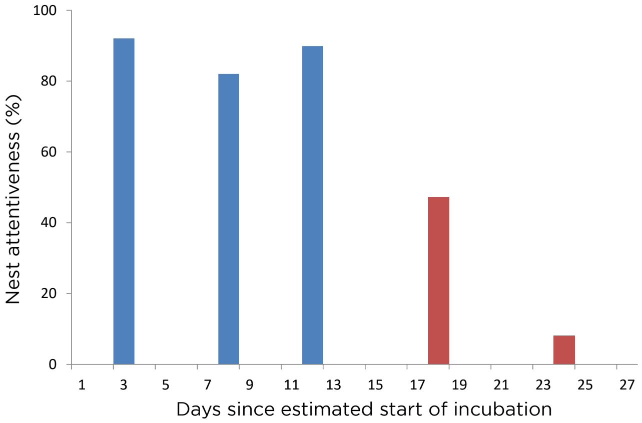

Figure 2. Nest attentiveness at the 2017 Black-chinned Honeyeater nest over five sample days (blue bars, incubation period; maroon bars, nestling period). Hatching assumed on Day 14.

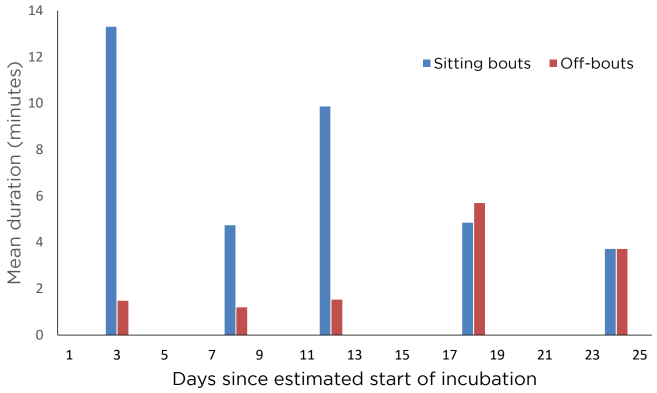

Figure 3. Mean duration (minutes) of incubation (Days 3–12) and brooding (Days 18–24) bouts and off-bouts at the Black-chinned Honeyeater 2017 nest.

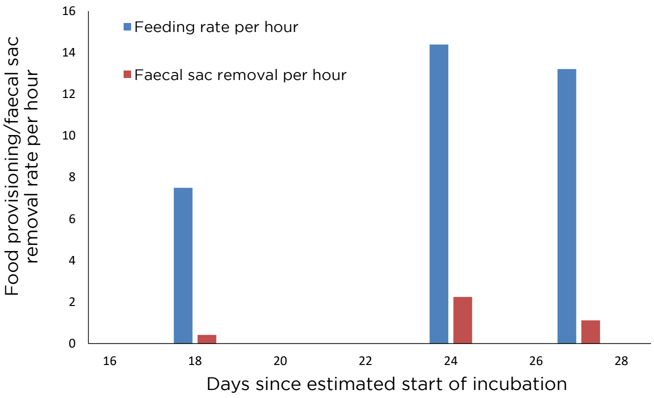

Figure 4. Rates of food provisioning and removal of faecal sacs at the Black-chinned Honeyeater 2017 nest.

Discussion

Role of male and female in nest building

The role of the male and female in nest building is unknown in 29 (41%) of the 70 Australian species of honeyeaters, excluding the chats *Epthianura* spp. and Gibberbird *Ashbyia lovensis* (data from Higgins *et al.* 2001). In 18 (44%) of the remaining 41 species, one sex constructs the nest alone and, although this is universally presumed to be the female, only two of these species are sexually dimorphic in plumage, enabling the identification of both male and female. Males often accompany their mate to the vicinity of the nest, presumably to guard against rival males. In at least seven species, both the male and the female apparently collect nesting material, but only the female builds the nest, the male merely transferring his contributions to her at the nest. In the remaining 17 species, both the male and the female are known to participate in building, though in at least four of these species the role of the male is variable.

In the Black-chinned Honeyeater, the role of the male and female in nest construction is unclear. Although Harrison (1969) and Rowley (1976) cited Slater's (1962) observation of all members of a group of five building a nest, others have suggested that only one bird, presumably the female, is involved in this task. Near Adelaide, South Australia, Elsworth (1997) described a pair regularly visiting his home garden: only one member collected wool from a sheepskin rug, while the other "stood guard nearby" (p. 170). At Victoria River Downs, Northern Territory, Boekel (1980) on four occasions observed one bird (possibly the same individual) collecting spider web and taking it to the nest, in each case accompanied by three other members of its group. The presence of an immature bird was interpreted as evidence that the nest under construction represented a second brood, though this bird did not participate in building activities.

Table 2. Number of prey items brought to the Black-chinned Honeyeater nest during video samples on 3 days during the nestling period. Bold values signify most important category.

Food item	*Estimated no. of days since chicks hatched*			
	4	*10*	*13*	*Total*
Unidentified	17	28	32	77
Lerp	0	**27**	8	35
Medium–large insect	5	2	**18**	25
Tiny–small item (<8 mm)	**20**	4	0	24
Insect larva	2	**16**	1	19
Total	44	77	59	180

Near Sydney, New South Wales, Gilbert (1919) watched one or both members of a pair of Black-chinned Honeyeaters simultaneously plucking hair from a calf and taking it to their nest. A short time later, one bird was seen weaving bark into a nest, while its mate waited with hairs obtained from the ground. Soon the former bird, assumed to be the female, took the hair from the latter and added it to the nest, while the latter flew off. Although Gilbert (1919) assumed the former bird to be the female, and the latter her mate, this brief observation merely indicates that one sex may take a dominant, but not necessarily exclusive, role in nest construction. My observations at the 2017 nest corroborate those of Harrison (1969) and Rowley (1976), confirming that in groups of three or more birds, multiple individuals contribute to nest building. Conversely, at a nest of the Brown-headed Honeyeater that was attended by a group of five colour-banded birds, only the breeding female constructed the nest, whereas at another nest, both members of a pair collected hair from a calf (Noske 1983).

Role of male and female in incubation

As with nest building, the role of the male and female in incubation is unknown in 30 (43%) of the 70 Australian species of honeyeaters. Incubation is carried out by one sex alone, presumably the female, in 33 (83%) of the other 40 species, and by both male and female in the remaining seven species. Based on morphology and ecology, the genus *Melithreptus* has been divided into two subgenera, each with three species (Schodde & Mason 1999), a treatment that has some molecular support (Toon *et al.* 2010). In at least two members of the subgenus *Melithreptus* (White-naped Honeyeater and White-throated Honeyeater) only the female incubates, but the role of the sexes is unknown in the third, the Black-headed Honeyeater. In contrast, at least two members of the subgenus *Eidopsarus* – the Brown-headed Honeyeater (Noske 1983) and Black-chinned Honeyeater (see above) – exhibit biparental incubation. It therefore seems likely that the third member of this subgenus, the Tasmanian-endemic Strong-billed Honeyeater, also exhibits biparental incubation.

Feeding of incubating birds, such as seen in the present study of Black-chinned Honeyeaters on Day 3 at the 2017 nest, was recorded in a colour-banded group of Brown-headed Honeyeaters, in which the female sitting on the nest was fed by three individuals, all of which also participated in incubation (Noske 1983). Although the feeding of incubating birds has been recorded in few honeyeater species, they include two members of the *Melithreptus* subgenus: White-naped Honeyeater (Marchant 1986) and Black-headed Honeyeater (Brent 1905; D.R. Milledge in Higgins *et al.* 2001). Both these species often breed cooperatively, but incubation is by the female only (Higgins *et al.* 2001; Herman 2005; RAN unpubl. data). Matysioková & Remeš (2014) analysed nest-attentiveness patterns among 320 species of passerines worldwide and found that, among species with female-only incubation, mean nest attentiveness was higher in species in which males fed the incubating female (78.2%, *n* = 156 species) than in those lacking incubation feeding (65.4%; *n* = 40 species), presumably as such feedings reduced the need for females to forage for themselves. Species with shared incubation had the highest mean nest attentiveness (87%, *n* = 124 species). That the (presumed) female Black-chinned Honeyeater is assisted by other group members, both directly (through shared incubation) and indirectly (through incubation feeding), suggests that she is energetically constrained as might be expected in a species with specialised foraging behaviour (Lollback 2007).

Nest attentiveness at the 2017 Black-chinned Honeyeater nest in the present study was high throughout the incubation period, ranging from 82% to 93.4% on the three sample days. The maximum nest attentiveness was almost as high as that of the Brown-headed Honeyeater (99% over 11.8 h of observations during which all four adult members of the group participated in incubating the eggs: Noske 1983). In the Black-chinned Honeyeater, the lower nest attentiveness and lower duration of incubation bouts on Day 8 than on Day 12 (Figures 2–3) might have been related to the ambient temperature being 2.5°C higher on that morning.

Given that only the female incubates in White-naped and White-throated Honeyeaters, nest attentiveness may be expected to be lower for these species than that reported here for the Black-chinned Honeyeater. In the Brisbane region, nest attentiveness for female White-throated Honeyeaters was lower, averaging 59% (*n* = 55 h between four nests), but mean incubation bouts and off-bouts were demonstrably longer (11.6 and 9.4 min., respectively; *n* = 143, 144: RAN unpubl. data) than those of the Black-chinned Honeyeater. The relatively short durations of incubation and off-bouts of the latter probably relate to the number of birds participating in incubation, causing frequent change-overs. In temperate south-eastern New South Wales, a female White-naped Honeyeater incubated for 77% of the time (*n* = 4 h at one nest), with incubation and off-bouts averaging 6.0 and 3.8 minutes (*n* = 10 in each case), respectively (Marchant 1986). The much higher nest attentiveness and shorter duration of incubation and off-bouts of the White-naped Honeyeater, compared with the morphologically very similar White-throated Honeyeater, are most likely related to climatic differences between the temperate and subtropical study areas, respectively, as passerines breeding in higher ambient temperatures tend to have longer incubation and off-bouts than those in colder environments (Conway & Martin 2000a; Matysioková & Remeš 2018; Austin *et al.* 2019).

Cooperative breeding and diet

Cooperative breeding, when more than two birds provide care at a nest, is well developed in Australia, being recorded in at least 80 species from 21 families (Clarke 1995). Of the 182 species of honeyeaters worldwide, 12% have been reported to breed cooperatively (Arnold & Owens 1998), though few species have been studied as extensively as the Noisy Miner *Manorina melanocephala* and Bell Miner *M. melanophrys* (e.g. Dow 1978; Clarke 1988; Archard *et al.* 2006). Although miners are obligate cooperative breeders, other honeyeater species are probably facultative or opportunistic in this respect.

Although there are several anecdotal reports of cooperative breeding in the Black-chinned Honeyeater, most concern the tropical 'Golden-backed Honeyeater' *M. g. laetior*. In Western Australia, Slater (1962, cited by Rowley 1976) observed a nest of these birds being built by a party of five adults, which continued to attend the nest and often queued up to feed the chicks. At Victoria River, north-western Northern Territory, Boekel (1980) observed two fledglings being fed by three or possibly four adults. Near Maningrida in Arnhem Land, Northern Territory, I found a nest with young that were fed by three or four adults (Noske 2021). Although these reports, and the current study, indicate that up to three helpers may assist the parents in nest building and provisioning nestlings, the roles of members of a breeding group can only be confirmed by colour-banding studies.

Like many honeyeaters, the diet of the Black-chinned Honeyeater mostly comprises insects and carbohydrate sources, such as nectar and honeydew (Gilbert 1919; Ford & Paton 1977; Paton 1980). Gilbert (1919, p. 31) claimed that "nectar constitutes the food of the young for the first few days, gathered chiefly from flowering eucalypts ….. and [later] insects of all descriptions are fed to them", presumably including the larvae of sawflies (Hymenoptera) and beetles (Coleoptera) which were eaten by adults. At Sheep Station Creek Conservation Park, however, most foraging was on the leaves of Gum-topped Box and ironbarks (including Broad-leaved Ironbark *E. fibrosa*), and rarely on flowers (RAN unpubl. data). Lerps are mentioned as a food source only by Barker & Vestjens (1991, cited by Higgins *et al.* 2001), yet my observations of foraging adults and provisioning of nestlings suggest that they are an important dietary item, at least in winter. Lollback (2007) found that Black-chinned Honeyeaters spent a large proportion of their foraging time probing between leaves that were bound together by leaf-tying caterpillars (Lepidoptera) or, less commonly, spiders (Araneae) and lerps. He suggested that insect larvae were far more

Table 3. Breeding records of Black-chinned Honeyeater in south-eastern Queensland. CP = Conservation Park, NP = National Park. Dates are given as day/month/year.

Location	*Stage*	*Date*	*Estimated laying months*	*Source*
Tallegalla, Lockyer Valley	Unknown	6/9/99	Aug./Sep.	BirdLife Atlas
Crows Nest	Building	16/7/02	Jul.	Martin *et al.* (2003)
Lake Kurwongbah, near Petrie	Fledglings	27/7/03	Jun.	Marie Tarrant pers. comm.
Sundown NP	Unknown	18/11/07	Nov.	BirdLife Atlas
Sheep Station Creek CP	Collecting fur	25/3/16	Apr.	Carla Perkins pers. com.
Lake Kurwongbah, near Petrie	Collecting fur	14/4/17	Apr.	RAN pers. obs.
Sheep Station Creek CP	Incubation	10/6/17	Jun.	This study
Sheep Station Creek CP	Building	11/6/18	Jun./Jul.	This study
Sheep Station Creek CP	Young juvenile	2/10/18	Sep.	This study
Postman's Track, Samsonvale	Incubation	6/9/22	Aug./Sep.	Tom Tarrant pers. comm.
Durikai State Forest	Nestlings	6/12/22	Nov.	RAN pers. obs.

important as a food source to this species than to the typically co-occurring Fuscous Honeyeater *Ptilotula fusca*, and that this specialisation accounted for their rarity. His prediction is partly supported by my observations of larvae constituting at least 11% of the food brought to nestlings.

Breeding season

Because of its wide distribution through northern and eastern Australia, the Black-chinned Honeyeater has been recorded 'breeding' in all months (Higgins *et al.* 2001). In north-western Australia, Black-chinned Honeyeater (*M. g. laetior*) eggs have been recorded from January to August (Boekel 1980; Johnstone & Storr 2004; RAN unpubl. data), and in north-eastern Queensland, subspecies *M. g. gularis* is reported to breed in January–February and August–September (Lavery *et al.* 1968; Storr 1984), suggesting a biannual breeding season. In New South Wales, most breeding activity of the Black-chinned Honeyeater takes place from August to December (Gilbert 1919; Hindwood 1937; Cooper *et al*. 2020), although Gilbert (1937) found the species nesting regularly from February to April in the Bankstown district near Sydney. Lollback (2007) described the breeding season in north-eastern New South Wales as August to February, but did not define 'breeding season' nor provide any breeding data.

Few breeding records of Black-chinned Honeyeaters are available for south-eastern Queensland. The BirdLife Australia Nest Record Scheme (NRS) contains 17 breeding records of Black-chinned Honeyeater (Higgins *et al.* 2001), but none for Queensland. Of 66 breeding records in the Atlas of Australian Birds database, only six pertain to Queensland and, of these, only two are from the south-east of the state, where breeding (stages unspecified) was observed in September and November (Table 3). Martin *et al.* (2003) observed birds plucking fur from a Koala *Phascolarctos cinereus*, and carrying it to a nest, on 16 July 2002 near Crows Nest. Similar behaviour was observed at Sheep Station Creek Conservation Park on 25 March 2016 (C. Perkins pers. com.) and at Lake Kurwongbah, near Petrie, on 14 April 2017 (RAN pers. obs.).

Combining all available records for south-eastern Queensland suggests a laying season from April to November (Table 3), with a possible peak from June to August. Considering other parts of the continent, there seems to be a trend from autumn–winter breeding in the tropics and subtropics towards spring–summer breeding in the temperate south where winters are colder. Moreover, laying in south-eastern Queensland appears to begin 2 months earlier than in northern New South Wales. Similarly, the laying season of Fuscous Honeyeaters in south-eastern Queensland begins 3 months earlier than in north-eastern New South Wales (RAN unpubl. data).

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References

Archard, G.A., Robertson, R.J., Jones, D., Painter, J., Crozier, R. & Clarke, M.F. (2006). Brooding behaviour in the cooperatively breeding Bell Miner (*Manorina melanophrys*). *Emu* **106**, 105–112.

Arnold, K.E. & Owens, I.P.F. (1998). Cooperative breeding in birds: A comparative test of the life history hypothesis. *Proceedings of the Royal Society, London B* **265**, 739–745.

Austin, S.H., Robinson, W.D., Ellis, V.A., Robinson T.R. & Ricklefs, R.E. (2019). Nest attendance by tropical and temperate passerine birds: Same constancy, different strategy. *Ecology and Evol*ution **9**, 13555–13566.

Barker, R.D. & Vestjens, W.J.M. (1991). *The Food of Australian Birds. 2. Passerines*. CSIRO, Canberra.

Boekel, C. (1980). Birds of the Victoria River Downs Station and of Yarralin, Northern Territory. Part 2. *Australian Bird Watcher* **8**, 205–211.

Brent, A.E. (1905). The Black-headed Honey-eater (*Melithreptus melanocephalus*). *Emu* **5**, 12–15.

Burgess, W. (1947). The Pied Honeyeater breeding in Victoria. *Emu* **46**, 392–393.

Clarke, M.F. (1988). The reproductive biology of the Bell Miner *Manorina melanophyrs. Emu* **88**, 88–100.

Clarke, M.F. (1995). Co-operative breeding in Australasian birds: A review of hypotheses and evidence. *Corella* **19**, 73–90.

Conway, C.J. & Martin, T.E. (2000a). Effects of ambient temperature on avian incubation behavior. *Behavioral Ecology* **11**, 178–188.

Conway, C.J. & Martin, T.E. (2000b). Evolution of passerine incubation behaviour: Influence of food, temperature, and nest predation. *Evolution* **54**, 670–685.

Cooper, R.M., McAllan, I.A.W., Brandis, C.C.P. & Curtis, B.R. (2020). *An Atlas of the Birds of New South Wales and the Australian Capital Territory*, *Volume 3 – Eastern Spinebill to Common Greenfinch*. NSW Bird Atlassers Inc., Sydney.

Dow, D.D. (1978). Reproductive behaviour of the Noisy Miner: A communally breeding honeyeater. *Living Bird* **16**, 163–185.

Eddy, R.J. (1961). Twenty years of the Painted Honeyeater. *Australian Bird Watcher* **1**, 122–128.

Elsworth, S. (1997). Observation of Black-chinned Honeyeaters breeding in the Hackham area during July/August 1994. *South Australian Ornithologist* **32**, 170.

Ford, H.A. & Paton D.C. (1977). The comparative ecology of ten species of honeyeaters in South Australia. *Australian Journal of Ecology* **3**, 399–407.

Ford, H.A., Watson, D.M., Tulloch, A.I.T., Barnes, M.D., Maron, M., Oliver, D.L. & Garnett, S.T. (2021). Black-chinned Honeyeater *Melithreptus gularis*. In: Garnett, S.T. & Baker, G.B. (Eds). *The Action Plan for Australian Birds 2020*, pp. 600–602. CSIRO Publishing, Melbourne.

Garnett, S.T., Szabo, J.K. & Dutson, G. (2011). *The Action Plan for Australian Birds 2010*. CSIRO Publishing, Melbourne.

Gilbert, P.A. (1919). The Black-throated Honey-eater (*Melithreptus gularis*). *Emu* **19**, 28–33.

Gilbert, P.A. (1937). Field notes from New South Wales. *Emu* **37**, 28–31.

Harrison, C.J.O. (1969). Helpers at the nest in Australian passerine birds. *Emu* **69**, 30–40.

Herman, K. (2005). The Ecology of the Black-headed Honeyeater *Melithreptus affinis* in Tasmania, Australia. PhD Thesis. University of Tasmania, Hobart.

Higgins, P.J., Peter, J.M. & Steele, W.K. (Eds) (2001). *Handbook of Australian, New Zealand & Antarctic Birds, Volume 5: Tyrant-Flycatchers to Chats*. Oxford University Press, Melbourne.

Hindwood, K.A. (1937). The Black-chinned Honeyeater. *Emu* **37**, 143.

Johnstone, R.E. & Storr, G.M. (2004). *Handbook of Western Australian Birds, Volume II. Passerines (Blue-winged Pitta to Goldfinch).* Western Australian Museum, Perth.

Lavery, H.J., Seton, D. & Bravery, J.A. (1968). Breeding seasons of birds in north-eastern Australia. *Emu* **68**, 133–147.

Lollback, G.W. (2007). Ecology of an Uncommon Species, the Black-chinned Honeyeater (*Melithreptis gularis gularis*), in North-eastern New South Wales. PhD Thesis. University of New England, Armidale, NSW.

Lollback, G.W., Ford, H.A. & Cairns, S.C. (2008). Is the uncommon Black-chinned Honeyeater a more specialised forager than the co-occurring and common Fuscous Honeyeater? *Emu* **108**, 125–132.

Longmore, W. (1991). *Honeyeaters and Their Allies of Australia*. *The National Photographic Index of Australian Wildlife*. Angus & Robertson, Sydney.

Marchant, S. (1986). Nesting notes on the White-naped Honeyeater. *Australian Birds* **20**, 52–55.

Marki, P.Z., Jønsson, K.A., Irestedt, M., Nguyen, J.M.T., Rahbek, C. & Fjeldså, J. (2017). Supermatrix phylogeny and biogeography of the Australasian Meliphagides radiation (Aves: Passeriformes). *Molecular Phylogenetics and Evolution* **107**, 516–529.

Martin, T.G., Joseph, L.N. & Possingham, H.P. (2003). Black-chinned Honeyeaters (*Melithreptus gularis*) stealing Koala (*Phascolarctos cinereus*) fur to build a nest. *Sunbird* **33**, 29–32.

Matysioková, B. & Remeš, V. (2014). The importance of having a partner: Male help releases females from time limitation during incubation in birds. *Frontiers in Zoology* **11**, 24.

Matysioková, B. & Remeš, V. (2018). Evolution of parental activity at the nest is shaped by the risk of nest predation and ambient temperature across bird species. *Evolution* **72**, 2214–2224.

McGilp, N. (1932). Some birds of the interior. *South Australian Ornithologist* **11**, 222–225.

Moffat, D, Whitmore, M.J. & Date, E.M. (1993). Communal breeding by Striped Honeyeaters. *Emu* **83**, 202–203.

North, A.J. (1907). *Nests and Eggs of Birds Found Breeding in Australia and Tasmania*, *Volume 2*. Special Catalogue No. 1. Australian Museum, Sydney.

Noske, R.A. (1983). Communal behaviour of Brown-headed Honeyeaters. *Emu* **83**, 38–41.

Noske, R.A. (2021). New localities for nine bird species in Arnhem Land, including those for the notable Gouldian Finch, Red Goshawk and Hooded Robin. *Northern Territory Naturalist* **30**, 50–70.

Paton, D.C. (1980). The importance of manna, honeydew and lerp in the diets of honeyeaters. *Emu* **80**, 213–226.

Priday, S. (2015). Habitat of the Black-chinned Honeyeater *Melithreptus gularis* in the Greater Brisbane region, Queensland. *Sunbird* **45**, 48–59.

Rowley, I. (1976). Co-operative breeding in Australian birds. *Proceedings of the 16th International Ornithological Congress* **16**, 657–666.

Schodde, R. & Mason, I.J. (1999). *The Directory of Australian Birds: Passerines.* CSIRO Publishing, Melbourne.

Slater, P. (1962). *Western Australian Birds*. Mercantile Press, Perth, for BP Pty Ltd, Kwinana, WA.

Storr, G.M. (1984). Revised list of Queensland birds. *Records of the Western Australian Museum Supplement*. 19, 1–189.

Toon, A., Hughes, J.M. & Joseph, L. (2010). Multilocus analysis of honeyeaters (Aves: Meliphagidae) highlights spatio-temporal heterogeneity in the influence of biogeographic barriers in the Australian monsoonal zone. *Molecular Ecology* **19**, 2980–2994.

Trémont, S. & Williams, B. (1999). Observations at nests of the Painted Honeyeater *Grantiella picta*. *Australian Bird Watcher* **18**, 49–58.

Whitmore, M.J. & Eller, C.M. (1983). Observations at a nest of Painted Honeyeaters. *Emu* **83**, 199–202.

Wood, K.A. & Ley, A.J. (2005). Nesting and foraging by a pair of Striped Honeyeaters at Baradine, New South Wales. *Australian Field Ornithology* **22**, 88–103.

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