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A nesting aggregation of Blue-fronted Lancebill *Doryfera johannae*, with additional remarks on a cave nest of the species

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Summary.—We report an unusual nesting aggregation of the poorly known Blue-fronted Lancebill *Doryfera johannae*, a trochilid that is thinly and disjunctly distributed in the Andes and Pantepui. The nests were clustered on wooden, man-made structures and were at different stages of the breeding cycle. Photos on publicly accessible databases provided evidence that the species' habit of nesting on buildings is geographically widespread. One nest of *D. johannae* described in the literature was sited at the base of deep shaft into an underground cave system; we report additional details associated with this nest. Nesting aggregations are apparently rare in the family Trochilidae and cave-nesting is evidently limited to a comparatively small number of species, despite essentially obligate colonial breeding in permanently dark sites, especially caves, by members of the closely related family Apodidae.

The hummingbird genus *Doryfera* Gould, 1847, comprises two species (Dickinson & Remsen 2013). Green-fronted Lancebill *D. ludovicae* is distributed from northern Costa Rica through Panama, and in the Andes from western Venezuela to north-west Bolivia. Blue-fronted Lancebill *D. johannae* is also primarily Andean, occurring from central Colombia to central Peru, with a separate population in the Pantepui of southern Venezuela, northernmost Brazil and western Guyana. Of the two species, the breeding biology of Green-fronted Lancebill is far better known, especially following the detailed study by Greeney *et al*. (2006). Both species are essentially solitary, although pairs are occasionally observed (Snow & Gochfeld 1977, Hilty & Brown 1986; GMK pers. obs.).

For *D. johannae*, the few published nesting data (Stiles & Kirwan 2018) are as follows. In south-eastern Ecuador, a nest in a cave shaft with a single egg (size 15 × 10 mm) was found in mid-July 1976 (Snow & Gochfeld 1977); this nest was suspended from a rock overhang in a cave and was a cylindrical structure of moss and cobwebs, with the cup in the top. It measured 110 mm top to bottom, with an internal diameter of 30 mm and internal depth of 29 mm. The egg was described as unincubated but was subsequently broken and not preserved, unlike the nest, which is in the Natural History Museum, Tring (NHMUK N/1978.1.2). Grantsau (1988: 22) reported additional egg data, mass 0.5 g, size 9.2 × 15.0 mm, but their provenance is unknown (perhaps his own, otherwise unpublished, data); he repeated Ruschi (1974) as the source for nest measurements of 60 mm top to bottom, with external diameter of 70 mm and internal diameter of 30 mm. A short video (Macaulay Library; www.macaulaylibrary.org, ML 201629101) of another nest that held two nestlings in early December 2014 at Río Bigal Biological Reserve in north-east Ecuador, discovered by H. Jacob, was referenced by Stiles & Kirwan (2018). Elsewhere, in central Colombia, a female with enlarged follicles was collected in September (Stiles 1999). Here, we report some additional breeding data for the species including an apparently unusual aggregation of

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active nests, which provides evidence also that *Doryfera* can accept man-made situations in which to breed, together with additional information concerning the remarkable 1976 nest.

Observations of Río Bigal nests

The following observations were made by GMK during 3–9 November 2017, at Río Bigal Biological Reserve (00°32′13.1″S, 77°25′28.5″W) on the south-east edge of Sumaco Napo Galeras National Park, Orellana province, eastern Ecuador, at *c*.950 m. All of the nests reported below were within the confines of, or in very close proximity to, the reserve 'headquarters', an open-sided, two-storeyed, principally wooded construction that is in virtually continual human use throughout the day (and night). One nest (nest 1) was attached to the underside of a wooden chalet on struts, *c*.2 m above ground, less than 10 m from the part of the main building in which the other nests were sited. Two of the other nests (2 and 3) were attached to the ceiling of the ground storey of this building, and within *c*.3 m and clear sight of each other; a fourth nest (nest 4) was sited under the ceiling of the upper storey and again within approximately 3 m of those on the ground storey, but obviously not in sight of the others. The remains of three older nests in various states of decay were also discovered on the upper storey of the main building, one of them sited on the underside of a wooden table, at one of its corners, less than 100 cm above floor level. Each active nest was constructed entirely of dry mosses, liverworts and spider webs, with no apparent lining. Their overall colour was generally brown but variable quantities of fresh green material was incorporated into all four of the nests, as described below. They were attached to the wooden substrate with a strong lip consisting of an obvious mat of spider webs. Nests were measured using dial callipers and are listed in order of discovery. There is some evidence from these measurements of the phenomenon reported by Greeney *et al*. (2006): 'dimensions show that nest cups were round early in incubation or before the onset of incubation, but that cups and nest cylinders stretched as incubation continued, and especially during the nestling period'. The length of the 'tail' below the nest, at 25.1–153.0 mm (mean 87.9 mm), was somewhat longer than that, 40–80 mm, observed in nests of *D. ludovicae* examined by Greeney *et al*. (2006). To minimise disturbance, GMK did not attempt a very close examination of the contents of any of the nests.

Nest 1.—outside breadth 127.5 mm, outside depth 89.0 mm, inside diameter 42.9 × 55.0 mm, entrance lip diameter 25.5 mm and height 14.9 mm, extraneous material below nest 86.7 mm, distance between roof and top of nest 24.0 mm, and length of attachment of spiders' web 37.5 mm. This nest contained two nestlings (Fig. 1A) which, based on comparison with the data presented by Greeney *et al*. (2006) for *D. ludovicae*, were probably *c*.10 days old; they were largely dark with well-developed charcoal blackish-looking pin feathers over the entire body including the wings and tail, although some pinkish skin was still visible in places on the dorsal surface, and the bill was somewhat pinkish black on the maxilla, still yellow-orange over most of the mandible, with paler yellow gape flanges.

Nest 2.—outside breadth 85.7 mm, outside depth 93.8 mm, inside diameter 50.6 × 47.4 mm, entrance lip diameter 25.4 mm and height 18.3 mm, extraneous material below nest 86.9 mm, distance between roof and top of nest 20.4 mm, and length of attachment of spiders' web 34.9 mm. Sited *c*.2.5 m above ground level, this nest contained two all-white and well-incubated eggs (Fig. 1B).

Nest 3.—outside breadth 122.6 mm, outside depth 111.3 mm, inside diameter 29.5 × 51.0 mm, entrance lip diameter 24.5 mm and height 30.2 mm, extraneous material below nest 25.1 mm, distance between roof and top of nest 10.5 mm, and length of attachment of spiders' web 34.9 mm. Sited *c*.2.5 m above ground level, empty (Fig. 1C) but apparently ready for eggs, as it (like all of the nests) was being regularly visited by a female.

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Figure 1. Four active nests of Blue-fronted Lancebill *Doryfera johannae* found at Río Bigal Biological Reserve, Orellana province, eastern Ecuador, November 2017: A (nest 1, with two nestlings); B (nest 2, with two well-incubated eggs); C (nest 3, empty but apparently ready for eggs; see text); and D (nest 4, with one very recently hatched chick) (Guy M. Kirwan)

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Nest 4.—outside breadth 82.4 mm, outside depth 60.7 mm, inside diameter 42.9 × 37.5 mm, entrance lip diameter 22.2 mm and height 17.8 mm, extraneous material below nest 153.0 mm, distance between roof and top of nest 23.6 mm, and length of attachment of spiders' web 52.0 mm. Contents: one very recently hatched chick, presumably less than 24 hours old, with the eggshell remnants still beside it (Fig. 1D). The chick's appearance was very similar to that of <3-day-old young of *D. ludovicae* depicted by Greeney *et al*. (2006: fig. 3): entirely naked with largely pink skin, but dark grey at the front of the head, over the forecrown and face, and on the upper back, with a blunt-tipped pale to medium yellow bill. For *D. ludovicae*, Greeney *et al*. (2006) noted that the dorsal surface of nestlings darkened considerably within 48 hours after hatching.

In addition to the video by H. Jacob mentioned above, the following previously unpublished data are now available based on material archived at Macaulay Library: two nests constructed in close proximity of which only one appeared active (with an adult perched on the rim, perhaps feeding young) under a rock overhang at Cascada Hollín, Loreto road, Napo province, Ecuador, in late December 2010 (P. Smith, ML 255461721); adult female feeding a fledged juvenile, from a nest sited 'underneath the house' at Reserva La Isla Escondida, Putumayo, Colombia, February 2017 (J. Beckers, ML 265577041 and ML 265577081); female on a nest (stage unknown, but constructed 1 m above ground on an abandoned house) at Cerro Chiviaza, Morona-Santiago province, Ecuador, early September 2019 (J. Brito, ML 175870381); nest (stage unknown) at Puente Quita Calzones, Cuzco, Peru, in late September 2021 (D. Thomas, ML 384867521); female on a nest (stage unknown) at WildSumaco Lodge, Napo province, Ecuador, late July 2022 (N. Hayward, ML 471598241 and ML 471591051); and female nestbuilding (nest appears largely complete) at Restaurante La Cumbre, Pasco, Peru, early September 2022 (T. Aronson, ML 481601191 and ML 481601201). No detailed notes are available on any of these nests, but the structure, materials, attachment, and substrate of those in September 2019 and 2021, July 2022, and September 2022 appear very similar to the nests found at Río Bigal. Only the nests in December 2010 and September 2021 were sited in natural localities, whereas the others were all on wooden buildings.

The Cueva de los Tayos nest

The 1976 British Cave Research Association Expedition was organised by the Scottish explorer Stan Hall (1936–2008) to investigate the Cueva de los Tayos (Cave of the Oilbirds [*Steatornis caripensis*]) on the east slope of the Andes, in Morona-Santiago province, south-east Ecuador. Until the Tham Luang cave rescue of Thailand in 2018 it was the most remarkable and expensive caving expedition in history. Motivated by the extraordinary claims in Erich von Däniken's *The gold of the gods* (1973), the 1976 expedition aimed principally to archaeologically investigate the cave system and research the gold sculptures, metal plaques, stone carvings and gold supposedly found by Däniken (b. 1935) and his colleague János Juan Móricz (1923–91) during their 1969 exploration of the caves. Whilst no evidence of treasure was found, the 70+ strong expedition personnel, notably including the astronaut Neil Armstrong, made several significant scientific discoveries, including the first known nest and egg of *Doryfera johannae* by James K. Campbell on 15 July 1977, evidently in close proximity to an active colony of *Steatornis caripensis* studied by Snow (1979). Snow & Gochfeld (1977) gave a detailed description and account of the hummingbird nest but, 46 years after it was collected, we obtained further information from surviving expedition members and their families.

Snow & Gochfeld (1977) described that the nest was 'collected by J. K. Campbell at the bottom of the 75 m shaft' and 'attached by a thick tab of cobweb to a slight rocky overhang

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Figure 2. The 'Paz de Luz Divina' entrance shaft to Cueva de los Tayos, Morona-Santiago province, south-east Ecuador, where the first nest of Blue-fronted Lancebill *Doryfera johannae* was collected (see Fig. 3) (© Eileen Hall)

1½m up from the bottom of the shaft'. We believe the shaft in question is that noted in Toulkeridis (2015) and christened by the expedition 'Paz de Luz Divina' (Peace of Divine Light). It is one of three shafts (two of them large) into the cave complex and is located *c*.4 km west of the town of Tena and 3 km south-east of San Pedro, at 01°00'3"S, 77°51'26"W; elevation 610 m. Eileen Hall (*in litt*. 2018), who also visited the cave system, estimated the shaft in question to be *c*.6–7 m wide at the entrance (see Fig. 2); Arthur Champion (*in litt*. 2018), another member of the expedition, reported that the shaft is only 50 m deep, with the difference being due to the way the winch and gantry were set up.

J. K. Campbell (*in litt*. 2018) provided the following description. 'The shaft was quite broad and quite a lot of light reached the bottom, which was covered in boulders and had a small amount of vegetation. I was near one of the walls when I noticed a strange-looking object above my head and wondered what it was. I never thought it might be a

Figure 3. Nest of Blue-fronted Lancebill *Doryfera johannae* collected at Cueva de los Tayos, Morona-Santiago province, south-east Ecuador, by J. K. Campbell in July 1976, held in the Natural History Museum, Tring (NHMUK N/1978.1.2) (Jonathon Jackson, © Trustees of the Natural History Museum, London)

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bird's nest—at the bottom of a deep shaft. I reached up and felt it and it just came away in my hand. I was rather distressed to find it *was* a bird's nest with some eggs (*sic*) in it and immediately tried to put it back in the same place, but it wasn't possible'. 'So, I took it out of the cave and showed it to Barbara Snow. I think she then descended the cave with me the next day and I showed her where it had been, and she was able to identify the bird when it returned looking for its nest'. Beginning ten days after the nest was collected, Snow observed a pair of *D. johannae* at the entrance to the same shaft and watched the female descend into it carrying nesting material on multiple occasions over several days (Snow & Gochfeld 1977). She also witnessed a third *Doryfera* (sex unknown) being chased away from the vicinity by the male, and stated that other expedition members reported seeing a dark hummingbird ('probably a lancebill') halfway down another of the cave's principal entrance shafts (60 m away). These additional data are interesting because they suggest a degree of territoriality or defence of the area around the nest in the species (at variance with the observations made at Río Bigal) and that nesting deep in the shaft of caves was not a one-off event.

Photos of the adults were taken at the time and have been supplied by James Campbell (confirming the species identification); the nest deposited at NHMUK is shown in Fig. 3. The distended ('pendent'), somewhat cylindrical appearance, particularly compared to those at Río Bigal, is potentially attributable to the Los Tayos nest having less basal support from the substrate, similar to the variation in shape and its causes that Greeney *et al*. (2006) noted in Green-fronted Lancebill.

Discussion

Our knowledge of the life history of Green-fronted Lancebill is considerably more detailed than the information available for Blue-fronted Lancebill (see summary in Stiles & Kirwan 2018). In Costa Rica, the first-named species breeds in the latter half of the wet season to the start of the dry, between August and January (Stiles & Skutch 1989), while in Colombia nesting has been recorded between July and late January (Hilty & Brown 1986, Ramírez González & Arias García 1994). Further south, a nest with eggs was found in Junín, eastern Peru in mid-September 1972 (Snow & Gochfeld 1977), with others discovered in north-west Ecuador in June–January (Greeney & Nunnery 2006). In eastern Ecuador, 36 nests were found between September 2001 and March 2002, with an obvious peak in (asynchronous) activity between mid-October and mid-December (Greeney *et al*. 2006), which is potentially mirrored by Blue-fronted Lancebill lower on the same slope of the Andes (GMK pers. obs.). The nest of Green-fronted Lancebill is constructed by the female over period of 12–16 days, and is a rather bulky cup of moss, tree-fern scales, fine fibres and cobwebs, placed in a dark, usually humid site, typically being attached to a hanging rootlet or vine under a rock overhang in a dark ravine or gorge (with the lower part often elongated to form a cylindrical structure) but can sometimes be attached to a wire under a bridge or roof, or less often be sited on a small ledge in a gorge or cave (Greeney *et al*. 2006). Green-fronted Lancebill frequently nests alongside streams, typically 0.8–6.0 m above ground; all of those found by Greeney *et al*. (2006) were in such situations. In comparison, the nests of *D. johannae* described herein were tens of metres from the nearest stream. The clutch in *D. ludovicae* is typically two white eggs, size 15.6–15.7 × 11.1 mm, in eastern Peru (Snow & Gochfeld 1977) or 14.1–15.7 × 9.1–10.0 mm, in eastern Ecuador (Greeney *et al*. 2006); incubation takes 19–21 days and the fledging period is 29–30 days (Greeney *et al*. 2006).

The nest found during the Los Tayos expedition appears quite unique among those described for Trochilidae (but not of course in the closely related Apodidae) in being sited very deep (either laterally or, especially, vertically) within a cave. In addition to Green-

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fronted Lancebill, Lopes *et al*. (2020) reported multiple nests of the recently described Dry-forest Sabrewing *Campylopterus calcirupicola* in limestone caves, one of which was up to 15 m inside, albeit the cave in question was described as having a large entrance which made its confines still rather light.

Colonial or pseudo-colonial nesting (with concurrently active nests, even if at different stages) seems rare in hummingbirds: in Peru, Carpenter (1976) found that multiple females of Andean Hillstar *Oreotrochilus estella* will nest semi-colonially in particularly suitable sites; Solano-Ugalde (2008) reported finding 11 nests, of which at least seven were active, of the closely related Ecuadorian Hillstar *O. chimborazo* under a concrete bridge in northern Ecuador, mirroring earlier observations of 'colonial nesting' by this species reported by Smith (1969); and for Cuban Emerald *Chlorostilbon ricordii* Regalado Ruiz (1998) found six nests, all with eggs, in very close proximity (some just 30 cm apart), in north-east Cuba. Clustering of nests has also been reported in Black-chinned Hummingbird *Archilochus alexandri* in south-east Arizona (Greeney & Wetherington 2009). In northern Chile, Estades *et al*. (2018) reported as many as 13–20 simultaneous nests of Chilean Woodstar *Eulidia yarrellii* during different breeding seasons (between 2006 and 2008) sited in a small (1.4-ha) olive grove, with multiple cases of nests in adjacent trees and five instances of two nests in the same tree, but inter-nest distances were not reported. In this case, it is clear that the habitat was unusually suitable for the species and its breeding, but also for the field workers to find nests, compared to the native vegetation surrounding the study site (Estades *et al*. 2018).

The novel data reported here suggest a degree of plasticity in the nesting ecology of *D. johannae*, e.g., willingness to accept man-made nest sites, echoing the detailed observations by Greeney *et al*. (2006) for *D. ludovicae*, but also those by Ramírez González & Arias García (1994). Given the number of nests of *D. johannae* sited on buildings reported via the online platform eBird in recent years, it appears that such acceptance may more easily enable studies of this still poorly known hummingbird in the future.

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