

Nest, egg and parental care of a nestling in the New Guinean Lesser Ground-robin *Amalocichla incerta*

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Abstract. The Lesser Ground-robin *Amalocichla incerta* (Petroicidae) is endemic to mid-mountain forests in mainland New Guinea. Spectrograms of four songs are depicted. We describe the elevation and nest-site, height above the ground, structure and materials of three nests discovered in the Yopno Urawa Som Conservation Area, Huon Peninsula, Papua New Guinea, and compare these observations with two previously described nests. All three of the nests in the present study were 1.0–2.1 m above ground. The colour and dimensions of two eggs are described. At one nest with a feathered nestling estimated to be 13–16 days of age, a pair of adults disposed of faecal sacs and provisioned the nestling at a rate of 7.5 feeds per hour. The nestling period of 22 days was similar to that of two other montane New Guinean robins, but longer than that of most temperate and tropical Australian robins.

Introduction

The Lesser Ground-robin *Amalocichla incerta* (Petroicidae) is a 30.7–32.5-g (mean 31.6 g, $n = 2$: Diamond 1972; Pruett-Jones & Pruett-Jones 1982), shy and elusive ground-dwelling Australasian robin endemic to mid-mountain forests in mainland New Guinea. It was named previously as the Lesser New Guinea Thrush and assigned to the thrush family Turdidae or subfamily Turdinae in the Old World Flycatchers (Muscicapidae) (Mayr 1941; Ripley 1964; Rand & Gilliard 1967; Diamond 1972). Beehler & Finch (1985) treated *Amalocichla* as Australasian robins based on the DNA–DNA hybridisation study by Sibley & Ahlquist (1982) that found the similar ground-dwelling Australo-Papuan scrub-robins *Drymodes* were most closely related to the Australian robin genera *Eopsaltria* and *Heteromyias* and distant from the *Turdus* thrushes. The molecular analysis by Norman *et al.* (2009) placed *Amalocichla* within the Petroicidae but did not support a sister relationship between *Amalocichla* and *Drymodes*. Phylogenetic analyses by Christidis *et al.* (2011) of all Australasian robin genera identified six lineages, with *Amalocichla* forming a separate lineage Amalocichlinae not related to *Drymodes*. *Amalocichla* is a sister lineage to the New Guinean *Pachycephalopsis* (Christidis *et al.* 2011; Beehler & Pratt 2016).

The 14–15-cm Lesser Ground-robin is sexually monomorphic, has a brown head, rufous-brown upperparts, brownish-buff underparts but with the belly whiter with more-rufous markings, long slender grey legs, a short tail, and a diagnostic whitish forehead-band and throat (Coates 1990). Of the two subspecies recognised by Beehler & Pratt (2016), *brevicauda* occurs on the Huon Peninsula, Papua New Guinea (PNG), where we conducted our study. The Lesser Ground-robin forages for arthropods on the forest floor at altitudes of 1200–2750 m above sea-level (asl), mainly 1750–2500 m asl (Coates 1990; Beehler &

Pratt 2016), and 1660–2420 m asl on the Huon Peninsula (Freeman *et al.* 2013). Its song, heard much more often than individuals are seen, is a light, breezy whistle of several notes (Boles 2007).

Very little is known about the breeding biology of the Lesser Ground-robin. Two nests and one egg have been described (Pruett-Jones & Pruett-Jones 1982; Coates 1990). Pruett-Jones & Pruett-Jones (1982) described nestling plumage at 11 days of age and on the day of hatching. Incubation behaviour and parental care of the young have never been quantified and the roles of the male and female in incubation and parental care activities are unknown. We here document the dimensions of three nests found in the Yopno Urawa Som Conservation Area (YUS CA, named after the Yopno, Urawa and Som Rivers), Huon Peninsula, PNG, and present new data on nest-site and height of the nest above the ground. We also document the colour and size of the egg, clutch-size, parental care of a nestling, and nestling growth and development. We present spectrograms of four different songs of the Lesser Ground-robin and photographs of the nest-site, nest, egg, an incubating adult on the nest, and a nestling.

Study site and methods

RHD and David Bryden conducted a 6-week exploratory trip in the Adelbert Mountains, Huon Peninsula, and around Tari in July–August 2014 to find a suitable site to study robins (Donaghey 2015a). We found four species of mid-mountain robins in the remote intact forest of the YUS CA, Huon Peninsula, so RHD selected Camp 12 as a base camp there (for further details see Donaghey *et al.* 2019). TB, DJB and RHD stayed at Camp 12 (elevation 2300 m asl; 06°01'S, 146°50'E) from 23 October to 6 December 2014. One of our guides, Liberth Wesley, discovered Lesser Ground-robin Nest 1 with a nestling on the afternoon of

30 October. We visited the nest-site (elevation 2411 m asl), with him at 1430 h on 31 October and photographed the nest and feathered nestling. The nestling was weighed with a digital electronic balance to the nearest 0.1 g (and again on 5 and 11 November) and the lengths of its wings and tail measured to the nearest millimetre with a metal ruler and the head–bill and tarsus lengths measured with callipers to the nearest millimetre. From a bush-hide built ~10 m from the nest by two of our guides, DJB and RHD conducted two 2-hour nest-watches (4 h/morning) between 0700 and 1100 h on 2, 3 and 5 November, for a total of 12 h, to determine the number and rate of feeding trips, nest sanitation, and comfort movements of the nestling.

TB returned to the YUS CA with SG from 6 October to 17 November 2017 to record bird vocalisations. They established a base camp at Camp Astrapia (2009 m asl; 06°01'S, 146°49'E). For two Lesser Ground-robin nests (Nests 2 and 3, each with a single egg), they described the nest-site, and recorded the altitude, height of nest above the ground and dimensions of the nest and egg, and photographed the nest-site, nest, and egg. TB recorded four different songs of Lesser Ground-robins with a Nagra LB and used file type WAV 48 kHz/24bit to prepare the spectrograms using Raven Pro 1.4, Hann window with FFT1024. All recordings were lodged both at the British Library of Wildlife Sound, UK, and the Macaulay Library, Cornell Lab of Ornithology, USA.

Tropical rainforest plants could not all be identified (from fruit and flowers) in the short time available to us at our study sites but they have been described for a 1-ha plot 2400 m asl <200 m upslope from Camp 12 (Inaho 2012; see also Donaghey *et al.* 2019). Inaho (2012) recorded 39 plant species in 36 genera and 28 families, but this species richness was low compared with lower elevations. He did not describe the vegetation at Camp Astrapia. During our stays at Camp 12 in October–December 2014 and Camp Astrapia in October–November 2017, there was little sunshine, and heavy rain fell most afternoons, evenings and some mornings.

Observations

Song

Spectrograms of four different songs of the Lesser Ground-robin (Figure 1) show that the whistled notes of the songs range in frequency from ~2 to 3.5 kHz and the duration of each song is c. 2 seconds. Two songs (2 and 4: see Figure 1) start with two notes of a low pitch, rise to a higher pitch and then four notes cascade to a lower pitch. These two songs resemble the pattern described by Pratt & Beehler (2015, p. 487) as “a beautiful tune of usually 6–7 clear piping notes” that “jump around in pitch and usually end on a low note”.

Nest-site, nest and egg

Nest 1, found in 2014, was 2.1 m above ground in a 4–5-m-tall, densely foliated, slender understorey tree. It was built on a horizontal branch 46 cm from the trunk of the nest-tree and 99 cm from the outermost foliage (Figures 2–3). The nest-tree was on a hill slope 2411 m asl, and the nest had a southerly aspect. Nest 2, found in 2017, was built in the fork of a Coffee *Coffea arabica* shrub and attached to the stem of a vine. It was built 1.2 m above the ground, with an easterly aspect, at an altitude of 1988 m asl (Figures 4–5). The foliage of a nearby tree provided cover and shade above the Coffee shrub and the nest. Nest 3, also found in 2017, was placed 1.0 m above the ground, on the side of a tree-trunk with a dense covering of moss, at an altitude of 1790 m asl, and thus was well camouflaged.

All three open-cup-shaped nests in this study were composed externally of bright-green moss, with the inner egg-cup lined with fine blackish rootlets (Figures 3–5). The bulkier Nest 1 had some dead leaves (20 cm long) and dried fern-frond pieces (10–23 cm long) on the exterior (Figure 3). Variation in the size of the nests is shown in Table 1. The external nest diameter was 13.0–18.0 cm and

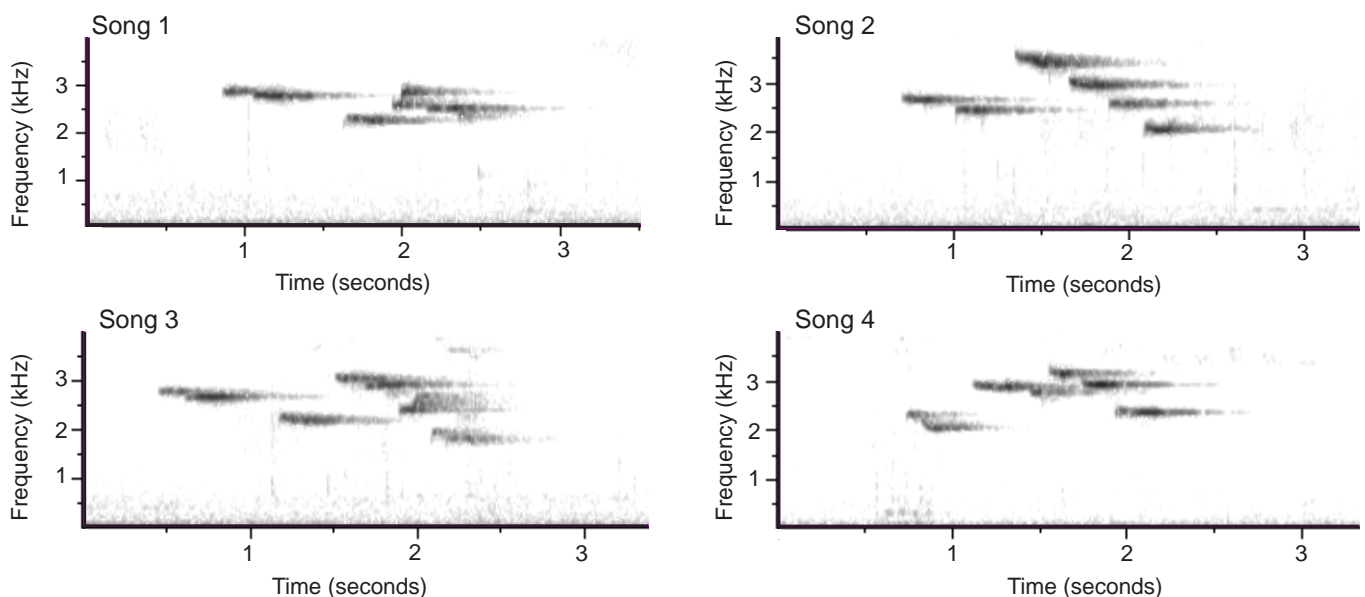


Figure 1. Spectrograms of four different songs of the Lesser Ground-robin in the Yopno Urawa Som Conservation Area, Huon Peninsula, PNG. Spectrograms: Tony Baylis



Figure 2. Site of Lesser Ground-robin Nest 1. Photo: Richard H. Donaghey



Figure 3. Nest structure, and external and internal materials of Lesser Ground-robin Nest 1. Photo: Richard H. Donaghey



Figure 4. Nest-site and Nest 2 of Lesser Ground-robin in the fork of a Coffee shrub. Photo: Tony Baylis



Figure 5. The egg and egg-cup materials in Lesser Ground-robin Nest 2. Photo: Tony Baylis



Figure 6. Incubating Lesser Ground-robin on Nest 2. Photo: A. Skeoch



Figure 7. Nestling Lesser Ground-robin the day before fledging from Nest 1. Photo: Donna J. Belder

Table 1. Characteristics of four Lesser Ground-robin nests, the first at Mt Missim, Kuper Range (Pruett-Jones & Pruett-Jones 1982) and the other three in the YUS CA, Huon Peninsula (this study).

| Nest no. YUS CA | Year | Altitude (m asl) | Nest-site | Nest height above ground (m) | Nest dimensions (cm) | | | |
|--------------------|------|---------------------|--|---------------------------------|----------------------|-------|----------|-------|
| | | | | | External | | Internal | |
| | | | | | Diameter | Depth | Diameter | Depth |
| | 1982 | 2030 | Tree-hollow | 1.2 | 7 | 6 | 4 | 3 |
| 1 | 2014 | 2411 | Interior branch of densely-foliaged understorey tree | 2.1 | 18.0 | 14.5 | 6.0 | 4.2 |
| 2 | 2017 | 1988 | Fork of coffee shrub | 1.2 | 13.0 | 12.5 | 8.0 | 5.0 |
| 3 | 2017 | 1790 | Side of moss-covered tree | 1.0 | 13.0 | 12.5 | 7.5 | 4.5 |

Table 2. Parental care of a Lesser Ground-robin nestling (Nest 1) in the YUS CA, PNG, 2014. Age of nestling is estimated (see text).

| Age of nestling (days) | Nest-watch time (h) | Observation (minutes) | No. feeding trips | | Time adults spent at nest | | | No. faecal sacs removed | |
|------------------------------|------------------------|--------------------------|-------------------|-----------------------|---------------------------------|--------------------------------|-----------|----------------------------|-------|
| | | | Total | Mean/h (and range) | Total, seconds (and minutes) | Mean visit length (seconds) | Minutes/h | Total | No./h |
| 13 | 0700–1100 | 240 | 29 | 7.3 (2–14) | 217 (3.62) | 6.9 | 0.90 | 6 | 1.5 |
| 14 | 0700–1100 | 240 | 28 | 7.0 (4–15) | 234 (3.90) | 8.4 | 0.98 | 5 | 1.3 |
| 16 | 0700–1100 | 240 | 33 | 8.3 (3–15) | 279 (4.65) | 8.5 | 1.17 | 6 | 1.5 |

the external depth 12.5–14.5 cm. The internal diameter of the egg-cup was 6.0–8.0 cm and the internal egg-cup depth 4.2–5.0 cm.

The clutch-size for both Nests 2 and 3 was one. The egg was white to off-white and speckled with dark-brown-to-black spots and blotches, and smaller greyish spots and blotches distributed over the entire surface but concentrated at the larger blunt end (Figure 5). The egg in Nest 2 measured 27.0 mm × 20.0 mm, and that in Nest 3 was 26.8 mm × 19.4 mm.

Figure 6 depicts an incubating Lesser Ground-robin on Nest 2. We did not conduct nest-watches of incubating birds, so were unable to determine if only the female incubates and whether the male feeds the female on and off the nest, as is characteristic of Australasian robins.

Parental care of the nestling

When first inspected on 31 October 2014, Nest 1 contained a single feathered nestling with its eyes fully open. The primary remiges of the nestling had emerged 10 mm from their sheaths, and long wispy grey down over the entire body protruded through a dense covering of feathers. The nestling was estimated to be 11 days of age on 31 October, based on a similar developmental stage of a nestling described by Pruett-Jones & Pruett-Jones (1982).

Three 4-hour morning nest-watches by two observers during the late nestling period confirmed that a pair

of Lesser Ground-robins provisioned the nestling and removed faecal sacs. The number and rate of feeding trips per hour, the time that the adults spent at the nest, and the number and rate of faecal sacs removed per hour are presented in Table 2. The mean number of meals delivered to the single nestling over a 4-h period was 30 (range 28–33) and the mean number of feeding trips per hour was 7.5 (range 2–15). An adult bringing food spent on average 7.9 seconds at the nest on each feeding trip. On average, six faecal sacs were removed by the adults per 4-h morning nest-watch at a rate of 1.4 faecal sacs per hour. The nestling was well-feathered, thus no brooding was observed.

The young Lesser Ground-robin emitted begging calls when an adult visited the nest (Nest 1). The comfort movements of this nestling, estimated to be 13–16 days of age, included preening the head and body, stretching the head and body up, thrusting the head forward, and ejecting faecal sacs.

Nestling growth and development

When discovered on 31 October 2014, the nestling (estimated to be 11 days old) in Nest 1 weighed 25.9 g (Table 3). Its weight, and lengths of wing, tail, head–bill and tarsus on Days 16 and 22 of the nestling period are presented in Table 3. At 22 days of age (the day before fledging), the nestling weighed 27.4 g (86.7% of mean adult weight), its wing-length was 62 mm (81.6% of adult

Table 3. Estimated age (days), weight (g) and lengths (wing, tail, head–bill and tarsus, mm) of a nestling Lesser Ground-robin (Nest 1) in the late nestling period, YUS CA, PNG, 2014.

| Date | Age | Weight | Wing | Tail | Head–bill | Tarsus |
|-------------|-----|--------|------|------|-----------|--------|
| 31 October | 11 | 25.9 | | | | |
| 5 November | 16 | 28.7 | 55.0 | 10.0 | 34.0 | 39.0 |
| 11 November | 22 | 27.4 | 62.0 | 24.0 | 37.7 | 41.1 |

Table 4. Weight (g), wing- and tail-lengths (mm) for nestlings (at or just before fledging) compared with adults in the Lesser Ground-robin (Nest 1, this study) and Grey-headed Robin (Frith & Frith 2000). Data for the adult Lesser Ground-robin are from Diamond (1972) and Pruett-Jones & Pruett-Jones (1982); data for the Grey-headed Robin are mean values from Frith & Frith (2000). A = adult, N = nestling.

| | Weight | | | Wing | | | Tail | | |
|---------------------|--------|------|---------|------|-------|---------|------|------|---------|
| | N | A | N/A (%) | N | A | N/A (%) | N | A | N/A (%) |
| Lesser Ground-robin | 27.4 | 31.6 | 86.7 | 62.0 | 76.0 | 81.6 | 24.0 | 51.0 | 47.1 |
| Grey-headed Robin | 27.9 | 36.3 | 77.0 | 53.2 | 108.4 | 49.0 | 11.0 | 75.4 | 14.6 |

wing-length) and its tail-length was 24 mm (47.1% of adult tail-length) (Table 4). The day before fledging, the nestling still had long grey down on the crown of its head. Its forehead was blackish, the crown dark brown with buff spots, the back brown with rich-buff spots, primaries dark brown edged with rufous, and the wing-coverts brown with rufous tips. The underparts, especially the breast, were strongly mottled dark brown to black and buff; the throat was brown with whitish streaks; and the mottled belly was whiter. The irides were brown and the legs grey (Figure 7).

Discussion

Breeding season

Records of Lesser Ground-robin nesting include a nest with an egg in mid October (Coates 1990), a nest with an egg and nestling in early–mid January (Pruett-Jones & Pruett-Jones 1982), a juvenile in December (Coates 1990), and our observations of nesting in October–November confirm that the breeding season extends for at least 4 months from the late dry to early wet season.

Nest and egg

The structure and materials of the three Lesser Ground-robin nests of this study were similar to those described in Pruett-Jones & Pruett-Jones (1982) and Coates (1990). However, the nests in the present study were bulkier, and resembled White-winged Robin *Peneothello sigillata* nests, which are bulky and composed externally of green moss (Coates 1990; RHD pers. obs.). Of two Lesser Ground-robin nests described before our study, one was placed on the ground and one in a tree-hollow 1.2 m above the ground (Pruett-Jones & Pruett-Jones 1982; Coates 1990; Boles 2007). In our study, contrary to Winkler *et al.* (2015, p. 402), who stated that “ground- and scrub-robins place

their large bowl-shaped nests of sticks on the ground”, we discovered that the three Lesser Ground-robin nests were composed externally of bright-green moss and placed 1–2 m above the ground. Although more nest records are needed, our tentative results suggest that in this species more nests are built above than on the ground. Pruett-Jones & Pruett-Jones (1982) thought that the nest above ground in a tree-hollow was unusual, considering that the Lesser Ground-robin is a ground-dweller, yet most ground-foraging robin species nest predominantly above the ground (Higgins & Peter 2002; Boles 2007).

Pruett-Jones & Pruett-Jones (1982) and Coates (1990) described the egg of the Lesser Ground-robin as white or whitish with small brownish-black spots or fine chocolate-brown spotting over the entire surface but provided no photographs. The two eggs in the YUS, CA (this study) were similar in background colour but (in proportion to the size of the egg) the spots and blotches were larger and more resembled those of the Little Shrike-thrush *Colluricincla megarhyncha* and Crested Bellbird *Oreoica gutturalis* illustrated in Beruldsen (1980) and Johnstone & Storr (2004). The dimensions of the Lesser Ground-robin eggs in the present study are within the range of 25.1–28.8 mm × 17.9–20.1 mm reported by Coates (1990).

Clutch-size

In the present study, clutch-size in the Lesser Ground-robin was one in two nests (Nests 2 and 3), and brood-size was one in another (Nest 1). These few data provided further evidence that clutch-size is one in montane New Guinean robin species (Donaghey 2015b).

Incubation behaviour

In Australian robins, only the female incubates the clutch and broods the young. While the female is incubating, the male delivers food to her on and off the nest. While

the female broods the altricial young, the male feeds the female, which either consumes the meal or passes it to the young. This pattern of a male feeding the female during the incubation and nestling periods has been observed in all subfamilies of Australasian robins except Amalocichlinae, and in the following Australian robin genera: *Eopsaltria*, *Tregellasia*, *Melanodryas*, *Poecilodryas*, *Heteromyias*, *Peneoenanthe*, *Drymodes*, *Microeca* and *Petroica* (Frith & Frith 2000; Higgins & Peter 2002; Russell *et al.* 2004; Rawsthorne & Donaghey 2012; Donaghey & Donaghey 2017; RHD pers. obs.). Among robins endemic to New Guinea, male feeding of a nesting female has been observed in the Papuan Flyrobin *Devioeca papuana* (Donaghey 2017), White-winged, Blue-grey *Peneothello cyanus*, Black-capped *Heteromyias armiti* and Green-backed Robins *Pachycephalopsis hattamensis* (RHD pers. obs.). In the Southern Scrub-robin *Drymodes brunneopygia*, there is uncertainty on the roles of the male and female in incubation: Higgins & Peter (2002, p. 836) stated that incubation is “probably usually by female alone” whereas Winkler *et al.* (2015, p. 402) stated, without evidence, that “except in the scrub-robins, where males take a more equal role in parental care, only the female builds the nest and incubates the eggs”. Two intensive studies of colour-marked Southern Scrub-robins, one by Brooker (2001) at Peron Peninsula, Western Australia, and one by RHD and Carolyn A. Donaghey over two breeding seasons at Gluepot Reserve, South Australia (Donaghey in Higgins & Peter 2002; RHD & CAD pers. obs.), confirmed that only the female incubates and broods. Furthermore, Donaghey in Higgins & Peter (2002) observed that, in response to a specific call by her mate, an incubating female Southern Scrub-robin flew off the nest to be fed by him. This pattern of incubation-feeding of the female by the male is consistent with sole incubation by the female. Based on all these observations and studies of Australasian robins, we thus predict that in *Amalocichla* ground-robins only the female incubates and broods, and that the male feeds the nesting female.

Nestling period

The Lesser Ground-robin nestling period of 22 days (this study) is similar to that in the New Guinean White-winged and Black-capped Robins (20–22 days) (RHD pers. obs.), the two Australian *Microeca* species, Jacky Winter *M. fascians* (18–20 days) and Lemon-bellied Flycatcher *M. flavigaster* (18–21 days), and the New Zealand robin species (17–22 days, usually 18 days) (Higgins & Peter 2002). In most temperate and tropical Australian robins, the nestling period is <15 days and nest-depredation is moderate to high (Higgins & Peter 2002). In the Grey-headed Robin *Heteromyias cinereifrons* of upland tropical rainforest in north-eastern Queensland, the nestling period is 12–13 days and nest success 54% (Frith & Frith 2000), whereas the congeneric New Guinean Black-capped Robin has a longer nestling period (22 days) and apparently low nest-depredation, based on a sample of three nests. We postulate that the longer nestling periods in New Zealand and montane New Guinean robins might have evolved mainly in response to a lower nest-depredation risk coupled with lower food availability.

Parental care of nestling

In the Lesser Ground-robin, we observed two adults delivering meals to the single nestling during the last half of the nestling period. Since the adults had similar plumage and were not colour-marked, we were unable to determine the individual contributions by the male and female. We observed two adults disposing of nestling faecal sacs. The single nestling was fed on average 7.5 times per hour (this study) compared with 9.7 feeds per hour for the brood of two in Grey-headed Robins (i.e. 4.8 feeds per nestling per hour: Frith & Frith 2000). The feeding rate per nestling per hour in the Lesser Ground-robin was higher than in other Australian robins, with the exception of the Jacky Winter (Donaghey & Donaghey 2017).

Growth and development of nestling

It would be insightful to compare the weight and growth measurements at fledging of the Lesser Ground-robin presented here with other similar-sized tropical Australasian robins. There are no published growth data for any other New Guinean robins; however, there are data available to compare the larger and heavier Grey-headed Robin (Frith & Frith 2000) of upland tropical rainforest in north-eastern Queensland. On the day of hatching, a nestling Lesser Ground-robin was covered in blackish down (Pruett-Jones & Pruett-Jones 1982) whereas hatchling Grey-headed Robins are naked and pink (Frith & Frith 2000). Table 4 compares nestling weights, and wing- and tail-lengths at or just before fledging in proportion to the adult in the Lesser Ground-robin (Nest 1) and Grey-headed Robin. In the present study, the weight of one Lesser Ground-robin the day before fledging was 87% of the mean adult weight (compared with 77% of mean adult weight in the Grey-headed Robin on the day of fledging); wing-length was 82% of adult wing-length (compared with 49% in the Grey-headed Robin); and tail-length was only 47% (compared with 15% in the Grey-headed Robin) (Table 4). These comparisons show that the longer, 22-day nestling period permits the Lesser Ground-robin to fledge with much longer wings and tail in proportion to the adult than in the Grey-headed Robin, which may allow the fledgling Lesser Ground-robin to better escape predators and thus enhance its survival.

Future research

Further research on the breeding biology of the Lesser Ground-robin could determine incubation rhythm, the role of the male and female in incubation and brooding, the extent of male courtship- and incubation-feeding of the female, and the role of the male and female in parental care of the young. It could also focus on a comparative field study of productivity, nest success, nest-depredation and predators, and the growth and development of montane New Guinean robins compared with lowland robin species.

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