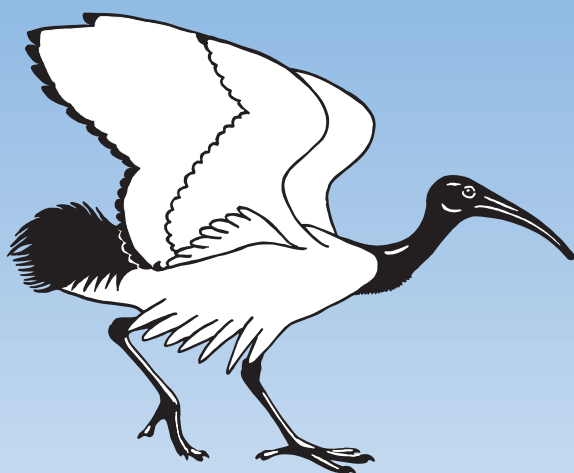


Bulletin of the British Ornithologists' Club



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Bulletin of the British Ornithologists' Club

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CLUB ANNOUNCEMENTS

Avian Odyssey 2025

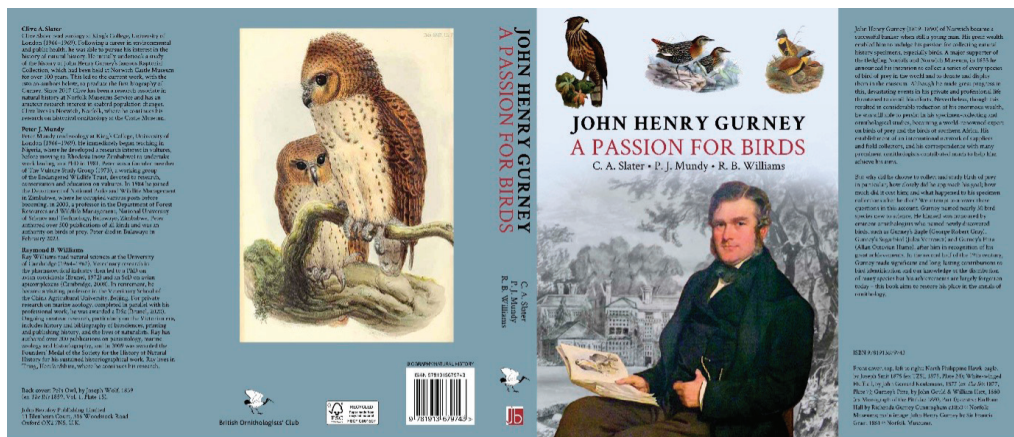
Avian Odyssey 2025, with frontline stories from global leaders in bird research, conservation and broadcasting, will take place on Saturday 20 September, starting at 10.00 h, in the Flett Theatre, Natural History Museum, Cromwell Road, London SW7 5BD. This significant collaboration with the Natural History Museum and leading conservation charities and NGOs will be a diverse day focused on inspiring everyone with the wonder of birds. Full information and registration details for both in-person attendance and online streaming are here: <https://www.nhm.ac.uk/our-science/study/events/british-ornithologists-club-annual-meeting.html>

New book

The Club is also delighted to announce the September publication of *John Henry Gurney: a passion for birds* by Clive Slater, Peter Mundy and Raymond Williams, and edited on behalf of BOC by Robert Prŷs-Jones.

The book details the life of John Henry Gurney (1819–90) who became a successful banker when still young. His wealth enabled him to indulge his passion for collecting natural history specimens, especially birds. A major supporter of the fledgling Norfolk and Norwich Museum, in 1853 he announced his intention to collect a series of every species of bird of prey in the world, and to donate them to the museum for display. Unfortunately, devastating events in his private and professional life threatened to derail his efforts. Nevertheless, he persisted in his specimen collecting and ornithological studies, and became a world-renowned expert on birds of prey and the birds of southern Africa. Gurney named nearly 30 bird species new to science and had several species named after him, perhaps most memorably the Critically Endangered Gurney's Pitta *Hydromis gurneyi*. He made significant and long-lasting contributions to bird identification and our knowledge of the distribution of many species. But why did he choose to collect and study birds of prey in particular; how closely did he approach his goal; and how much did it cost him? This book attempts to answer these questions.

John Henry Gurney: a passion for birds will be published by John Beaufoy Publishing in association with the British Ornithologists' Club in September 2025. ISBN: 9781913679743. £39.99 hardback, 472 pages, 135 illustrations. Copies are available for pre-order from NHBS: <https://www.nhbs.com/john-henry-gurney-book>.



Seeking a new Chairperson

The British Ornithologists' Club (<https://boc-online.org/>) was founded in 1892 and is devoted to the study of avian systematics and species distribution, worldwide. It endeavours to promote the importance of avian taxonomy, both as an end in itself and as baseline information to drive efforts in avian science, conservation, and the promotion of biodiversity. It holds quarterly meetings including talks on birds followed by social suppers, often in collaboration with the Linnean Society of London and the Natural History Museum, London. It publishes the online journal, the *Bulletin of the British Ornithologists' Club*, and a series of checklists of various countries, as well as other occasional publications. It is a Charitable Incorporated Organisation.

The Club is seeking a new Chairperson to join the established team of Trustees from January 2026. The role is fully supported by the Club's secretary, Treasurer, Bulletin Editor, Meetings Secretary, and Webmaster. The main tasks are to organise and chair Trustee meetings, and work with the other Trustees to further the aims and work of the club. In addition, other tasks include: developing financial strategy and reporting in collaboration with the Club's Treasurer, preparing the Club's Annual Report, liaison with other institutions, signing official documents, oversight of the Hon. Editor, oversight of Club Announcements in collaboration with the Hon. Editor and Webmaster, oversight of the Club's arrangements with its online provider for the Bulletin, and data protection officer.

There is no stipend for the post, but legitimate expenses will be covered. In the first instance, interested parties should contact the Club Secretary, Andrew Richford, at andysrichford@gmail.com.

Friends of the BOC

The BOC has since 2017 become an online organisation without a paying membership, but instead one that aspires to a supportive network of Friends who share its vision of ornithology—see: <http://boc-online.org/>. Anyone wishing to become a Friend of the BOC and support its development should pay UK£25.00 by standing order or online payment to the BOC bank account:

Barclays Bank, 16 High Street, Holt, NR25 6BQ, Norfolk

Sort Code: 20-45-45

Account number: 53092003

Account name: The British Ornithologists' Club

Friends receive regular updates about Club events and are also eligible for discounts on the Club's Occasional Publications. It would assist our Treasurer, Richard Malin (e-mail: rmalin21@gmail.com), if you would kindly inform him if you intend becoming a Friend of the BOC.

The *Bulletin* and other BOC publications

Since volume 137 (2017), the *Bulletin* of the BOC has been an online journal, published quarterly, that is available to all readers without charge. Furthermore, it does not levy any publication charges (including for colour plates) on authors of papers and has a median publication time from receipt to publication of five to six months. Prospective authors are invited to contact the *Bulletin* editor, Guy Kirwan (GMKirwan@aol.com), to discuss future submissions or look at <http://boc-online.org/bulletin/bulletin-contributions>. Back numbers up to volume 136 (2016) are available via the Biodiversity Heritage Library website: www.biodiversitylibrary.org/bibliography/46639#/summary; vols. 132–136 are also available on the BOC website: <http://boc-online.org/>

BOC Occasional Publications are available from the BOC Office or online at info@boc-online.org. Future BOC-published checklists will be available from NHBS and as advised on the BOC website. As its online repository, the BOC uses the British Library Online Archive (in accordance with IZCN 1999, Art. 8.5.3.1).

The ambiguous identity of *Muscicapa trailli* Audubon, and a neotype designation for Willow Flycatcher *Empidonax traillii* (Tyrannidae)

by Matthew R. Halley 

Received 1 October 2024; revised 15 July 2025; published 1 September 2025

<http://zoobank.org/urn:lsid:zoobank.org:pub:4DF99AF3-FBC3-4416-9266-629F11430504>

SUMMARY.—In 1973, a composite species long known as Traill’s Flycatcher *Empidonax traillii* (Audubon, 1828) was split into two morphologically similar species, diagnosed primarily by vocal (song) characters: Willow Flycatcher *E. traillii* (Audubon) (‘Fitz-bew’) and Alder Flycatcher *E. alnorum* Brewster, 1895 (‘Fee-bee-o’). Application of the name *E. traillii* to the Willow Flycatcher, after the split, has been (and remains) disputed. The holotype (the subject of Audubon’s Plate 45) was a male collected on 17 April 1822, in Arkansas, USA, where *E. traillii* and *E. alnorum* co-occur during spring migration. There is no evidence that Audubon preserved the bird, and there is circumstantial evidence that he did not. Audubon’s holotype (male) was supposedly a breeder (not a migrant), despite the early date, because it associated with a female whose ovary was in an advanced stage of development (also not preserved). This reflects a misreading of Audubon’s account, and a misunderstanding about ovarian anatomy and development. Furthermore, some ‘types’ promoted by 20th century authors lacked valid claims to such status, and some authors (notably those who assembled evidence to support the split), led astray by a false type, applied the name *E. traillii* to the Alder Flycatcher. Here, to resolve two centuries of instability, I review the case and designate a data-rich neotype that preserves the modern usage of the name *E. traillii* (Audubon), fixing it to the Willow Flycatcher.

The ‘Traill’s Flycatcher’ complex comprises two morphologically similar species, Willow Flycatcher *Empidonax traillii* (Audubon, 1828) and Alder Flycatcher *E. alnorum* Brewster, 1895, which were confounded under the name *E. traillii* (Audubon) until the mid-20th century (e.g., AOU 1895: 88, Ridgway 1907: 556, Hellmayr 1927: 208, Phillips 1948). Both species are long-distance migrants that typically vacate the USA during the non-breeding season (e.g., Gorski 1971, Paxton *et al.* 2011, Areta *et al.* 2016). The split was adopted by the North American Check-list Committee (NACC) of the American Ornithologists’ Union (AOU), chaired by Eugene Eisenmann (1906–81), in April 1973, after four decades of innovative field studies of vocal behaviour,¹ which implied that the broadly sympatric ‘songforms’ now known as Alder Flycatcher (‘Fee-bee-o’) and Willow Flycatcher (‘Fitz-bew’) are reproductively isolated sister species (Stein 1954, 1958, 1963, Gorski 1969, Eisenmann *et al.* 1973). Ever since, that hypothesis has found broad support in

¹ The discovery of *E. traillii* and *E. alnorum* in syntopy during the breeding season, which precipitated the recognition of two species, is attributed to Roger Tory Peterson (1908–96), who found both ‘songforms’ at a breeding site near Jamestown, Chautauqua county, New York, in June 1931 (Stein 1963: 21, Kaufman 2024: 355). In the Carnegie Museum of Natural History, Pittsburgh (CM), there are three specimens of *E. alnorum* (CM P162460–62) and two specimens of *E. traillii* (CM P162463, P162464) that were collected by Peterson in Chautauqua county in June 1931, with label annotations reading ‘3-syllable song’ and ‘2-syllable song’, respectively. A third *E. traillii* specimen (‘2-syllable song’), collected by Peterson on 7 June 1931, is at the Cleveland Museum of Natural History (CMNH 13446).

genetic, developmental and behavioural studies (e.g., Zink & Johnson 1984, Kroodsmas 1984, Prescott 1987, Seutin & Simon 1988, Winker 1994, Johnson & Cicero 2002, Bramwell 2019, Bemmels *et al.* 2021, but see Shields *et al.* 1987).

However, there are inconsistencies in Audubon's (1831) text, which have been debated but not resolved, threatening nomenclatural stability (e.g., Brewster 1895, Oberholser 1918, Phillips 1948, Aldrich 1951, Stein 1963, Browning 1993). The new species first appeared on Pl. 45 of *The birds of America* (1828), accompanied by the name 'Muscicapa trailli' (with one i). This was apparently a simple spelling error, which Audubon (1831) self-corrected, because other eponymous names that he published in his early plates used the double-i convention (e.g., *Muscicapa bonapartii* Audubon, 1827 [Pl. 5]; *M. selbii* Audubon, 1827 [Pl. 9]; and the fraudulent *Falco washingtonii* Audubon, 1828 [Pl. 11], see Halley 2020). However, although the corrected binomen (*traillii*) has been widely used since Audubon (1831), the plate (Audubon 1828) holds priority for nomenclatural purposes (Stone 1906: 303): 'Forty-seven new specific names occur on the plates, and should date from them and not from the [*Ornithological biography*].' Thus, the species was based on a single male (holotype), as depicted in Pl. 45 (Audubon 1828). For the remainder of this paper, I use the amended spelling (*traillii*) and recognise the priority of Audubon (1828).

With respect to the split of the taxonomic composite, Eisenmann (1970: 108) stated: 'For reasons to be detailed elsewhere, I believe that (regardless of specific or subspecific status) Audubon's name *traillii* belongs to the Arkansas prairie [breeding] population, which is a ['Fitz-bew'] vocalizer, and *alnorum* Brewster to the northern ['Fee-bee-o'] singers.' Notably, as Eisenmann (1970) recognised, this opinion conflicted with Aldrich (1951) and Stein (1963), who applied the name *E. traillii* to the Alder Flycatcher based on a provenance-deficient specimen designated (invalidly, see below) as a lectotype by Oberholser (1918) and Phillips (1948). Despite this disagreement, NACC concluded that Audubon's type was 'not preserved' and applied the name *M. traillii* to the Willow Flycatcher, based on the (erroneous, in retrospect) conjecture that 'Audubon named *traillii* on the basis of an apparently mated pair (not preserved), taken ... where only the "Fitz-bew" song-type breeds' (Eisenmann *et al.* 1973: 416).

Here, I review the material basis of *M. traillii* and use modern specimens to reassess the veracity of Eisenmann *et al.*'s (1973) claims. The first, that the taxon was based on a 'pair' of specimens (i.e., male and female syntypes), is obviously incorrect because only one bird (the male holotype) appeared on Pl. 45, pre-dating Audubon's (1831) narrative by three years (Stone 1906: 306). The second conjecture, that *M. traillii* was based on material collected 'where only the "Fitz-bew" song-type breeds' (Eisenmann *et al.* 1973), was apparently based on a misinterpretation of Audubon's (1831) account. This requires some explanation. In the following section, I review historical sources and discuss my own dissection of a female *E. traillii*, collected during the early laying period, to correct a long-standing misconception about ovarian development in this species.

The material basis of Traill's Flycatcher

Audubon's intaglio prints ('plates') were distributed in sets ('numbers') of five, because of the large size of the double-elephant folio paper, with Pl. 45 in the ninth set, published in 1828 (Fig. 1, see Corning 1969: 67–71). Audubon's original artwork, which was engraved for Pl. 45, bears the following signed annotation: 'No 9. Plate 45.— / Fort of Arkansas[,] April 17th 1822 / John. J. Audubon' (Fig. 2, N-YHS 1863.17.45). The location refers to the fortified 'Arkansas Post' settlement on the Arkansas River, c.47 km by boat, upstream of its confluence with the Mississippi River (Arnold 2017), and about 402 km upstream of



Figure 1. Cropped view of Pl. 45 of *The birds of America*, showing the iconotype of *Muscicapa trailli* Audubon, 1828, with the plate caption inset. Reproduced courtesy of the John James Audubon Center at Mill Grove in Audubon, PA, and the Montgomery County Audubon Collection.



Figure 2. Cropped view of Audubon's original artwork for Pl. 45 (N-YHS 1863.17.45), showing the iconotype of *Muscicapa trailli* Audubon, 1828, and its various annotations. The appearance of the name '*Muscicapa palustris*' confirms that Audubon decided to name the species after Thomas Stewart Traill (1781–1862) retroactively (i.e., several years after the drawing was made). Reproduced courtesy of the New-York Historical Society; digital image created by Oppenheimer Editions.

Audubon's home (as of March 1822) near Natchez, Mississippi. He made the long journey by steamboat (Arthur 1937: 250).

By December 1820, about one year before Audubon's trip to Arkansas Post, he had 'determined Never to draw from a Stuffed Specimen, [and] Carried No Skins' (Corning 1929: 61). Audubon's diary from 1822–24, which covered the period of this trip, was destroyed by his granddaughter in 1895 (Arthur 1937: 243, Halley 2022). There is no evidence that Audubon preserved his specimens from Arkansas Post, and Eisenmann *et al.* (1973) concluded that the specimens were 'not preserved' when they split the species (see Browning 1993). Other than the annotated artwork (N-YHS 1863.17.45), the only source of

information about the holotype is Audubon's (1831) text. There, we learn that he observed the male (holotype) with a female (no type status), which he also collected, but apparently did not preserve; and he presumed they were a mated pair. Audubon (1831: 236) wrote:

'The pair chased the insects as if acting in concert, and doubtless had a nest in the immediate neighbourhood, although I was unable to discover it. It being in the month of April, I suspected the female had not begun to lay. Five of the eggs in the ovary were about the size of green pease.'

Here, we encounter the paradox that has long puzzled ornithologists. Audubon's (1831: 236) statement about the female's ovary ('Five of the eggs ...') has been widely accepted as evidence that his male and female were a breeding pair (e.g., Eisenmann *et al.* 1973), and that the female had 'developing eggs nearly ready for nest disposition' (Holimon & James 2003: 81). However, James & Neal (1986: 9) noted that '[17 April] is well before the earliest [spring] migration arrival date [for *E. traillii*] in Arkansas ever reported, [and seemingly too early] in the season to show indications of nesting and egg laying.' The status of Audubon's specimens is critical because both species occur in Arkansas during spring migration, but only Willow Flycatcher remains to breed (Holimon & James 2003). There is no evidence that the migratory or breeding phenology of *Empidonax* flycatchers has dramatically shifted over two centuries (Stone 1913). Therefore, ornithologists have either assumed that Audubon's birds were Willow Flycatchers that 'arrived and bred earlier than the average for the species' (e.g., Phillips 1948, Eisenmann *et al.* 1973, Browning 1993: 242–243), or that they were migrants (non-breeders) and therefore unidentifiable (e.g., Aldrich 1951). This conflict appears to stem from a misunderstanding about the development of the ovarian follicles.

In *E. traillii*, like many other birds, females lay one egg per day until clutch completion (usually 3–4, rarely five), and their shelled eggs are 18.15×13.64 mm on average, as calculated from a sample of preserved specimens ($n = 78$ eggs from 21 clutches) in the Western Foundation of Vertebrate Zoology, Camarillo (Sedgwick 2020). The female's body can only accommodate one shelled egg at a time, because of the anatomy of the oviduct (i.e., lack of space), and accordingly the ovarian follicles do not develop all at once. Their growth proceeds in a sequence that mirrors the eventual laying sequence, resulting in what Holmes *et al.* (2003) have termed a 'graded size hierarchy'.

The size hierarchy is amply demonstrated by DMNH 85887, an adult female *E. traillii* that I collected on 14 June 2024, which had two ovarian follicles (unshelled) in advanced stages of development and a freshly convoluted oviduct (c.4 mm wide), evidence that she had recently laid an egg. Based on this, there is a high probability that she was collected on the first or second day of her laying period, shortly after she deposited an egg in an unlocated nest, probably between 04.00 h (one hour before dawn) and 06.30 h (when she was collected). Her largest ovarian follicle, which would have been laid as a shelled egg the following morning (15 June), measured 7.06×6.57 mm with digital callipers—about the size of a garden pea (*Lathyrus oleraceus*), which are 5–8 mm in diameter when full grown (POWO 2024). However, the second largest follicle, which was presumably 'scheduled' for 16 June, measured only 3.93×3.67 mm, and the third and fourth were progressively smaller (1–2 mm²) and less differentiated from the background (granular) texture of the ovary (Fig. 3).

In *E. traillii*, during the laying period, because of the size hierarchy among the ovarian follicles, there is no time when 'Five of the [follicles are] about the size of green pease' (Audubon 1831: 236). Audubon's (1831) comment implies that the follicles of his female specimen were approximately the same size (non-differentiated), which can only mean

Prep # P 10586 Catalog # 85887 ☐ salvaged ☒ collected ☐ TSBR net prep types ☒ study skin ☒ wing R (L) ☐ skeleton ☐ stomach ☐ vocal tract ☒ blood slide ☐ FTA card ☐ parasites ☐ photo ☐ audio rec. Tissues ☐ brain ☒ muscle ☐ liver ☐ heart ☒ blood x2 on FTA	Species: <i>Empidonax traillii</i> Collector: Matthew R. Halley Field #: 1 Locality: USA: Delaware: New Castle: C&D Canal Wildlife Area: Reedy Point Date: 14 June 2024 Age: (Ad) Imm. Juv. Unk. Bursa: none Skull: 100% Days in rehab: — Sex: Male (Female) Unk. Gonads: Ovary - largest ovum 7.06 x 6.57 mm, 2 orange - unlabelled 2nd largest: 3.93 x 3.67 mm } yellow 3rd and 4th largest are progressively smaller 4.62 x 1.1 mm Ethyl Acetate? (Yes) No Parasites: none found Muscle (0-3): — Body mass: 13.1522 g Fat: little Heart mass: 0.1303 g Wingspan: 211 mm Tail length: 55 mm Skull width: 13.67 mm Wing length (L): 66 mm Kipp's D (L): 16.31 mm Tarsus (L): 16.12 mm Eye mass (L): 0.2077 g Eye width (L): 8.77 mm Cornea width (L): 4.06 mm Wing length (R): 66 mm Kipp's D (R): 16.97 mm Tarsus (R): 16.24 mm Eye mass (R): 0.2058 g Eye width (R): 8.89 mm Cornea width (R): 4.32 mm Stomach contents (SC): _____ SC Mass: _____ Molt / General condition: Some molt on shoulders neotype candidate? Preparator: Matthew R. Halley (618) Prep date: 20 September 2024 Washed w/ soap: (Yes) No	probably laid an egg right before collected here. Day 1 of laying period?
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Figure 3. Original data form used by the author (MRH) during preparation of DMNH 85887, the neotype of *Empidonax traillii* (Audubon), on 20 September 2024 (Matthew R. Halley)

that she was not in breeding (laying) condition. Rather, the non-differentiated follicles and the early date (17 April) both suggest that Audubon's female was a migrant—not a breeder. This is critical because the presumed breeding status of the male (holotype) has always hinged on its association with the breeding female. Audubon did not comment on the size of its testes or seminal vesicles, possibly because they were not enlarged. With no evidence that the unpreserved holotype was a breeder, we must conclude that it too was a migrant, and therefore unidentifiable. We cannot be certain that the holotype was a Willow Flycatcher, as current nomenclature implies, or even that Audubon's male and female were the same species.

Unmasking the false types

Around the turn of the 20th century, American ornithologists seeking to retain and stabilise the nomenclature of their predecessors, and/or to secure types for their home institutions, often attributed type status to data-deficient specimens with insufficient details of provenance (e.g., Stone 1899, Faxon 1915, Bangs & Penard 1919; see Halley 2019, 2021, 2025). With respect to the supposed type(s) of *M. traillii*, Brewster (1895) wrote: 'Fortunately three of Audubon's specimens, given by him many years ago to Professor [Spencer] Baird [1823–87] and labeled by Mr. [Robert] Ridgway [1850–1929] as the types of *E. traillii*, are preserved in the National Museum [of Natural History, Smithsonian Institution, USNM]. They are numbered respectively [USNM] 960, 1865 and 2039.' Ridgway (1907: 556) likewise stated that the 'types [were in the] coll. U. S. Nat. Mus.' Oberholser (1918) noted that two of the specimens mentioned by Brewster (1895)—USNM 2960 ('960' was a typo) and 2039—had been collected by John K. Townsend (1809–51) and therefore could not be types. Then, he argued that USNM 1865 and 1866—the latter specimen overlooked by Brewster (1895)—were 'the original specimens collected by Audubon near the Arkansas River' (Oberholser

1918: 90), and that ‘in size and color the one now marked [USNM] No. 1865 ... is found to agree substantially with Audubon’s [1831] original description, [so] it may reasonably and properly be considered the type.’ Phillips (1948: 509) agreed and, to erase doubt, explicitly selected USNM 1865 as the ‘lectotype’ of *E. traillii*, after which Deignan (1961: 284) listed it in his USNM type catalogue.

However, the provenance of USNM 1865 is questionable, despite its confirmed association with Audubon. Baird obtained it from Audubon in late February or early March 1845, at the same time as USNM 1866, then catalogued them together in the USNM ledger (p. 73) immediately upon his return to Washington (Fig. 4). By this time, Baird was a leading authority on tyrant flycatcher systematics in the USA, having recently described Least Flycatcher *E. minimus* (Baird & Baird, 1843) and Yellow-bellied Flycatcher *E. flaviventris* (Baird & Baird, 1843). Notwithstanding, in the ledger, he gave no indication that USNM 1865 and 1866 were collected by Audubon in Arkansas in 1822, nor did Baird *et al.* (1858: 193–194) list or mention the specimens in their published account of *E. traillii* (which appears to have been based primarily on *E. alnorum* specimens, see Stein 1963: 46), even though they had ample opportunity and cited Audubon as the taxonomic authority. This implies that Baird did not consider USNM 1865 to be Audubon’s illustrated specimen.

Audubon’s (1839: 426) statement that ‘Many specimens of this Flycatcher have been procured by Mr. Townsend about the Columbia River, several of which are still in my possession’, may refer to the specimens that later became USNM 1865 and 1866. This hypothesis fits the general pattern, because most of the birds that Baird obtained from Audubon in 1845, according to the USNM ledger, were either from Townsend’s western travels (1834–37) or Audubon’s own 1843 Missouri River expedition (Fig. 4). Whereas, during his early career (i.e., around the time when he encountered the Arkansas birds), Audubon admittedly ‘Carried No Skins’ (Corning 1929: 61). As Browning (1993: 243–244) noted, ‘USNM 1865 is nomenclaturally important only if the specimen can be associated with Audubon and his description of *E. traillii*’—which it cannot be. Phillips’s (1948) ‘lectotype’ designation, like Oberholser’s (1918) less-explicit mention of ‘the type’, was invalid from the outset because it was based solely on unsubstantiated speculations about a data-deficient specimen (ICZN 1999, Art. 74.2).

Notwithstanding, for a time, ornithologists proceeded as if the lectotype designation was valid. Aldrich (1951: 194) identified USNM 1865 as ‘a migrant of the breeding population of the northern and eastern boreal region’ (i.e., Alder Flycatcher), and Stein (1963: 46), after plotting measurements of USNM 1865 against a sample of specimens of known song type, concurred: ‘[USNM 1865] should be considered a Fee-bee-o’ (Alder Flycatcher). However,

1864	<i>Parus carolinensis</i>		1843. Missouri river.	Mr. Audubon.
5	<i>Tyrannula traillii</i>			"
6	"			"
7	<i>Guiraca melanocephala</i>	♂	1843. Fort Union	
8	"	♀	"	
9	<i>Picus harrisii</i>	♀	Sept. 1834. Columbia Riv.	Mr. Townsend
1870	<i>Tyrannus verticalis</i>	ad.	June 1843. Fort Union	

Figure 4. Digital scan of the USNM ledger, in which Baird entered two data-deficient specimens of ‘*Tyrannula traillii*’ (USNM 1865 and 1866) obtained from ‘Mr. Audubon’. The specimens were catalogued at the same time as other material obtained from Audubon, in early 1845, primarily originating from Townsend’s western expedition (e.g., USNM 1869 from ‘Columbia Riv.’) and Audubon’s 1843 Missouri River expedition (e.g., USNM 1864 from ‘Missouri river’ and USNM 1867 and 1870 from ‘Fort Union’). Reproduced courtesy of the Smithsonian Institution, Division of Birds.

as discussed above, when Eisenmann *et al.* (1973) split the species, they concluded that Audubon's specimens were 'not preserved' (i.e., rendering the identification of USNM 1865 irrelevant, see Browning 1993), then applied the name *M. traillii* to the Willow Flycatcher (*contra* Aldrich 1951 and Stein 1963). Audubon's (1831: 236) description of the bird's voice ('wheet, wheet'), which does not match the typical advertising song of either species, could arguably match the 'flight song' of *E. traillii* described by McCabe (1951), but this cannot be stated with certainty. Browning (1993: 243) conceded: 'Because the holotype of *traillii* is lost ... it is not possible to prove that Audubon's birds were Willow Flycatchers.'

Neotypification of *Empidonax traillii* (Audubon, 1828)

Despite authoritative statements like '[*E.*] *traillii* clearly pertains to [Willow Flycatcher] and has priority' (AOU 1983: 452, 1998: 395), the identity of *M. trailli* Audubon, 1828, is ambiguous because it was based on a holotype reportedly collected during the spring migration in Arkansas, where both Alder and Willow Flycatchers occur (see above). There is no evidence that Audubon's birds were breeding and his comment about the female's reproductive development has been widely misconstrued. The holotype is not extant or traceable, nor is the female mentioned by Audubon (1831), and probably neither was preserved (see above).

Therefore, to fix the taxonomic identity of *M. trailli* Audubon, 1828, in accordance with prevailing use, I hereby designate a neotype: DMNH 85887 (the same breeding female mentioned above), preserved at the Delaware Museum of Nature & Science, Wilmington, DE (Fig. 5). This action stabilises nomenclature and prevents confusion arising from alternative identifications, by fixing the name to the eastern subspecies of Willow Flycatcher (*E. traillii traillii*), as unanimously recognised by modern checklists (Dickinson & Christidis 2014, Clements *et al.* 2023, HBW & Birdlife International 2024, Gill *et al.* 2024). This action clarifies the taxonomic application (status) of the name (Art. 75.3.1), describes, illustrates and references the defining characters of *E. traillii* (Audubon) and its neotype (Art. 75.3.2),



Figure 5. DMNH 85887, the neotype of *Muscivora traillii* (Audubon). Preserved blood slides, frozen muscle tissue, and stomach not shown; see text for provenance (Matthew R. Halley)

provides data sufficient to ensure recognition of the neotype specimen (Art. 75.3.3), provides grounds for believing that all original type material has been lost and is untraceable (Art. 75.3.4), shows that traits of the neotype are included in the original description (Art. 75.3.5); and the specimen is deposited in a recognised institution (Art. 75.3.7).

Choice of type locality.—Most ornithologists now recognise one subspecies of Willow Flycatcher in eastern North America (*E. t. traillii*), west to Minnesota, although breeding specimens from southern Ontario and Quebec are reportedly ‘paler and greener on the back, and with paler crown and cheeks than *traillii*’ (Browning 1993, Sedgwick 2020) and have been separated by some authors as *E. t. campestris* Aldrich, 1951. In selecting a neotype for *E. t. traillii*, it would be wise to avoid areas of overlap with *E. t. campestris*. Audubon’s type locality is not advisable because intergrades (apparent hybrids) between *E. t. traillii* and *E. t. campestris* have been reported in Arkansas (Browning 1993). It would also be unwise to select a specimen from the north-eastern portion of the *E. t. traillii* breeding range, because the range boundaries of the taxa are unclear (Sedgwick 2020). Finally, considering the ambiguities that arose in Audubon’s case, a breeding specimen would be preferable to one collected at a stopover site. Given these circumstances, the selection of a data-rich specimen (DMNH 85887) from the Mid-Atlantic breeding population (Delaware), located unambiguously in the range of *E. t. traillii* (i.e., south of the breeding range of *E. alnorum* and distant from the disputed boundary with *E. t. campestris*) will reduce ambiguity and promote stability (ICZN 1999, Art. 75.3.6).

Collection of the neotype.—I collected DMNH 85887 on the west bank of the Delaware River, near its confluence with the Chesapeake and Delaware (C&D) Canal, at a site called Reedy Point, C&D Canal Wildlife Area, Delaware (39°33′16.49952″N, 75°34′36.95376″W). The habitat at the type locality is an occasionally inundated, brackish floodplain with swampy vegetation and a long history of colonial and industrial disturbance. The breeding range of Willow Flycatcher evidently expanded eastward to the Atlantic seaboard in the 20th century (Phillips *et al.* 1966, Hess *et al.* 2000).

I arrived at 05.15 h, on the morning of 14 June 2024, and erected mist-nets in a swampy area where multiple *E. traillii* were singing. No other *Empidonax* species was expected or encountered (www.ebird.org checklist S196783863). At 06.30 h, about 15 minutes after opening the nets, I captured two *E. traillii* adults in the same net panel, which (upon dissection) turned out to be male and female (presumably a mated pair). I drew approximately 50 µL of blood via brachial venipuncture from each bird into microhematocrit capillary tubes, then smeared blood droplets on two glass slides (per bird) and fixed them in pure methanol. I also placed some blood droplets on an FTA card and stored it in a zipped plastic bag with silica beads (desiccant). I took digital photos (e.g., Fig. 6), euthanised the birds via cardiac compression, placed them in individual plastic bags with small pieces of cotton soaked in ethyl acetate, then transported them on ice to a DMNH storage freezer (−20°C). The male (DMNH 85888), which had enlarged testes—left: 8.59 × 4.62 × 3.82 mm (callipers), 0.0981 g (scale); right: 7.92 × 4.69 × 4.29 mm (callipers), 0.0907 g (scale)—has no name-bearing status but is nevertheless notable for its association with the neotype, and might be considered as a sort of allotype (or ‘alloneotype’).

Preparation of the neotype.—I prepared the study skin and sampled tissues on 20 September 2024 (Fig. 3, prep. = MRH618). The bird showed some signs of moult on the shoulders. No parasites were found, despite ethyl acetate fumigation and ruffling of each feather tract. The following measurements were taken, as noted, with a digital scale to the nearest 0.0001 g (Denver Instrument Company, model TL104), a metric ruler to the nearest 1 mm, or digital callipers to the nearest 0.01 mm. Body mass was 13.1522 g with little fat (scale); heart mass was 0.1303 g (scale); max. wingspan was 211 mm (ruler); the flattened



Figure 6. DMNH 85887, neotype of *Muscivora traillii* (Audubon), taken at the type locality just prior to collection, on 14 June 2024 (Matthew R. Halley)

length of the closed wing, measured from the carpal joint to the tip of the longest primary, was 66 mm, for both left and right wings (ruler); wing chord (unflattened), taken from the closed right wing of the dried skin on 24 June 2025, was 66.5 mm; with the right wing (of the fresh, unprepared bird) closed, the distance between the tips of the longest primary and first secondary ('Kipp's distance', Kipp 1959) was 16.97 mm; and on the left side, Kipp's distance was 16.31 mm (callipers); the length of the tail, from the insertion point of the two central rectrices to the tip, was 55 mm (ruler); the max. width of the skull (temple to temple) was 13.67 mm (callipers); the lengths of the right and left tarsometatarsi, measured from the intertarsal joint to the end of the final leg scale, were 16.24 and 16.12 mm, respectively (callipers); the max. diameter of the right eye was 8.89 mm, with an aperture diameter of 4.32 mm (callipers); the max. diameter of the left eye was 8.77 mm, with an aperture diameter of 4.06 mm (callipers); the right and left eyes weighed 0.2058 and 0.2077 g, respectively (scale).

The ovary was enlarged with two follicles in an advanced stage of development. The largest follicle measured 7.06 × 6.57 mm, and the second largest 3.93 × 3.67 mm (callipers). Both were orange-yellow. The oviduct was c.4 mm wide and convoluted, indicating that the female had recently laid an egg (see above). The skull was 100% pneumatized and no bursa was found. The stomach was saved and refrozen for a forthcoming dissection. Samples of breast muscle were preserved in 95% ethanol (DMNH P10586) and placed in a storage freezer (−20°C). A backup tissue tube was deposited at the Academy of Natural Sciences of Drexel University (Philadelphia, PA).

Diagnosis.—*E. traillii* ('Fitz-bew') is morphologically similar to *E. alnorum* ('Fee-bee-o') and best distinguished by voice, especially in eastern North America. In size, *E. traillii* tends to have a larger bill and slightly shorter and more rounded wings, although the distributions of these characters are overlapping and can be obscured by sex and age. Discriminant function approaches using bill length and wing formulae are generally unreliable (Seutin 1991), although some wing and tail formulae may be used with caution (e.g., Stein 1963, Phillips *et al.* 1966, Hussell 1990, Pyle 1997). Pyle (2022: 265) concluded that the species should be 'separated with great caution' and 'Successful identification of Alder and Willow Flycatchers in the hand involves a synthesis of plumage characters, measurements, wing morphology by age and sex, consideration of geographic variation, and [even then] the use of a buffer zone in which birds should be left unidentified.' Indeed, most of the formulae used by Pyle (1997) failed to identify the neotype (DMNH 85887) and

TABLE 1

Wing and tail measurements taken from the neotype (DMNH 85887) and its likely mate (DMNH 85888), compared to 95% confidence intervals published by Pyle (1997: 149). All measurements are in mm. Measurements of the DMNH specimens were taken from the dried study skin with digital callipers (LP = longest primary; pp5–10 = primaries numbered following Pyle 1997; LS = longest secondary; TL = tail length as in Methods), except wing chord (WC) which was taken from the dried specimens using a metric ruler.

Variable	DMNH 85887	DMNH 85888	<i>E. traillii</i> (Pyle)	<i>E. alnorum</i> (Pyle)
LP-p6	4.72	4.19	1.8–5.2	3.8–7.4
P6-p10	1.91	3.14	1.4–6.4	-1.2–3.5
P9-p5	8.89	8.66	4.7–9.7	6.9–11.1
LP-LS	16.87	14.98	10.3–17.4	10.2–17.1
WC-TL	9.0	12.5	6.2–17.4	12.4–20.3

its likely mate (DMNH 85888) to species, except for the difference between the wing chord and tail length (WC-TL) of the neotype (9.0), which is a clear match to *E. traillii* (Table 1). In any case, the neotype’s identity is unambiguous because it was collected at a locality where only Willow Flycatchers breed (i.e., following the rationale of Eisenmann *et al.* 1973), and confirmed by the songs (‘Fitz-bew’) that guided the placement of my nets.

Acknowledgements

The neotype (DMNH 85887) and its likely mate (DMNH 85888) were collected under US Fish & Wildlife Service permit no. MBPER0036206 and Delaware Fish & Wildlife permit no. 2024-WSC-018. I am grateful to Ashley Kempken for fruitful conversations and for databasing the specimens. J. Mlíkovský and one anonymous reviewer made helpful comments on an early version of the manuscript.

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New breeding information on Brazilian birds. 3: Nyctibiidae, Caprimulgidae, Apodidae and Trochilidae

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SUMMARY.—This is the third publication in a series presenting novel breeding data for Brazilian birds based on field work in several regions of the country since the 1980s. We cover various aspects of breeding biology, including seasonality, nest architecture, materials and measurements, clutch size, egg morphology, incubation and nestling periods, and parental care. Many data are presented scientifically for the first time. Overall, information on 361 nests of 19 species is presented in this paper, namely two Nyctibiidae, three Caprimulgidae, one Apodidae and 13 Trochilidae: Great Potoo *Nyctibius grandis* (six nests), Common Potoo *N. griseus* (17 nests), Rufous Nightjar *Antrostomus rufus* (three nests), Common Pauraque *Nyctidromus albigollis* (21 nests), Spot-tailed Nightjar *Hydropsalis maculicaudus* (one nest), Lesser Swallow-tailed Swift *Panyptila cayennensis* (nine nests), Black Jacobin *Florisuga fusca* (12 nests), Rufous-breasted Hermit *Glaucis hirsutus* (31 nests), Reddish Hermit *Phaethornis ruber* (26 nests), Planalto Hermit *P. pretrei* (41 nests, rare behavioural observations of trochilid nestlings imitating stinging caterpillars), Black-eared Fairy *Heliophryx auritus* (two nests), Ruby-topaz Hummingbird *Chrysolampis mosquitos* (ten nests), Black-throated Mango *Anthracothorax nigricollis* (16 nests), Glittering-bellied Emerald *Chlorostilbon lucidus* (21 nests), Fork-tailed Woodnymph *Thalurania furcata* (six nests, with rare information on use of insect galls in bird nests), Long-tailed Woodnymph *T. watertonii* (60 nests, first complete data on breeding), Swallow-tailed Hummingbird *Eupetomena macroura* (38 nests), Versicoloured Emerald *Chrysura versicolor* (15 nests) and Glittering-throated Emerald *C. fimbriata* (26 nests).

We continue our series of publications on breeding information for Brazilian birds (see Studer & Crozariol 2022, 2023). In this third paper, we present data for 19 species: Great Potoo *Nyctibius grandis* ($n = 6$ nests), Common Potoo *N. griseus* ($n = 17$), Rufous Nightjar *Antrostomus rufus* ($n = 3$), Common Pauraque *Nyctidromus albigollis* ($n = 21$), Spot-tailed Nightjar *Hydropsalis maculicaudus* ($n = 1$), Lesser Swallow-tailed Swift *Panyptila cayennensis* ($n = 9$), Black Jacobin *Florisuga fusca* ($n = 12$), Rufous-breasted Hermit *Glaucis hirsutus* ($n = 31$), Reddish Hermit *Phaethornis ruber* ($n = 26$), Planalto Hermit *P. pretrei* ($n = 41$), Black-eared Fairy *Heliophryx auritus* ($n = 2$), Ruby-topaz Hummingbird *Chrysolampis mosquitos* ($n = 10$), Black-throated Mango *Anthracothorax nigricollis* ($n = 16$), Glittering-bellied Emerald *Chlorostilbon lucidus* ($n = 21$), Fork-tailed Woodnymph *Thalurania furcata* ($n = 6$), Long-tailed Woodnymph *T. watertonii* ($n = 60$), Swallow-tailed Hummingbird *Eupetomena macroura* ($n = 38$), Versicoloured Emerald *Chrysura versicolor* ($n = 15$) and Glittering-throated Emerald *C. fimbriata* ($n = 26$).

Methods

Background.—In May 1985, AS created the ‘NORDESTA Reforestation & Education Association’ (<https://nordesta.org/?lang=en>). She has been studying the breeding of

Brazilian birds for more than 40 years, principally in north-east Brazil, with notes and photographs of c.300 species in the field. MAC undertook a comprehensive bibliographic review of nests of Neotropical birds to understand nest evolution and species affinities, and was invited by AS to collaborate in the present series. Thus, most field observations were made by AS, and MAC prepared the texts and discussions.

Data collection.—All nests were found opportunistically between 1980 and the present. Once a nest was found, whenever possible it was monitored every 2–3 days. In some cases, camera traps were installed nearby. Nests were measured with a folding ruler or tape measure, as was the height of nests above ground (from the latter to the point where the nest was fixed or supported). Nest dimensions tend to change with use, but we had no means of standardising this, and measurements were taken opportunistically when the risk of stress to the occupants was deemed lowest. Eggs were measured using an analogue pachymeter and weighed with Pesola scales of different capacities according to the species. Incubation periods were calculated from the laying of the last egg until the first nestling hatched, and nestling periods from the hatching of the first nestling until the first young fledged. To minimise interference with birds' behaviour, observations on parental care were made using binoculars from a camouflaged portable hide. For some taxa, we analysed content on WikiAves (www.wikiaves.com.br/), with the date on which each such analysis was performed mentioned in the relevant account. When a nest was found with a nestling, its age was calculated through prior experience with other nests of the same or related species, and when the chick fledged we used the average time spent in the nest to calculate the age of the nestling on a given date.

Taxonomy and terminology.—For classification, taxonomy and systematic order, we follow the most recent list of the Comitê Brasileiro de Registros Ornitológicos (Pacheco *et al.* 2021). For species that do not occur in Brazil we follow *Birds of the world* (<https://birdsoftheworld.org/bow/home>). Possibly confusing terminology is explained at relevant points in the text; however, we rely mainly on the definitions in Campbell & Lack (1985), Erritzøe *et al.* (2007) and Straube *et al.* (2010). To describe nest type, we follow the nomenclature of Simon & Pacheco (2005). Egg colorations were based on Séguy (1936) and their shapes on Makatsch (1974). Plants were identified in the field or with the help of specialists, mainly via photos rather than collection of samples. Botanical and fungal taxonomy follows Forzza (2020). In describing nest materials, 'petiole' includes the mid-rib of the leaf.

Presentation of accounts.—Texts for each species follow the same sequence of a brief introduction, then the results/discussion. Introduction: geographic distribution and review of the literature describing each species' breeding in Brazil and elsewhere. Results: number of nests analysed in the text, locations and when these nests were found, breeding season, environment and height of nests above ground, nest substrate, measurements and classification, materials used, clutch size, egg morphology, incubation and nestling periods, development of nestlings/juveniles and, finally, specific observations at some nests. Note that not all nests used in each description are included in the tables as we were unable to obtain complete data for all of them, thus some discrepancies exist between the numbers of nests mentioned in the text and the tables. Breeding success and nest fate are not our focus but will be published elsewhere, given the relative lack of such data for the Neotropics. Here, we only present information concerning predators or other specific observations. The graphs indicate the date a nest was found when active, meaning they do not reflect nest stage, either with eggs or nestlings. For further details, see Studer & Crozariol (2022, 2023).

Results and Discussion

Family Nyctibiidae.—Potoos are endemic to the Neotropics, from Mexico and the Greater Antilles to northern Argentina, and reach peak diversity in Amazonia and other humid lowland forests (Winkler *et al.* 2020a), although there are only seven species and two genera in total (Costa *et al.* 2017, Winkler *et al.* 2020a). Five species occur in Brazil (Pacheco *et al.* 2021). Among the most interesting nocturnal birds in the world, their morphology permits them to perfectly camouflage their roost sites, mimicking vertical tree stumps on which they frequently perch. Potoos have two small slits in the upper eyelid, enabling the birds to observe their surroundings during the day, even with their eyes closed, conferring a certain advantage when nesting (Borrero 1974, Cleere & Nurney 1998). Their cryptic behaviour makes them one of the least-known families in terms of natural history (Sick 1997, Costa & Donatelli 2009, Winkler *et al.* 2020a).

GREAT POTOO *Nyctibius grandis*

The largest species of the family occurs from Mexico to the Pantanal, including throughout Amazonia, with a population in the Atlantic Forest, between Bahia and Rio de Janeiro (Sick 1997, Adams 2020), and a probable 17th-century record in north-east Brazil (Teixeira 1992). It prefers damp tall forests, commonly beside or near rivers, rarely in urban areas (Ribeiro & Vasconcelos 2003, Adams 2020). Few breeding data have been published, both from Brazil (Euler 1900, Sick 1951, 1997, Lopes *et al.* 2013, Pérez-Granados & Schuchmann 2020) or elsewhere (Haverschmidt 1948, Vanderwerf 1988, Haverschmidt & Mees 1994, Young & Zook 1999, Cisneros-Heredia 2006, Navarro *et al.* 2011).

Observations were made at six nests of *N. grandis*, found between 2009 and 2024, in the municipalities of Alto Parnaíba, Maranhão ($n = 2$), Gilbués, Piauí ($n = 3$) and Poconé, Mato Grosso ($n = 1$). We found four nests with eggs in August (Gilbués and Alto Parnaíba), one with an egg in November (Poconé) and one with a newly hatched chick in October (Alto Parnaíba), indicating that nesting occurs between late July and mid-November, coinciding with the general bird breeding seasons in these areas. In Brazil, Lopes *et al.* (2013) observed a juvenile in February in Minas Gerais, Sick (1997) a male incubating in July in Mato Grosso, and in the Brazilian Pantanal vocal monitoring suggests the species breeds from July–December, in the local dry season (Pérez-Granados & Schuchmann 2020). In Suriname, eggs have been found in February and chicks in June, October and November (Penard & Penard 1908, Haverschmidt 1948, Haverschmidt & Mees 1994). In Venezuela, there are records of an egg in March (Navarro *et al.* 2011) and chicks during June–August (Vanderwerf 1988). In Costa Rica, a chick was observed in April (Young & Zook 1999), in Colombia ‘nesting’ has been reported in March and April (Adams 2020) and in Ecuador in December (Cisneros-Heredia 2006).

Like other potoos, the species does not build a nest, which is of the ‘simple/unlined’ type. We found ‘nests’ in crevices on broken branches near the main trunk of large trees, such as *Hymenaea courbaril* (Fabaceae; $n = 2$), both 8 m above ground, *Qualea* sp. (Vochysiaceae; $n = 1$), 3.5 m above ground, *Copaifera langsdorffii* (Fabaceae; $n = 1$) at 6.5 m, and *Tabebuia* sp. (Bignoniaceae; $n = 1$) at 8 m. Other nests of the species were also found in large trees. Sick (1997) mentioned a nest 12 m above ground in a *Caryocar brasiliense* (Caryocaraceae), and in Costa Rica, a nest was 34 m high in a 44 m *Hernandia didymantha* (Hernandiaceae) (Young & Zook 1999). In Venezuela, a nesting branch was c.30 cm thick, with an angle of c.20°, but the laying site was level and slightly wider than the rest of the branch (Vanderwerf 1988). One of our crevices measured 3 cm in internal height and 10 cm in external diameter, another

was 2 cm in internal diameter and a third nest had an internal height of 4 cm and internal diameter of 7.5 cm.

Clutch was always one egg, white with a few brown dots of varying sizes, distributed randomly over the entire surface, although usually more concentrated near the blunt pole (Fig. 1). Two eggs at Gilbués measured 46.0×34.7 mm and 46.2×34.5 mm. Previous descriptions agree with our observations concerning coloration (Euler 1900, Sick 1951, Navarro *et al.* 2011, Adams 2020) but our eggs were smaller. For example, Euler (1900) reported size as 60×42 – 44 mm, Sick (1951) 52.1×38.3 mm and Navarro *et al.* (2011) 52×37 mm, the latter very similar to Cohn-Haft's report of 52×38 mm (Adams 2020). There are no other measurements to better understand this variation in size, which may be related to the variation in female size, age, or geographical region.

We could not determine the incubation period, which seems to be unknown for this species. However, in one nest at Gilbués, the egg was found on 25 August 2023 and the chick hatched only on 3 October, after 39 days. Between the first date and 10 September, the adult was seen at the nest only at night, but thereafter it stayed on the nest all day, perhaps explaining the long incubation. The nestling disappeared on 10 October.

Chicks hatch covered in white down, with a dark bill and grey feet that are proportionately quite large for the bird's size (Fig. 2). At six days old, the slits in the eyelids are already visible (Fig. 3) but, when hidden under the adult's feathers at this age, seeing the nestling is difficult. With time, pale grey feathers with brownish streaks appear, and the bird acquires a coloration similar to but paler than the adult (Fig. 4), as previously described (Wetmore 1968, Lopes *et al.* 2013).

We were unable to determine how long chicks stayed in the nest, which is unknown (Adams 2020), although a period of at least 55 days has been reported (Vanderwerf 1988).

At Alto Parnaíba, on 24 August 2010 at 18.15 h an incubating adult began to move slowly; it stretched its wing slightly, then started looking around. At 18.20 h, it flew off and landed on a broken branch <50 m away. From there, it flew again, caught some airborne prey and returned to the egg. On 25 September, the chick was ten days old and was being guarded by an adult. At 18.30 h, the latter took off and landed c.50 m from the nest. Shortly afterwards, one of the adults fed the chick (Fig. 5). Provisioning events were short, lasting just 10–15 seconds. On 3 October at 17.14 h, when it was still light, the adult had its bill half-open, revealing the pink mouth (Fig. 6). The young leaned against the adult, and both were calm, closing and opening their eyes. At 18.11 h, the nestling suddenly hid under the adult, with only its short tail visible. At 18.26 h, the nestling was again fully visible, and the adult had its bill half-open. At 18.35 h, the adult flew off and observations ceased.

At another nest, in Gilbués, first found on 25 September with a two-day-old chick, an adult and c.29-day-old chick were observed on 22 October 2009 between 16.10 and 19.10 h. Until 18.05 h when the adult left the nest, both individuals were quiet. The adult returned to the nest at 18.45 h and proceeded to feed the chick three times at 18.50 h, each feeding event lasting just a few seconds. On 28 October, between 17.45 and 18.15 h, both remained quiet with half-closed eyes. At 18.18 h the adult flew off, returning at 18.34 h, when it fed the nestling twice, by inserting its bill into the mouth of the young (Fig. 7). The same adult fed the chick several times between 18.47 and 19.45 h without leaving the nest in the interim. At 19.55 h, the adult flew off and our observations ended shortly afterwards. It is still unknown whether one or both adults feed the young (Adams 2020).

On 24 August 2024, at Gilbués, we found another an egg on a broken trunk of a *Copaifera langsdorffii*, but on our next visit on 26th the egg was broken. The adult remained on the nest with the broken egg until 29 August, when it was abandoned.



Figure 1. Egg of Great Potoo *Nyctibius grandis* in a nest, Gilbués, Piauí, Brazil, August 2023 (NORDESTA collection)

Figure 2. Three-day-old Great Potoo *Nyctibius grandis* nestling, Alto Parnaíba, Maranhão, Brazil, October 2020 (NORDESTA collection)

Figure 3. Adult and six-day-old nestling Great Potoo *Nyctibius grandis*, Alto Parnaíba, Maranhão, Brazil, October 2020; note the small palpebral slits already present in the nestling, which has three ants on its back (NORDESTA collection)

Figure 4. Adult and 20-day-old nestling Great Potoo *Nyctibius grandis*, Gilbués, Piauí, Brazil, November 2009 (NORDESTA collection)

Figure 5. Adult Great Potoo *Nyctibius grandis* feeding a ten-day-old nestling, Alto Parnaíba, Maranhão, Brazil, September 2020, showing the food bolus being transferred from the adult to the nestling (NORDESTA collection)

Figure 6. Adult and nestling Great Potoo *Nyctibius grandis*, showing the pink gape of the adult, Alto Parnaíba, Maranhão, Brazil, October 2010 (NORDESTA collection)

Figure 7. Adult Great Potoo *Nyctibius grandis* feeding a 35-day-old nestling, Gilbués, Piauí, Brazil, October 2009; the adult inserts its bill into that of the nestling (NORDESTA collection)

COMMON POTOO *Nyctibius griseus*

The most common and widely distributed potoo species, occurring from Nicaragua to Argentina and throughout Brazil. It occupies varied primary and secondary forest environments, including urban and peri-urban areas, where it will nest (Sick 1997, Cestari *et al.* 2018, Voudouris 2020, Mendonça *et al.* 2009). It is undoubtedly the best-known species in the family in terms of breeding, with multiple publications, both from Brazil (Euler 1900, Ihering 1900, 1914, Goeldi 1902, Santos 1938, 1942, Pinto 1953, Teixeira *et al.* 1983, Belton 1984, Sick 1997, Lopes & Anjos 2005, Buzzetti & Silva 2008, Mendonça *et al.* 2009, Corbo & Macarrão 2010, Cestari *et al.* 2011, Sazima 2011, Marini *et al.* 2012, Lopes *et al.* 2013, Maurício *et al.* 2013, Cestari *et al.* 2018, Nacinovic 2018, Pérez-Granados & Schuchmann 2020) and elsewhere (Fiebrig 1921, Muir & Butler 1925, Belcher & Smooker 1936, Haverschmidt 1958a, Wetmore 1968, Skutch 1970, 1983, Foster & Johnson 1974, Saibene 1987, Haverschmidt & Mees 1994, Tate 1994, Azpiroz 2001, Greeney *et al.* 2004, 2008, de la Peña 2011, 2019, Sánchez-Martínez & Yusti-Muñoz 2016, Moresco 2019).

We describe observations at 17 nests of *N. griseus*, found between 1986 and 2016 in Arcos, Minas Gerais ($n = 11$) and Quebrangulo, Alagoas ($n = 6$). In Quebrangulo, nests were found between April and September, and in Arcos between October and December (Table 1). Breeding, therefore, occurred at the start of the wet season or during the rains at both localities. Elsewhere in Brazil, breeding has been reported in October and December in São Paulo and the Distrito Federal (Corbo & Macarrão 2010, Cestari *et al.* 2011, Marini *et al.* 2012), December in Rio de Janeiro and Goiás (Teixeira *et al.* 1983, Mendonça *et al.* 2009, Nacinovic 2018), October–March in Paraná (Lopes & Anjos 2005) and January in Rio Grande do Sul (Lopes *et al.* 2013, Maurício *et al.* 2013), where a male with moderately enlarged testes was collected in November (Belton 1984). A well-grown nestling was seen in Araripe National Forest, Ceará, on 20 February 2023 (MAC).

Like other Nyctibiidae, the nest of *N. griseus* is the ‘simple/unlined’ type. It selects small depressions in trees, usually where a branch has broken off, small natural cavities in hollows, usually sloping (e.g. Fig. 8), or even man-made structures, such as atop fence posts (Fig. 9; Table 1). The landscapes where nests were found varied from open areas with sparse trees ($n = 12$), forest fragments ($n = 7$), forest edges or clearings ($n = 2$) to inside forest ($n = 1$). Sites were usually low, 2.3 ± 1.1 m above ground, with four on wooden fence posts (Table 1). The species often reused the same site annually, with the same nest used in three consecutive years at Arcos and another over the same period at Quebrangulo. The sites where eggs were laid measured 2.0 ± 0.5 cm ($n = 3$) in internal height, 4.5 ± 0.3 cm ($n = 1$) in external diameter and 3.3 ± 0.3 cm in internal diameter ($n = 2$) (Table 1). These data agree with the literature (Euler 1900, Muir & Butler 1925, Wetmore 1968, Saibene 1987, Tate 1994, Sick 1997, Lopes & Anjos 2005, Mendonça *et al.* 2009, Sánchez-Martínez & Yusti-Muñoz 2016).

The species always lays a single-egg clutch. Eggs are white to pale buff, with numerous small brown, dark mauve and light mauve spots over their entire surface but more concentrated at the blunt pole (Fig. 9). They were elliptical and measured $41.1 \pm 1.7 \times 29.7 \pm 0.9$ mm ($n = 6$); mass 20.1 ± 2.6 g ($n = 5$) (Table 2). Eggs are sometimes larger than the internal height of the chosen site so that part of the egg is visible above the side of the niche (Fig. 8) as Skutch (1970) noted. Egg morphology aligns with prior descriptions (Euler 1900, Wetmore 1968, Sick 1997, Lopes & Anjos 2005, Mendonça *et al.* 2009, Cestari *et al.* 2011, Sánchez-Martínez & Yusti-Muñoz 2016). Smaller eggs, however, have been reported (Muir & Butler 1925, Pinto 1953, Haverschmidt 1958a, Saibene 1987). It is worth emphasising that very few egg mass data are available for *N. griseus*. Santos (1942) reported that the species

TABLE 1
Measurements of Common Potoo *Nyctibius griseus* nests found at various sites in Brazil, including their height above ground. NM = not measured; NI = not identified.

Locality	Date found	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Height above ground (m)	Construction site
Arcos/MG	5 Oct 1988	NM	NM	NM	2.2	<i>Myracrodruon urundeuva</i>
Arcos/MG	29 Nov 1988	2.0	NM	NM	1.3	<i>Anadenanthera falcata</i>
Arcos/MG	7 Nov 1989	NM	NM	NM	0.6	<i>Solanum lycocarpum</i>
Arcos/MG	5 Nov 1991	NM	NM	NM	2.1	<i>Sapium glandulatum</i>
Arcos/MG	15 Nov 1993	2.5	4.5 × 4.0	3.5	2.2	<i>Rapanea gardneriana</i>
Arcos/MG	5 Dec 1993	NM	NM	NM	2.0	Wooden fence
Arcos/MG	25 Oct 1994	NM	NM	NM	4.0	<i>Handroanthus impetiginosus</i>
Arcos/MG	1 Oct 1997	NM	NM	NM	1.4	Wooden fence
Arcos/MG	18 Nov 1998	NM	NM	NM	3.2	<i>Myrsine gardneriana</i>
Arcos/MG	10 Dec 1998	NM	NM	NM	4.0	NI
Arcos/MG	19 Oct 2001	NM	NM	NM	1.6	Wooden fence
Quebrangulo/AL	13 May 1986	NM	NM	NM	0.8	<i>Erythrina mulungu</i>
Quebrangulo/AL	27 Sep 1989	NM	NM	NM	2.0	<i>Anacardium occidentale</i> (dry)
Quebrangulo/AL	4 Sep 1990	1.5	NM	3.0	3.5	<i>Anacardium occidentale</i>
Quebrangulo/AL	7 Sep 1992	NM	NM	NM	1.5	Wooden fence
Quebrangulo/AL	30 Apr 2015	NM	NM	NM	2.6	<i>Jenipapo americana</i>
Quebrangulo/AL	24 Jul 2016	NM	NM	NM	3.5	<i>Anacardium occidentale</i>
	Mean ± SD	2.0 ± 0.5	4.25 ± 0.3	3.3 ± 0.3	2.3 ± 1.1	
	Min.–max.	1.5–2.5	4.0–4.5	3.0–3.5	0.6–4.0	

TABLE 2
Measurements of Common Potoo *Nyctibius griseus* eggs at Arcos, Minas Gerais, Brazil. NM = not measured.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
5 Oct 1988	1	17.5	40.9	29.4
29 Nov 1988	1	NM	39.0	29.0
7 Nov 1989	1	17.0	40.9	28.8
25 Oct 1994	1	22.0	43.8	31.1
1 Oct 1997	1	22.0	41.8	29.4
19 Oct 2001	1	22.0	39.9	30.2
Mean ± SD	1 ± 0.0	20.1 ± 2.6	41.1 ± 1.7	29.7 ± 0.9
Min.–max.	1	17–22	39.0–43.8	28.8–31.1

can lay two eggs, which seems hardly possible based on the small sites chosen for laying and has never been documented.

All the nests we found already had eggs, so we were unable to quantify the incubation period. Even so, one egg took at least 28 days and another 34 days to hatch. Lopes & Anjos (2005) and Moresco (2019) mentioned 29 days, Sick (1997) 33 days and Skutch (1970) 33



Figure 8. Egg of Common Potoo *Nyctibius griseus*, Quebrangulo, Alagoas, Brazil, May 1986; due to the internal height of the location chosen for laying, it is common for the egg to be seen when viewed from the side (NORDESTA collection)

Figure 9. Eggs of Common Potoo *Nyctibius griseus* in nests at (left) Quebrangulo, Alagoas, Brazil, September 1992; (right) Arcos, Minas Gerais, Brazil, October 2001 (NORDESTA collection)

Figure 10. Four-day-old Common Potoo *Nyctibius griseus*, Arcos, Minas Gerais, Brazil, December 1993 (NORDESTA collection)

Figure 11. Nestling Common Potoo *Nyctibius griseus* at c.20 days old, Arcos, Minas Gerais, Brazil, November 1998; the arrows indicate natal feathers still attached to permanent feathers (NORDESTA collection)

Figure 12. Adult Common Potoo *Nyctibius griseus* feeding a c.3-5-day-old nestling, Arcos, Minas Gerais, Brazil, December 1998; like Great Potoo *N. grandis*, the adult inserts its bill into that of the nestling (NORDESTA collection)

days or more. Both adults have been observed incubating the eggs and tending the young (Skutch 1970, Foster & Johnson 1974).

On hatching the chick is entirely covered in very dense white down, the throat is pale lilac and the bill is black (Fig. 10). It remains motionless, tucked under the adult's ventral plumage. At c.3 weeks old, definitive feathers develop, and the plumage becomes grey and beige, with some spots (Fig. 11); see Sánchez-Martínez & Yusti-Muñoz (2016) for more information. As the definitive feathers grow, they push out the down plumes, which remain attached at the tip for some time (Fig. 11), as noted by Sick (1997). On fledging, juvenile plumage resembles the adult, but is paler and the tail is shorter. The juvenile often faces the adult, both motionless. At four nests, young remained in the nest for 46, 47, 54 and 57 days. Sánchez-Martínez & Yusti-Muñoz (2016) mentioned a nestling period of 46 days, Skutch (1970) c.47 days, Tate (1994) 49 days, Sick (1997) 51 days and Saibene (1987) 52 days. As Sick (1997) noted, when summing the incubation and nestling periods, *Nyctibius* spp. have among the most extended development periods for birds in the Americas, reaching up to 85 days.

Of the 16 nests we monitored, seven were successful (four at Arcos and three at Quebrangulo), five were predated (three in Arcos and two in Quebrangulo), and humans destroyed one. We were unable to determine the fate of the other three.

At Arcos, Minas Gerais, on 29 November 1988, on our approach a brooding adult abandoned its camouflage, opened its large yellow eyes and opened its mouth wide to reveal the purplish throat, aggressive behaviour that was also observed by Haverschmidt (1958a) and by Greeney *et al.* (2008). However, the bird did not leave the nest. At the same nest, on 21 December, the 24-day-old chick also exhibited aggressive behaviour. On initial approach, it adopted a camouflage posture, but on further approach adopted an intimidating posture, puffing up its plumage, opening its eyes and swinging its body round while pecking at the air.

At a second nest in Arcos, on 18 November 1998, an egg was in the process of hatching on a broken *Myrsine gardneriana* (Primulaceae) 3.2 m above ground. On 19 November, the chick hatched and, on 21 November, observations commenced. At 19.00 h, while it was still light, as we moved away from the nest, the adult and chick abandoned their mimetic posture, lowered their heads and opened their eyes. From 19.10–19.40 h, there was a thunderstorm with lightning and heavy rain. At 19.40 h, the rain stopped and a second adult arrived, replacing that in the nest. The arriving bird shook itself vigorously and stretched its neck several times as if forcing food into its mouth. The chick stretched upwards, between the breast feathers of the adult, which lowered its head and passed food into the chick's bill over the course of the next three minutes. Like the previous species, the nestling opens its bill and the adult inserts its bill into the nestling's (Fig. 12). At 20.00 h, the other adult arrived and replaced its partner. During our observations, in common with others (Skutch 1970, Lopes & Anjos 2005), the adults never left the chick alone for more than a few seconds. As the nestling grows, feeding sessions become more frequent, although, as noted by Cestari *et al.* (2011), time spent by the adults at the nest decreases. On 22 November, both adults fed the young. At 19.40 h, the adult with the chick suddenly flew off, caught an insect, returned to the nest and fed the young, a behaviour repeated at 19.45 h. At c.19.50 h, a second adult flew past and touched the back of the perched adult, which then left its post and was replaced by the arriving adult. After c.5 minutes, the latter fed the chick. On 23 November, during 38 minutes of observations, from 19.47–20.25 h, there were four feeding events. To defecate, the chick stretched its tail out of the nest, even when under the adult's plumage. This behaviour has rarely been observed or described in the literature (e.g. Cestari *et al.* 2011) but could be important for deterring predators. On 25

November, observations commenced at 19.00 h, the adult with its head down and the chick under its ventral feathers until 19.35 h, when the latter became restless and ejected a faecal sac. Between 19.52 and 20.45 h, there were eight feeding sessions. Usually, the adult fed the young twice per session, but sometimes only once before flying off to forage again. When observations ceased at 20.45 h, the adult, on noticing our presence, gave a quite loud *craak*, *craak*, *craak* vocalisation.

At a third nest in Arcos, on 15 December 1998, an adult with a chick that hatched on 8 December and was thus c.7 days old was resting on a broken stump. At 19.40 h, it was dark and the adult slowly stretched its wings, one at a time. It then left to forage for insects nearby, returning to the same perch on six occasions. The young followed the adult's movements with its head, and was fed at 20.15 h, 20.20 h and twice at 21.45 h. Given the short interval between feeds, we believe more than one adult was involved. On arriving at the nest, the adult would remain quiet for a few seconds, observing the surroundings, then raised its bill to force the food upwards and then fed the chick. Each feeding bout lasted from a few seconds to three minutes.

A nest at Quebrangulo, Alagoas, containing a four-day-old chick, was observed from 18.40–20.40 h on 28 July 2016. At 18.40 h, as darkness fell, the adult left the nest to catch insects nearby, returned to feed the chick, left and reappeared a second time. At 18.50 h, a second adult arrived and the one in the nest left. At 19.20 h, the first adult returned and, in flight, touched the back of the one on the nest. After c.1 minute, the second adult left and the first perched next to the chick, stretched its neck, regurgitated the contents of its crop and fed the chick for two minutes. From 19.30–20.40 h, both adults fed the chick, with one leaving the nest three times to catch insects nearby before quickly returning each time.

Family Caprimulgidae.—Cosmopolitan family, absent only from Antarctica and high latitudes. Caprimulgidae are nocturnal, inhabit varied environments and are more often heard than seen (Winkler *et al.* 2020d). Unlike Nyctibiidae, they land horizontally, are primarily terrestrial, and, due to their nocturnal and inconspicuous behaviour, we know little about their breeding habits (Sick 1997, Winkler *et al.* 2020d). Twenty genera and 97 species are recognised (Winkler *et al.* 2020d), of which 34 are found in South America (Remsen *et al.* 2024) and 27 in Brazil (Pacheco *et al.* 2021).

RUFOUS NIGHTJAR *Antrostomus rufus*

A dark nightjar with an easily identified melodic song, it occurs from Nicaragua to northern Argentina and throughout Brazil (Sick 1997, Múnera-Roldán *et al.* 2007, Rumelt 2020), in varied habitats, and has apparently expanded its distribution in Brazil (Rumelt 2020). Little is known about the species' reproduction, especially in Brazil (Ihering 1900, 1914, Maurício *et al.* 2013) but also elsewhere (Belcher & Smooker 1936, Wetmore 1968, Di Giacomo & López Lanús 1998, Salvador *et al.* 2014, Schaaf *et al.* 2023).

We made observations at three nests found between 1992 and 2008 in Alto Parnaíba, Maranhão ($n = 1$), Arcos, Minas Gerais ($n = 1$) and Caseara, Tocantins ($n = 1$). Eggs were found in September ($n = 2$) and October ($n = 1$). In Alto Parnaíba song practically ceased after the eggs were laid, but started again, albeit very sporadically, after they hatched. For Brazil, we found only one published breeding datum, involving eggs laid on 24 October 1997 in Rio Grande do Sul (Maurício *et al.* 2013), but by reviewing the WikiAves website (on 26 April 2024) we found 35 records of eggs between August and March, mainly in August–December ($n = 32$), with a tendency for breeding to occur later, in November–March, in the north-east. The species' breeding period in Brazil, although still poorly known, seems to coincide with that in north-east Argentina (Di Giacomo & López Lanús 1998, Salvador *et al.* 2014, Schaaf



Figure 13. Rufous Nightjar *Antrostomus rufus* in nest following a fire, Alto Parnaíba, Maranhão, Brazil, September 2008 (NORDESTA collection)

et al. 2023). In Trinidad & Tobago, breeding has been recorded in February–May (Belcher & Smooker 1936), very similar to Panama (Wetmore 1968), whilst in Suriname, the gonads of a specimen collected on 26 October were enlarged (Haverschmidt & Mees 1994).

Eggs were laid on the ground close to forest fragments, without any kind of depression, on leaves present in the area. Clutch size was two in all three nests. Eggs were dirty white with diffuse pale violet-brown spots or vermiculations. Two eggs, oval-elliptical in shape, measured 31.7×23.0 mm, 9.4 g and 31×23 mm, 9 g. Egg morphology matches previous descriptions in the literature (Ihering 1900, 1914, Belcher & Smooker 1936, Wetmore 1968, Di Giacomo & López-Lanús 1998, Salvador *et al.* 2014), although there may be some variation in colour (Belcher & Smooker 1936). As all the nests we found had eggs, we were unable to quantify the incubation period, which in one nest was at least 15 days. The species' incubation period is still unknown, but is probably similar to that of Silky-tailed Nightjar *A. sericocaudatus* and Cuban Nightjar *A. cubanensis* with *c.*19 days, but potentially sometimes longer in the first-named (Bodrati & Cockle 2018, Kirkconnell *et al.* 2020), and Chuck-will's-widow *A. carolinensis* with *c.*20 days (Straight & Cooper 2020).

The two eggs found at Arcos on 15 September 1992 had disappeared on 22 September. In Alto Parnaíba, at a nest with two eggs on 15 October 2003, during the late afternoon, we observed an adult land close to the eggs, where it remained motionless for five minutes. Discreetly, it moved to cover the eggs, remaining for 60 minutes until observations ceased. It only opened and closed its eyes a few times, never opening them more than halfway. On 25 October the eggs hatched, and on 27 October the chicks had already moved away.

On 9 September 2008, from 07.00 until 17.00 h, at a nest in Alto Parnaíba, the adult incubated the two eggs continuously throughout. On 11 September, a fire broke out nearby, forcing the adult to move, albeit only slightly, when it reached the nest and, as soon as

the fire had passed, the bird returned to incubate (Fig. 13). On the following days, 12–13 September, the adult was still incubating, but the fate of this nest is unknown.

COMMON PAURAQUE *Nyctidromus albicollis*

The commonest and best-known caprimulgid in the Americas, Common Pauraque occurs from the southern USA to northern Argentina, including all of Brazil (Sick 1997, Latta & Howell 2020). Many studies provide breeding data, both from Brazil (Euler 1869, 1900, Ihering 1900, Schirch 1928, Snethlage 1935, Mitchell 1957, Oniki & Willis 1983, Salles 1988, Andrade 1996, Sick 1997, Alvarenga 1999, Buzzetti & Silva 2008, Kirwan 2009, Marini *et al.* 2007, 2012, Maurício *et al.* 2013, Nacinovic 2018, Lima *et al.* 2019, Guilherme & Lima 2020a, Santos *et al.* 2022) and elsewhere (Allen 1905, Penard & Penard 1910, Stone 1918, Belcher & Smooker 1936, Dickey & van Rossen 1938, Hellebrekers 1942, Haverschmidt 1955, 1972, Slud 1964, Wetmore 1968, Skutch 1972, Binford 1989, Haverschmidt & Mees 1994, Winker *et al.* 1999, Thurber 2003, Bodrati 2004, Cadena-Ortiz & Buitrón-Jurado 2015, Cockle *et al.* 2016, Moresco 2018, de la Peña 2019, Barrios 2023, Vereá 2023, LaPergola *et al.* 2024).

We made observations at 21 nests of *N. albicollis* found between 1981 and 2010 at Alto Parnaíba, Maranhão (*n* = 2), Arcos, Minas Gerais (*n* = 7), Camaçari, Bahia (*n* = 3), Caseara, Tocantins (*n* = 2) and Quebrangulo, Alagoas (*n* = 7). Breeding occurred mainly between September and December, with the only records of nests in February and March at Quebrangulo (Fig. 14). A review by Guilherme & Lima (2020a) indicated that breeding occurs in every month, except May, but mainly in August–December, in alignment with our observations.

N. albicollis does not build a nest, laying its eggs directly on the ground, usually in a shallow depression lined with dead leaves and *c.*12–14 cm in diameter. Our observations coincide with the literature (Skutch 1972, Oniki & Willis 1983, Guilherme & Lima 2020a).

Clutch size was almost always two eggs, mean 1.9 ± 0.3 eggs (*n* = 15) (Table 3), although in cases when only one egg was present it is possible that the clutch was incomplete. Eggs are pale salmon, slightly spotted with dark pink and pale lilac, and measure $30.6 \pm 1.4 \times 22.6$

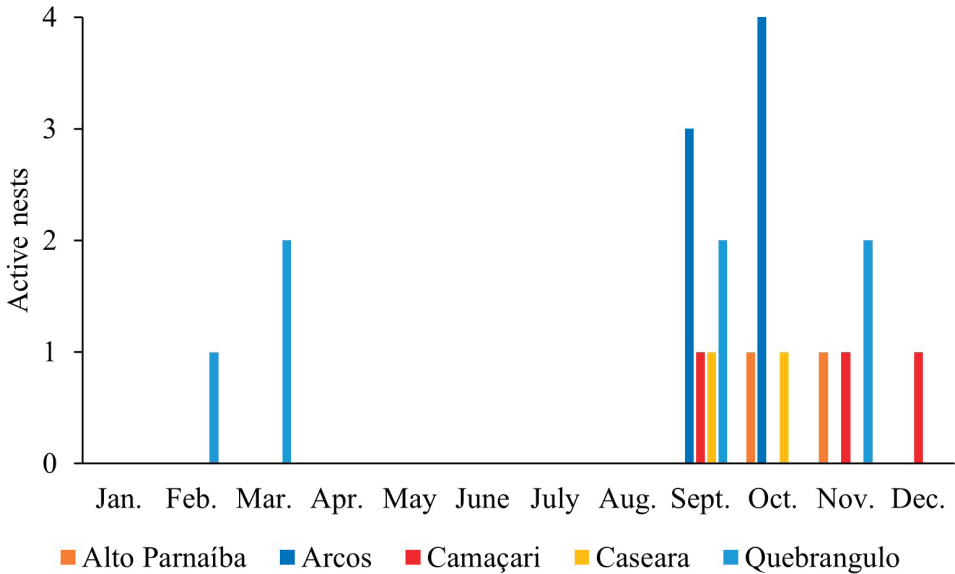


Figure 14. Number of active nests by month (based on date of discovery) of Common Pauraque *Nyctidromus albicollis* at Alto Parnaíba, Maranhão (*n* = 2), Arcos, Minas Gerais (*n* = 7), Camaçari, Bahia (*n* = 3), Caseara, Tocantins (*n* = 2) and Quebrangulo, Alagoas (*n* = 7).

TABLE 3
Measurements of Common Pauraque *Nyctidromus albicollis* eggs found at various sites in Brazil. NM = not measured.

Locality	Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
Alto Parnaíba/MA	26 Oct 2003	2	9.0	31.2	22.2
			8.5	30.1	21.6
Alto Parnaíba/MA	6 Nov 2010	2	NM	NM	NM
Arcos/MG	29 Sep 1988	2	9.0	30.5	23.7
			9.0	32.6	23.3
Arcos/MG	7 Oct 1988	2	8.0	32.2	22.7
			7.0	29.4	22.2
Arcos/MG	10 Oct 1988	2	9.0	33.7	24.8
			9.0	31.6	23.3
Arcos/MG	21 Sep 1993	2	7.8	29.4	23.0
Arcos/MG	9 Sep 1993	2	8.1	29.9	23.3
			8.3	29.9	23.8
Arcos/MG	23 Oct 1995	2	7.2	30.9	21.0
			6.9	29.8	21.0
Arcos/MG	26 Oct 1995	NM	8.0	31.6	23.7
Caseara/TO	18 Sep 2010	2	NM	NM	NM
Caseara/TO	27 Oct 2010	2	NM	NM	NM
Quebrangulo/AL	13 Nov 1981	2	NM	NM	NM
Quebrangulo/AL	24 Feb 1984	NM	6.6	28.5	21.1
Quebrangulo/AL	28 Sep 1993	2	7.9	28.3	21.6
Quebrangulo/AL	19 Mar 1997	NM	9.2	31.1	23.3
Quebrangulo/AL	6 Mar 2000	1*	7.9	30.0	22.2
Camaçari/BA	27 Dec 1984	NM	8.3	31.0	21.5
Camaçari/BA	30 Nov 1987	2	NM	NM	NM
Camaçari/BA	26 Sep 1995	1*	NM	NM	NM
	Mean ± SD	1.9 ± 0.3	8.1 ± 0.8	30.6 ± 1.4	22.6 ± 1.1
	Min.–max.	1–2	6.6–9.2	28.3–33.7	21.0–24.8

*Perhaps an incomplete clutch.

± 1.1 mm, mass 8.1 ± 0.8 g (*n* = 19) (Table 3). There is significant variation in the size of the eggs, as also evidenced in previous publications (Belcher & Smooker 1936, Wetmore 1968, Skutch 1972, Oniki & Willis 1983, Guilherme & Lima 2020a). Early authors suggested that adults could transport eggs with their bills (Euler 1900, Penard & Penard 1910), which was discussed by Alvarenga (1999). Penard & Penard (1910) even suggested that only one egg is laid to accommodate this behaviour. Although our observations indicate that a clutch of two eggs is normal, single-egg clutches are common in parts of Amazonia, including Suriname, and Belém (Pará) and Acre in Brazil (Haverschmidt 1955, 1972, Oniki & Willis 1983, Haverschmidt & Mees 1994, Sick 1997: 415, Guilherme & Lima 2020a).

Nests were always found with eggs or nestlings, so the incubation period could not be determined precisely, but in three cases it was at least 14 ($n = 2$) and 16 days ($n = 1$). The species' incubation period is still poorly known. Guilherme & Lima (2020a) indicated a minimum of 13 days, Vereá (2023) 14–15 days, Oniki & Willis (1983) 18–19 days, and Skutch (1972) 19–20 days. Hatching was asynchronous in two of our nests, with the chicks hatching on consecutive days.

Chicks hatch covered in abundant, long, fine, reddish-beige down that provides excellent camouflage against the dead leaves. The chicks remain motionless, usually with their eyes closed. The iris is dark brown, legs purplish, and bill grey with a white egg tooth, clearly visible after hatching. The throat is beige, with a darker area at the edges of the bill. The vibrissae are thin and grey. Soon after hatching, the chicks begin to move away from the hatching site. Observations over 15 days at Quebrangulo in 1993 showed that the chicks moved 10–20 m every two days, thus they are semi-precocial (Latta & Howell 2020). We were able to follow chicks for five ($n = 2$), seven ($n = 7$) and 10 days ($n = 1$) after hatching. Adults started bringing food to the chicks when it got dark.

On 26 October 2003 at Alto Parnaíba, we found a nest with one egg and one chick a few hours old, with the shell still attached, which sought cover under bushes on our approach. The adult made short flights nearby, presumably as distraction, immediately returning to the chick after our departure. On 6 November 2010, in the same area, we found a nest with two eggs. On 10 November the adult was incubating but, on our approach, 'puffed up' its breast feathers, indicating alarm (see Marini *et al.* 2012). Two days later, on 12 November, two chicks hatched. On 13 November, the young were a few metres apart; on 15 November, they could not be found.

SPOT-TAILED NIGHTJAR *Hydrosalis maculicaudus*

Widely distributed, from Mexico to south-east Brazil but with disjunct populations, some of them migratory (Arizmendi *et al.* 2020). In Brazil, it is absent or rare in most of the north-east and south (Sick 1997, Arizmendi *et al.* 2020).

Breeding behaviour is little known, with only a few relevant publications, mainly from other countries (Penard & Penard 1910, Zimmerman 1957, Haverschmidt 1972, Haverschmidt & Mees 1994, Ingels *et al.* 2010, Moreno *et al.* 2014). For Brazil, we found just two publications, from Pará (Snethlage 1935) and Rio de Janeiro (Nacinovic 2018).

Just a single nest was found by us, in Arcos, Minas Gerais, on 27 September 1994. It was discovered with two eggs during the daytime. The eggs were on sandy soil, amid dry leaves, next to a dirt road in an open area with many forest fragments. They were very pale pink (185; Séguéy 1936) with small, ill-defined rusty and pale violet spots throughout. Oval-shaped, the eggs measured 28.3×21.0 mm, 6.8 g and 28.0×21.6 mm, 6.9 g. They hatched on 13 October but the young could not be found on 17 October.

Snethlage (1935) reported finding three nests within a short distance of each other at Almeirim, Arumanduba, Pará, but did not



Figure 15. Eggs of Spot-tailed Nightjar *Hydrosalis maculicaudus* collected by Emilie Snethlage and deposited at the Museu Paraense Emílio Goeldi, Belém (left) MPEG.OVO 0341 and (right) MPEG.OVO 0342 (Marco A. Crozariol)

provide measurements of the eggs, which she collected on 30 December 1912 and are in the Museu Paraense Emílio Goeldi, Belém. They were measured by MAC in March 2023: 24.4×18.2 mm (MPEG.OVO 0340), 24.7×18.7 mm (MPEG.OVO 0341), 24.6×18.4 mm (MPEG.OVO 0342), 25.7×18.2 mm (MPEG.OVO 0343) and 25.2×18.2 mm (MPEG.OVO 0344) (Fig. 15). MPEG.OVO 0353, indicated as this species, has very different measurements (29.6×22.1 mm) and seems to have been mistakenly included among the eggs collected at Almeirim. There is, however, a sixth egg in MPEG, collected at Santo Antônio do Prata, Pará, on 11 December 1917, which measured 25.3×18.5 mm (MPEG.OVO 0339). The mean of the six eggs from Pará is $25 \pm 0.5 \times 18.4 \pm 0.2$ mm, vs. ours from Minas Gerais at $28.2 \pm 0.2 \times 21.3 \pm 0.4$ mm, the latter being larger. Two eggs from Rio de Janeiro measured $25.5 \pm 0.7 \times 19.8 \pm 0.4$ mm (Nacinovic 2018). An egg from Mexico was 26.1×16.6 mm (Zimmerman 1957) whereas two from Suriname were much shorter, at just $23.3 \pm 0.2 \times 18.1 \pm 0.0$ mm (Haverschmidt 1972). Another six from Suriname were also small, $23.1\text{--}24.8 \times 16.5\text{--}19.0$ mm (Haverschmidt & Mees 1994), albeit with much variation, especially in width. The size of the species' eggs is clearly very variable and needs more detailed study.

Family Apodidae.—Cosmopolitan, these birds feed exclusively on aerial plankton, spending most of their lives in flight. Some species can spend up to ten months without landing (Hedenström *et al.* 2016, Winkler *et al.* 2020c). Both choice of nest site and nest characteristics show much diversity. Use of saliva is widespread in the family, with some species building nests exclusively of this material (Lack 1956, Sick 1997, Winkler *et al.* 2020c). Nineteen genera and 112 species are recognised (Winkler *et al.* 2020c), 26 of which occur in South America (Remsen *et al.* 2024) including 17 in Brazil (Pacheco *et al.* 2021).

LESSER SWALLOW-TAILED SWIFT *Panyptila cayennensis*

One of the most easily identified species of Apodidae in the Neotropics, *P. cayennensis* occurs from Mexico to Amazonia, with a disjunct population in the Atlantic Forest, from north-eastern to southern Brazil (Sick 1997, Chantler *et al.* 2020). Because its nests are, unlike most Apodidae, large and conspicuous, and often sited under the roofs and eaves of houses, information on nesting both from Brazil (Goeldi 1898, Ihering 1900, Snethlage 1935, Sick 1947, 1958, 1997, Carvalho 1960, Oniki & Willis 1983, Teixeira *et al.* 1988, Stratford 2004, Buzzetti & Silva 2008) and elsewhere (Richmond 1893, Sclater 1897, Penard & Penard 1910, Greenway 1934, Belcher & Smooker 1936, Rogers 1939, Hellebrekers 1942, Haverschmidt 1954, 1958b, Edwards 1959, Whitaker 1960, Wetmore 1968, Pulgarín-R. 2005, Collins & Thomas 2012) is quite abundant.

Observations were made at nine nests of *P. cayennensis* found between 1985 and 2017 in Quebrangulo, Alagoas ($n = 7$) and Caseara, Tocantins ($n = 2$). All were active in January–April (Table 4). In Brazil, active nests have been reported between June and September in Pará and Mato Grosso, and in November in Rio de Janeiro (Sick 1958, Oniki & Willis 1983). Sick (1958), however, mentioned that breeding can occur year-round, but this may be an error induced by the species' habit of roosting in nests when they are not nesting (Buzzetti & Silva 2008).

Nests were on average 4.8 ± 3.6 m above ground ($n = 9$), attached to rocky walls ($n = 4$), trees such as *Eriotheca macrophylla* (Malvaceae; $n = 2$) and *Hymenaea courbaril* (Fabaceae; $n = 1$) or under verandas ($n = 2$) (Table 4; Figs. 16–19). They are tubular, attached at the top, or the top and sides, with the entrance always in the base. Inside the tube, there is a compartment in the shape of a concave platform on one side, usually opposite the attachment, where the eggs are laid (Fig. 20). Nests measured: external height 35.4 ± 6.5 cm ($n = 9$), max. external width 11.4 ± 1.3 cm ($n = 5$), min. external width 7.3 ± 0.8 cm ($n = 6$), entrance diameter $8.4 \pm$

TABLE 4
Height above ground and site of Lesser Swallow-tailed Swift *Panyptila cayennensis* nests found at various sites in Brazil.

Locality	Date found	Height above ground (m)	Construction site
Quebrangulo/AL*	11 Mar 1985	2.2	Rock
Quebrangulo/AL	19 Apr 1985	7.2	<i>Eriotheca macrophylla</i>
Quebrangulo/AL*	9 Mar 1986	3.0	Rock
Quebrangulo/AL	16 Mar 1986	1.6	<i>Hymenaea courbaril</i>
Quebrangulo/AL*	18 Feb 1987	3.4	Rock
Quebrangulo/AL	12 Apr 1999	8.5	Rock
Quebrangulo/AL	15 Apr 1999	12.0	<i>Eriotheca macrophylla</i>
Caseara/TO	8 Jan 2014	2.5	Outdoor porch roof
Caseara/TO	9 Apr 2017	2.5	Outdoor porch roof
Mean ± SD		4.8 ± 3.6	
Min.–max.		1.6–12.0	

*Different nests but constructed in the same place in consecutive years.



Figure 16. Nests of Lesser Swallow-tailed Swift *Panyptila cayennensis*. Above left: arrow indicating nest built on side of a rock in an open area, Quebrangulo, Alagoas, Brazil, April 1985. Below left: nest under a veranda, Caseara, Tocantins, Brazil, January 2014; note the clay cocoons glued to the side of the nest. Right: arrow indicating a nest on an *Eriotheca macrophylla*, Quebrangulo, Alagoas, Brazil, April 1999 (NORDESTA collection)

1.1 cm ($n = 5$), internal height 26.5 ± 3.1 cm ($n = 6$) and mass 60 ± 30 g ($n = 3$). The internal platform had an external height of 1.9 ± 0.3 cm ($n = 4$), external diameter 4.7 ± 0.7 cm ($n = 5$) and internal diameter 3.9 ± 0.5 cm ($n = 5$) (Table 5; Fig. 20). In one nest measuring 30 cm, the



17



18



19

Figure 17. Lesser Swallow-tailed Swift *Panyptila cayennensis* nest under a roof, Caseara, Tocantins, Brazil, April 2017; note the traces of old nests nearby, dismantled to build the new nest (NORDESTA collection)

Figure 18. Nest of Lesser Swallow-tailed Swift *Panyptila cayennensis* next to an active wasp nest, Caseara, Tocantins, Brazil, April 2017 (NORDESTA collection)

Figure 19. Lesser Swallow-tailed Swift *Panyptila cayennensis* nest, with the wings of a just-arrived adult visible, Caseara, Tocantins, Brazil, April 2017 (NORDESTA collection)

platform was 17 cm from the entrance, just over halfway up. Under the Simon & Pacheco (2005) scheme, the nest could be classified as 'closed/long', 'retort/lateral', or 'pensile', although these authors indicated that this species' nest would conform to 'a closed/retort/lateral type, with a vertical/downward tube'.

Nests are constructed using a variety of silky and feathery plant materials, feathers and tiny pieces of flexible bark. As described previously (Haverschmidt 1958b, Sick 1958), this material is bound together with abundant saliva, making it a solid structure with the consistency of felt, giving rise to the popular name 'andorinhão-estofador' (upholsterer swift). The nest is strong but sufficiently flexible to be folded and unfolded without impacting its shape or the material detaching itself. Its colour varies greatly depending on the material used or the age of the nest, from dark to light, mostly golden. The same nest can be reused several times, sometimes with minor renovations or additions to the structure, giving it an interesting appearance, as the new material can have a different colour. Nestbuilding can take from a few weeks to a few months. The pair builds mainly in the early morning, but also during the day to a lesser extent. Construction starts by fixing the material to the support and, as the nest takes the shape of a ring, proceeds from top to bottom (see Haverschmidt 1958b). It is not uncommon for material in one nest to be reused

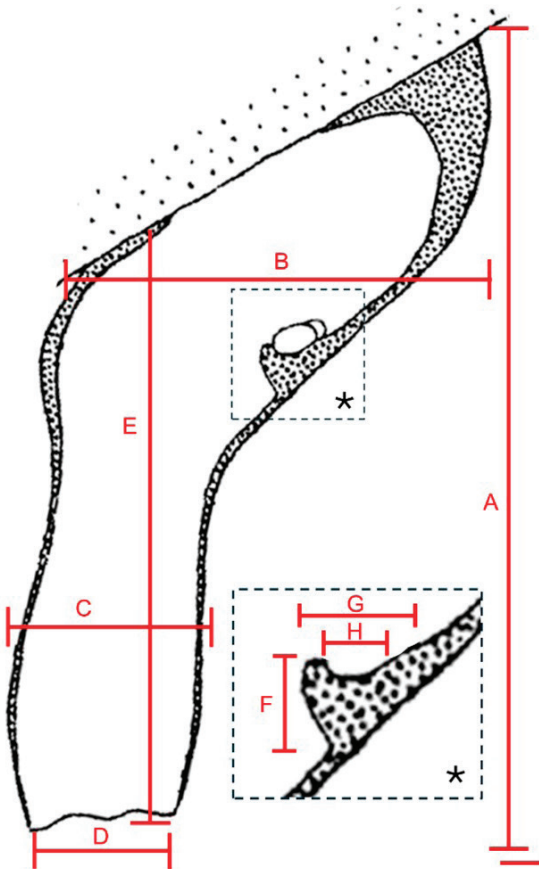
TABLE 5
Measurements of Lesser Swallow-tailed Swift *Panyptila cayennensis* nests found at various sites in Brazil. See Fig. 20 for measurement details. NM = not measured.

Nest	External height (cm)	Greater external width (cm)	Smaller external width (cm)	Opening diameter (cm)	Internal height (cm)	External height of egg chamber (cm)	External diameter of egg chamber (cm)	Internal diameter of egg chamber (cm)	Mass (g)
1	45	12	7.0	7.5	30	1.5	5.0	4.5	NM
2	30	NM	NM	NM	NM	NM	NM	NM	30
3	35	10	NM	NM	28	NM	NM	NM	60
4	35	NM	7.0	7.0	NM	2.0	5.0	4.0	NM
5	29	NM	NM	NM	NM	NM	NM	NM	NM
6	25	NM	6.0	NM	21	NM	NM	NM	90
7	40	13	8.0	9.0	27	NM	3.5	3.0	NM
8	40	10	8.0	9.5	25	2.0	5.0	4.0	NM
9	40	12	7.5	9.0	28	2.0	5.0	4.0	NM
Mean ± SD	35.4 ± 6.5	11.4 ± 1.3	7.3 ± 0.8	8.4 ± 1.1	26.5 ± 3.1	1.9 ± 0.3	4.7 ± 0.7	3.9 ± 0.5	60 ± 30
Min.–max.	25–45	10–13	6–8	7.0–9.5	21–30	1.5–2.0	3.5–5.0	3.0–4.5	30–90

Figure 20. Nest of Lesser Swallow-tailed Swift *Panyptila cayennensis* modified from Sick (1958). A: external height; B: greatest external width; C: smallest external width; D: diameter of the entrance; E: internal height; F: external height of egg chamber; G: external diameter of the egg chamber; H: internal diameter of egg chamber. See Table 5.

in another. At Caseara, we observed the same pair build three nests in consecutive years, always by dismantling the previous nest and building a new one next to it. Finally, the oldest nest was visible only as an imprint (Fig. 17).

We also witnessed other bird species take material from these nests, including an unidentified tyrannid and Planalto Hermit *Phaethornis pretrei*. An active nest in the same location on 18 February 1987 was used by bees to build their small tubular clay nests (Fig. 16). Nests at Caseara were both next to active wasp nests (Fig. 18). Their architecture, site, material and measurements agreed with the literature (Penard & Penard 1910, Greenway 1934, Snethlage 1935, Belcher & Smooker 1936, Sick 1947, 1958, Haverschmidt 1954, 1958b, Wetmore 1968, Stratford 2004, Pulgarín-R. 2005). Beebe



& Beebe (1910) mentioned a possible symbiosis with wasps, but as the percentage of nests built near wasps' nests is not high (Sick 1958), and was recorded in Brazil only recently (Biancalana 2018), this attribute does not seem to be essential in the choice of nesting site. Whitaker (1960) mentioned a possible nest with a false entrance.

Although Haverschmidt (1958b) mentioned that the birds are easy to observe during nest construction, we had difficulty observing the species arriving and departing the nest because they come and go so quickly. Because of this, it was long thought that the nest of *P. cayennensis* belonged to the Bat Falcon *Falco rufigularis*, as revealed in Amazonian legends (Goeldi 1898). *P. cayennensis* nests were collected and sold in markets, such as in Belém, Pará, to serve as amulets (Goeldi 1898).

A nest found on 9 March 1986 contained two white long oval eggs, but a child destroyed them. On 2 April 1986, another clutch of two eggs was found in the same nest. They measured 20.0×13.5 mm, mass 1.9 g and 20.2×13.5 mm, 1.95 g. On 9 April, the eggs were found broken on the ground. On 18 February 1987, the same nest was refurbished and contained three eggs, 22.2×13.6 mm, mass 2.0 g; 20.5×13.4 mm, 1.7 g; 20.9×13.0 mm, 1.71 g, respectively. On 26 February, this nest with eggs and the female were collected for the Museu Nacional, Rio de Janeiro, collection (Teixeira *et al.* 1988). Since then, no other nest has been constructed at this site despite monitoring. Sick (1997: 431) mentioned a case where a neighbouring tree fell on and crushed a nest with a pair and chick inside, and that it is not uncommon for eggs and chicks to fall from the nest when the adults enter.

According to Haverschmidt (1958b) chicks are born naked, with pink skin and a dark bill, and they remain naked with their eyes closed until they are at least 12 days old. By the time young leave the nest they resemble the adults.

A nest at Caseara on 29 April 2017 contained two well-developed chicks. Between 11.00 and 13.00 h, the young often moved around in the nest and, at 11.50 h, their heads poked out several times. From 11.20–11.45 h, the tips of an adult's wings (Fig. 19) were frequently stretched beyond the nest's entrance. At 12.00 h, an adult arrived and flew straight in, stayed only 25 seconds, then left upside-down (Fig. 21). On 3 May at 07.30 h, the chicks fledged.



Figure 21. Adult Lesser Swallow-tailed Swift *Panyptila cayennensis* exiting the nest, Caseara, Tocantins, Brazil, April 2017; note its upside-down position (NORDESTA collection)

Family Trochilidae.—One of the most impressive bird families in the world in terms of morphology, physiology and behaviour. It includes the world's smallest birds, and although they often feed on insects (Remsen *et al.* 1986) they are best known for their nectar consumption and bill adaptations to the morphology of flowers (Winkler *et al.* 2020b). Hummingbirds are confined to the Americas and occur in varied environments, from arid regions to humid forests, from sea level to the high Andes (Winkler *et al.* 2020b). A large family, comprising 112 genera and 363 species (Winkler *et al.* 2020b), of which 266 occur in South America (Remsen *et al.* 2024) and 89 in Brazil (Pacheco *et al.* 2021). Despite a large body of literature on hummingbirds, there is still much to be discovered about the natural history of many species (Winkler *et al.* 2020b). In Brazil, Augusto Ruschi (1915–86) and Rolf Grantsau (1928–2015) made the greatest contribution to understanding the family's breeding biology. Ruschi, in particular, proposed a classification for their nest types (Ruschi 1949a, 1973b), which we use here, in addition to the schema of Simon & Pacheco (2005).

BLACK JACOBIN *Florisuga fusca*

In Brazil, the species occurs mainly in the Atlantic Forest, from the north-east to Rio Grande do Sul, as well as Paraguay, Uruguay and Argentina (Sick 1997, Schuchmann *et al.* 2020a). Although the nest was probably described (and illustrated) for the first time as long ago as 1822 by Prince Wied-Neuwied (1782–1867) (Fig. 22), published breeding data are still few, all from Brazil and not very detailed (Euler 1900, Ruschi 1949b,c, 1973c, Mitchell 1957, Grantsau 1988, Sick 1997, Stenzel & Stenzel 2006, Straube *et al.* 2014), as the species is considered to be only a non-breeding visitor to Paraguay and Argentina (Areta & Bodrati 2010, Di Sallo *et al.* 2021).

Observations were made at 12 nests of *F. fusca* found between 1997 and 2020, all of them in the municipality of Quebrangulo, Alagoas between September and March, peaking in the dry season in October–December (Table 6). The few records in the literature agree with this period (Euler 1900, Ruschi 1949c). However, in Rio de Janeiro, it has also been observed nesting in July/August (Stenzel & Stenzel 2006), which indicates that the species can breed most of the year over its range as a whole.

All nests were sited in forest and low above ground, on average 1.1 ± 0.3 m (0.6–1.6 m, $n = 12$; Table 6). Nests are wholly supported basally by the dorsal surface of the leaf limbus, usually close to the base of the leaf, where it is inserted into the stem (Figs. 23–25). The bird selects plants with relatively broad sturdy leaves. We identified the following species as nest supports: *Costus spiralis* (Costaceae; $n = 1$), *Aspidosperma spruceanum* (Apocynaceae; $n = 2$), *Anaxagorea dolichocarpa* (Annonaceae; $n = 2$) and *Clusia paralicola* (Clusiaceae; $n = 4$), many of them still young. Nests are of the 'low cup/base' type, 'III Type, 1st Subtype', being broadest at the base, and measured: external diameter 7.3 ± 1 cm ($n = 7$), internal diameter 3.1 ± 0.5 cm ($n = 7$), external height 3.8 ± 1.9 cm ($n = 7$), internal height 1.7 ± 0.7 cm ($n = 7$), and weighed 2.8 ± 1.3 g ($n = 5$) (Table 6). From above, nests appeared relatively circular in shape. As the



Figure 22. Nest of Black Jacobin *Florisuga fusca* illustrated in Wied-Neuwied (1822); probably the first description and illustration of the species' nest.

TABLE 6
Measurements of Black Jacobin *Florisuga fusca* nests at Quebrangulo, Alagoas, Brazil. NM = not measured.

Date found	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)
15 Oct 1997	3.5	2.0	8	3.0	5	1.0
1 Dec 1997	2.0	1.0	6	3.0	2	1.0
16 Oct 1998	7.0	2.0	8	2.5	NM	0.6
30 Nov 1998	6.0	3.0	8	3.5	3	1.1
4 Dec 1998	NM	NM	NM	NM	NM	1.5
3 Dec 1999	NM	NM	NM	NM	2	1.1
28 Oct 2000	2.5	1.5	8	3.0	2	1.6
4 Mar 2004	3.0	1.5	6	4.0	NM	2.6
29 Sep 2005	2.5	1.0	7	3.0	NM	1.1
10 Jan 2008	NM	NM	NM	NM	NM	0.7
16 Nov 2017	NM	NM	NM	NM	NM	1.1
26 Nov 2020	NM	NM	NM	NM	NM	1.6
Mean ± SD	3.8 ± 1.9	1.7 ± 0.7	7.3 ± 1	3.1 ± 0.5	2.8 ± 1.3	1.1 ± 0.3
Min.–max.	2–7	1–3	6–8	2.5–4.0	2–5	0.6–1.6

TABLE 7
Measurements of Black Jacobin *Florisuga fusca* eggs at Quebrangulo, Alagoas, Brazil.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
15 Oct 1997	2	0.8	13.8	9.8
		0.8	13.6	10.0
1 Dec 1997	1*	0.9	14.7	10.7
16 Oct 1998	2	0.6	15.9	9.6
		0.6	15.9	9.7
30 Nov 1998	2	0.8	14.8	10.7
		0.8	14.9	10.7
3 Dec 1999	2	0.8	15.4	9.7
		0.8	15.4	9.6
28 Oct 2000	2	0.8	14.1	10.7
		0.7	13.8	10.4
Mean ± SD	1.8 ± 0.4	0.8 ± 0.1	14.8 ± 0.8	10.1 ± 0.5
Min.–max.	1–2	0.6–0.9	13.6–15.9	9.6–10.7

*Perhaps an incomplete clutch.

supporting leaves are usually angled, with their tips curled down, the bird builds the wall with the tallest external height on the side with the leaf tip (see Figs. 23–25), sometimes with the base extended in the same direction and, in some cases, can reach almost 5 cm long. The nest is built of soft cotton-like material, usually yellowish buff or golden. Some nests were constructed entirely of vegetable wool ($n = 3$), usually *Eriotheca macrophylla* (Malvaceae), always bound with abundant spider webs (Fig. 24). Internally, as well as plant wool and



Figure 23. Nest of Black Jacobin *Florisuga fusca*, Quebrangulo, Alagoas, Brazil. Left: nest site, with arrow indicating nest, November 2017. Above right: lateral view of the nest. Centre right: view of the nest with eggs from above, November 2020. Below right: seven-day-old nestlings, which are very similar in colour to the nest's material (NORDESTA collection)



Figure 24. Black Jacobin *Florisuga fusca* nestlings at c.10 days old, Quebrangulo, Alagoas, Brazil, December 2020; the plumage is very similar in colour to the nest's material, which is bound together with abundant spider webs and fixed to the supporting leaf (NORDESTA collection)

webs, we also found spider oothecae, and in one nest, some small fragments of dry leaves on the outside. The bird collected a silky, silver-coloured material from the fruit of a vine species, which we were unable to identify. Ruschi (1949c) described a nest constructed solely of spider webs and the pale-coloured bark of *Ceiba speciosa* (Malvaceae) but indicated that the species also uses *Typha* sp. (Typhaceae), Bromeliaceae, Bombacaceae, Poaceae and Asclepiadaceae (Ruschi 1973c). We often found old nests next to new ones, indicating a certain site fidelity, and we observed that material from the old nest can be reused in the new one. In November 1995, just 15 days after two chicks fledged, an adult, probably the same one that had bred, completely dismantled the nest to build another on the same plant, <1 m away. After a few days, the leaf where the first nest had been built was perfectly clean and smooth, as if there had never been a nest there. In rare cases, birds remodel and reuse

the old nest. Our observations match those reported in the literature (Euler 1900, Ruschi 1949c, 1973c, Grantsau 1988).

The species' typical clutch was two eggs ($n = 5$), but we also found nests with one ($n = 1$), the latter perhaps incomplete. Eggs were white and elliptical to long oval (Fig. 23) and measured $14.8 \pm 0.8 \times 10.1 \pm 0.5$ mm; mass 0.8 ± 0.1 g ($n = 11$) (Table 7), similar to those described by Ruschi (1949c), apparently the only prior description of the species' eggs.

Incubation lasted 16 days at a nest followed from when the first egg was laid and 15 days at another nest with a freshly laid egg. Ruschi (1949c) reported 15 days. On hatching, chicks are already covered in a dense layer of down feathers, very similar in colour and texture to the nest material, which guarantees their camouflage; only the chicks' heads lack these feathers (Figs. 23–24). From a distance, the chicks cannot be distinguished from the nest material. In the first few days, the nestling's bill is short and orange with a dark tip, and the inside of the mouth and tongue are yellowish. As they develop, the bill darkens, with a black maxilla and grey mandible. The contour feathers start to develop, but the orange dorsal feathers, which provide camouflage, remain until 14 days old. Even in well-developed nestlings, remnants of these feathers may be present in the dorsal region. As soon as they develop, the malar feathers are rusty red (Fig. 25), and these persist long after the bird has fledged. In five nests monitored from the eggs hatching, the young fledged in 19, 21, 22, 23 and 24 days, respectively. Ruschi (1949c) mentioned 25 days.

Adults are very aggressive towards other birds in the vicinity of their nests, even chasing very large insects away. During incubation, the female often shifts position in the nest, as do the nestlings. On departing the nest, the adult usually flies downwards, before climbing away from the ground, similar to the observations by Stenzel & Stenzel (2006), who suggested this represented anti-predatory behaviour.

During one afternoon observation of 100 minutes (16 November 1997) at a nest with two young of 16 days, the female fed them twice. During 100-minute-long observations in the early morning at two nests (23 December 1998 and 16 November 2000), each with two young of 9–10 days old, the female fed them three times. All feeding sessions lasted between 15 to 35 seconds, and each young was fed several times



Figure 25. Nestlings of Black Jacobin *Florisuga fusca*, Quebrangulo, Alagoas, Brazil. Above: note feathers on dorsal region of chicks at c.15 days old, December 1998. Below: note rusty-red malar region of chicks at c.19 days old, January 1999 (NORDESTA collection)

RUFOUS-BREASTED HERMIT *Glaucis hirsutus*

With a broad geographical and elevational distribution, this species occurs from Panama to Bolivia and, in Brazil, in most states from the north to São Paulo, but not in dry biomes such as the Caatinga and Cerrado (Sick 1997, Hinkelmann *et al.* 2020a). Breeding data are not rare, either from Brazil (Dias da Rocha 1911, Estevão 1926, Snethlage 1928, Snethlage 1935,

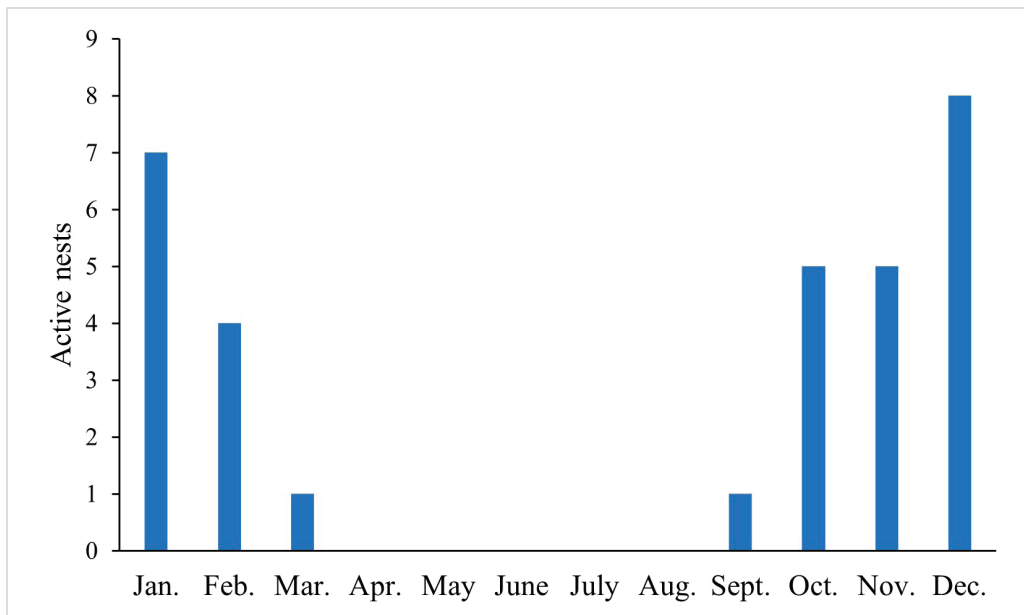


Figure 26. Number of active nests by month (based on date of discovery) of Rufous-breasted Hermit *Glaucis hirsutus* at Quebrangulo, Alagoas, Brazil.

Ruschi 1949b,d, 1968, 1973d,e, Pinto 1953, Novaes & Carvalho 1957, Oniki & Willis 1983, Grantsau 1988, Sick 1997, Buzzetti & Silva 2008, Stenzel & Souza 2009, Muscat *et al.* 2014) or from elsewhere (Allen 1905, Penard & Penard 1910, Stone 1918, Todd & Carriker 1922, Darlington 1931, Belcher & Smooker 1936, Hellebrekers 1942, Worth 1942, Snow & Snow 1964, 1973, Haverschmidt 1968, Wetmore 1968, Snow 1973a, Schuchmann 1977, Freymann & Schuchmann 2008, Vereia *et al.* 2009).

We observed 31 nests of *G. hirsutus* between 1997 and 2022, in the municipality of Quebrangulo, Alagoas. The breeding season was well demarcated, between September and March, with a peak in December–January (Fig. 26). For Brazil, breeding has been reported in September in Espírito Santo (Ruschi 1949d) and May–October in Pará (Pinto 1953, Novaes & Carvalho 1957, Oniki & Willis 1983). Thus, over the country as a whole breeding basically occurs year-round, much like on Trinidad (Snow & Snow 1973).

Nests were mainly in forested environments, both inside ($n = 11$) and at edges or in clearings ($n = 13$), in some cases in fragments ($n = 6$), often near wetlands or streams (e.g. Fig. 27). They were sited 2.3 ± 1.2 m (0.4 – 4.7 m) above ground or water ($n = 31$; Table 8). Commonly used support plants were *Euterpe edulis* (Arecaceae; $n = 14$) and *Musa paradisiaca* (Musaceae; $n = 12$), more sporadically *Taquara micrantha* (Poaceae; $n = 2$) and *Cyathea* sp. (Cyatheaceae; $n = 1$) (Fig. 27). Novaes & Carvalho (1957) also noted use of Arecaceae for nest construction. Nests were attached to the underside of leaves or, in the case of *Cyathea*, by attaching them to the underside of the leaf petiole so that they are suspended with the oological chamber concealed beneath them (Fig. 27). They are of the type ‘high cup/lateral’, ‘I Type’, and measured: external diameter 5.7 ± 0.7 cm ($n = 21$), internal diameter 3.5 ± 0.5 cm ($n = 21$), external height without caudal appendage 7.1 ± 1.6 cm ($n = 20$), caudal appendage 12 ± 8.3 cm ($n = 8$), internal height 2.7 ± 0.6 cm ($n = 21$), and weighed 3.4 ± 1.5 g ($n = 25$; Table 8). This description agrees with the prior literature (Penard & Penard 1910, Todd & Carriker 1922, Belcher & Smooker 1936, Ruschi 1949d, 1973d, Novaes & Carvalho 1957, Wetmore 1968, Snow & Snow 1973, Sick 1997). However, the nest described and illustrated by Wied in

TABLE 8
Measurements of Rufous-breasted Hermit *Glaucis hirsutus* nests at Quebrangulo, Alagoas, Brazil. NM = not measured.

Date found	External height (cm) ¹	Nest 'tail' (cm) ²	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground or water (m)
14 Feb 1997	7.0	19	3.0	7	3.0	5	2.0
11 Jan 1998	7.0	13	3.0	6	4.0	5	1.7
31 Oct 1998	7.0	NM	3.0	5	3.5	5	2.3
17 Nov 1998	9.0	27	3.5	7	4.0	2	4.0
14 Dec 1998	6.0	NM	3.0	6	3.5	3	2.6
22 Dec 1998	7.0	NM	3.0	6	3.0	2	4.7
5 Jan 1999	NM	NM	NM	NM	NM	NM	4.0
15 Jan 1999	5.0	NM	3.0	6	4.0	3	2.3
8 Feb 1999	NM	NM	NM	NM	NM	2	2.2
5 Oct 1999	5.0	NM	3.0	5	3.0	3	2.0
8 Oct 1999	5.5	NM	3.0	5	4.0	5	2.5
15 Oct 1999	10.0	NM	2.0	6	4.0	4	3.3
19 Dec 2000	8.0	4	3.0	5	4.0	3	0.7
29 Jan 2001	10.0	NM	3.0	6	4.0	2	1.1
3 Dec 2002	NM	NM	NM	NM	NM	NM	1.6
27 Feb 2003	NM	NM	NM	NM	NM	4	3.0
23 Nov 2003	NM	NM	NM	NM	NM	NM	0.55
5 Dec 2003	NM	NM	NM	NM	NM	3	0.65
9 Dec 2003	NM	NM	NM	NM	NM	2	2.7
11 Dec 2003	NM	NM	NM	NM	NM	NM	3.8
29 Jan 2004	8.0	NM	2.0	5	3.0	3	3.6
4 Feb 2004	9.0	NM	2.0	5	3.0	3	3.7
6 Mar 2004	8.0	4	2.0	7	3.0	3	0.7
5 Oct 2004	6.0	NM	2.0	5	3.0	3	3.0
1 Nov 2004	5.0	NM	2.0	6	3.0	3	2.5
31 Dec 2004	NM	NM	4.0	5	3.5	3	3.1
23 Jan 2006	6.0	16	3.0	6	4.0	9	2.2
30 Jan 2006	6.0	6	2.0	5	3.0	3	0.8
23 Sep 2006	NM	NM	NM	NM	NM	NM	1.9
23 Nov 2009	8.0	7	3.0	6	4.0	3	2.5
9 Nov 2022	NM	NM	NM	NM	NM	NM	0.4
Mean ± SD	7.1 ± 1.6	12.0 ± 8.3	2.7 ± 0.6	5.7 ± 0.7	3.5 ± 0.5	3.4 ± 1.5	2.3 ± 1.2
Min.–max.	5–10	4–27	2–4	5–7	3–4	2–9	0.4–4.7

¹ Not including the nest 'tail'.
² Materials hanging below the nest.



Figure 27. Nest of Rufous-breasted Hermit *Glaucis hirsutus* on *Cyathea* sp., over water, Quebrangulo, Alagoas, Brazil, November 2022 (NORDESTA collection)

Figure 28. Nest of '*Trochilus brasiliensis*' illustrated in Wied-Neuwied (1822), which is considered by some authors to be that of Rufous-breasted Hermit *Glaucis hirsutus* (e.g. Euler 1900). Pinto (1953) thought it to be a nest of Reddish Hermit *Phaethornis ruber*, but the illustration does not coincide with the nest of either species.

1822 for '*Trochilus brasiliensis*' (Fig. 28) and reported by Euler (1900) as involving *G. hirsutus*, cannot be of the present species, given its different mode of attachment and architecture, as noted by Snethlage (1935), Pinto (1953) and Novaes & Carvalho (1957). Pinto (1953) and

TABLE 9
Measurements of Rufous-breasted Hermit *Glaucis hirsutus* eggs at Quebrangulo, Alagoas, Brazil.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
14 Feb 1997	2	1.0	17.5	9.1
		1.0	17.4	9.0
11 Jan 1998	2	0.8	17.5	9.2
		0.7	17.0	9.4
31 Oct 1998	2	0.7	16.3	9.5
		0.7	16.2	9.4
17 Nov 1998	2	0.8	16.2	8.9
		0.8	15.5	9.0
14 Dec 1998	3	0.7	15.2	9.5
		0.8	16.0	9.6
		0.8	15.5	9.6
5 Jan 1999	2	0.8	16.1	9.1
		0.8	16.1	9.5
8 Feb 1999	2	0.8	17.5	9.1
		0.8	17.6	9.3
5 Oct 1999	2	0.8	17.7	9.2
		0.7	17.2	9.3
19 Dec 2000	2	0.7	16.7	9.5
		0.7	16.4	9.4
23 Nov 2003	2	0.7	16.0	9.3
		0.7	15.8	10.0
15 Oct 2009	2	0.8	15.9	9.2
		0.8	15.3	9.1
Mean ± SD	2.1 ± 0.3	0.8 ± 0.1	16.5 ± 0.8	9.3 ± 0.3
Min.–max.	2–3	0.7–1.0	15.2–17.7	8.9–10.0

Novaes & Carvalho (1957) considered the illustration to refer to Reddish Hermit *Phaethornis ruber*, but the nest’s characteristics do not match those of the latter species either. We remain unsure of the species involved.

Externally, the materials used in 16 nests were: only fine roots (*n* = 2), only fine black fibres, like horsehair, presumably of the genus *Marasmius* (*n* = 1), fine roots and *Marasmius* sp. (*n* = 1), fine, smooth sticks and spider webs (*n* = 1), *Marasmius* sp., spider webs and fine, smooth sticks (*n* = 1), *Marasmius* sp., spider webs and lichens (*n* = 1), *Marasmius* sp., spider webs and small dry leaves (*n* = 1), *Marasmius* sp., spider webs, small dry leaves and petioles (*n* = 1), *Marasmius* sp., small dry leaves, spider webs, lichens and thin lianas (*n* = 1), *Marasmius* sp., small dry leaves, spider webs, thin roots and petioles (*n* = 1) and thin roots, small dry leaves, spider webs and petioles (*n* = 1). Internally, only *Marasmius* sp. (*n* = 4), fine roots alone (*n* = 1), *Marasmius* sp. and fine roots (*n* = 1), *Marasmius* sp. and fine roots bound with spider webs (*n* = 1), fine roots, spider webs and other unidentified plant fibres (*n* = 1), *Marasmius* sp. and petioles (*n* = 1), *Marasmius* sp., small dried leaves and lichens (*n* = 1), petioles, lichens, mosses and green leaves (*n* = 1) and fine roots, *Marasmius* sp., spider webs,

mosses, lichens, fine lianas and other unidentified plant fragments ($n = 1$). Among the varied materials used, *Marasmius* sp. and spider webs ($n = 8$), fine roots and small dried leaves ($n = 5$) are the primary external components, and *Marasmius* sp. ($n = 9$) and fine roots ($n = 5$) the main internal materials. We dismantled one nest that weighed 3 g, which externally comprised 160 hyphae of *Marasmius* sp. 10–30 cm long, three hyphae of *Marasmius* sp. from 50–60 cm long, 18 strips of moss of 2–4 cm, ten pieces of lichen of 1–2 cm, five fragments of dry leaves of 1–2 cm, five thin filaments of lianas of 4–5 cm, three dry grass leaves of 3–16 cm and many cobwebs. Inside were only 12 hyphae of *Marasmius* sp., 10–20 cm long. Using spider webs on the outside helps fix the material to the support. Use of *Marasmius*, which is highly malleable, enables the structural construction; its use as lining is already well known for many bird species (Aubrecht *et al.* 2013, Gómez-García *et al.* 2014, Rana *et al.* 2021). Despite all the volume of material, the nest structure is thin and its contents are often visible through the walls, as Sick (1997) noted. From a distance, the nest tail is very reminiscent of the small pieces of vegetal debris that attach themselves naturally to spider webs in the forest, providing some camouflage for the nest. The nests we followed took 15–30 days to be constructed, vs. only *c.* 8 days in Pará (Novaes & Carvalho 1957) whilst Sick (1997: 443) reported 5–10 days. For more information on the process and materials used, see Novaes & Carvalho (1957), Snow & Snow (1973) and Schuchmann (1977).

Except one nest with three eggs, clutch size was two ($n = 11$ nests; Table 9), laid at one- or two-day intervals. Eggs are elliptical, long to long-oval, and white. On average, they measured $16.5 \pm 0.8 \times 9.3 \pm 0.3$ mm; mass 0.8 ± 0.1 g ($n = 23$; Table 9) in accord with the literature (Penard & Penard 1910, Belcher & Smooker 1936, Ruschi 1949d, Wetmore 1968), although eggs from Belém, Pará, were slightly shorter (Novaes & Carvalho 1957). Haverschmidt (1968) found a nest with three eggs, but according to his field observations the third egg belonged to a second female. Several nests found on Trinidad by Snow & Snow (1973) also had more than two eggs, once as many as five. These authors, like Haverschmidt (1968), suggested that clutches larger than two eggs were the product of multiple females. The same may or may not be true for our nest with three eggs. At seven nests followed from egg laying, the incubation period was 15 ($n = 1$), 16 ($n = 2$), 17 ($n = 3$) and 18 days ($n = 1$), mean 16.6 ± 1 days, vs. 16 days in Pará (Novaes & Carvalho 1957), 16–17 days in Espírito Santo (Ruschi 1973d) and 17 days on Trinidad (Snow & Snow 1973).

Three-day-old chicks have very dark grey skin on the head and back, with small tufts of whitish feathers, whilst the skin on the belly is between pink and brown. The maxilla is buff, and the mandible orange-yellow with a black tip and pale buff tomia. The inside of the bill and tongue are yellow, the eyes blackish, and tarsi, toes and nails buff. At 16 days the plumage is already dark, with some pale streaks, with the overall colour close to greenish brown. The maxilla turns black and the mandible tends to reddish with a black tip. The inside of the bill and tongue remain yellow, whilst the tarsi and toes are dark grey. Our observations are similar to those of Novaes & Carvalho (1957) in Pará. The nestling period in seven nests was 25 ($n = 1$), 27 ($n = 2$), 28 ($n = 2$), 29 ($n = 1$) and 31 days ($n = 1$), mean 27.9 ± 1.9 days. Novaes & Carvalho (1957) reported 22 days in Pará and Ruschi (1973d) 20–25 days in Espírito Santo. Sick (1997: 444) mentioned that the young may remain near the nest post-fledging, even returning to it to roost. In the nest, the adult is very aggressive toward any approaching bird, attacking in fast straight-line flight with accompanying vocalisations to scare the intruder away.

During field observations in the months of February and December in 1999, 2001 and 2022 at Quebrangulo we observed an adult foraging. Each feeding session was in the early morning and lasted 100 minutes. Each nest had two chicks and, notwithstanding the difference in the age of the nestlings (from 6–14 days), the female visited 3–5 times and



Figure 29. Adult female Rufous-breasted Hermit *Glaucis hirsutus* feeding chick in the nest, Quebrangulo, Alagoas, Brazil, November 2022 (NORDESTA collection)

fed each nestling several times. However, the duration of feeding bouts differed at each nest. They lasted 5–18 seconds at the nest with ten-day-old chicks, 47–50 seconds for six-day-old chicks and 20–30 seconds for 14-day-old chicks. Females alternated their position, sometimes delivering food in flight and sometimes perched on the nest edge. The nestlings positioned themselves as soon as they heard the adult's wings beating, but remained facing the supporting leaf, so they had to bend their necks back with their bills inclined at an angle (Fig. 29). On arriving at the nest, the females flew around as if checking the environs. After feeding the chicks, they were brooded for 6–18 minutes. Chicks eject their faeces in a stream over the side of the nest, even when the adult (which behaves similarly) is present, so there is no need to clean it.

REDDISH HERMIT *Phaethornis ruber*

One of the smallest birds in the world, weighing <3 g, *P. ruber* is widespread in South America, being absent only from Chile, Paraguay, Argentina and southern Brazil. It inhabits both forest environments and more anthropogenic open areas (Sick 1997, Hinkelmann *et al.* 2020b). Although there are many descriptions of the species' breeding ecology, both from Brazil (Estevão 1926, Snethlage 1935, Ruschi 1949b,e, 1973f, Pinto 1953, Oniki 1970a,b, 1975, 1978, Oniki & Willis 1983, Grantsau 1988, Buzzetti & Silva 2008, Lopes *et al.* 2013, Muscat *et al.* 2014) and elsewhere (Davis 1934, 1958, Mobbs 1971, Snow 1973b, Robens & Robens 1984, Schuchmann 1986, Raine 2007, Felton *et al.* 2008, Freymann & Schuchmann 2008), most are brief and anecdotal.

We observed 26 *P. ruber* nests between 1998 and 2022 in the municipality of Quebrangulo, Alagoas. Breeding occurred in September–February, with one nest in April, and peaked in October–December (Fig. 30). In Pará, breeding occurs in May–November (Pinto 1953, Oniki 1970b, Oniki & Willis 1983) and in São Paulo in October–November (Muscat *et al.* 2014).

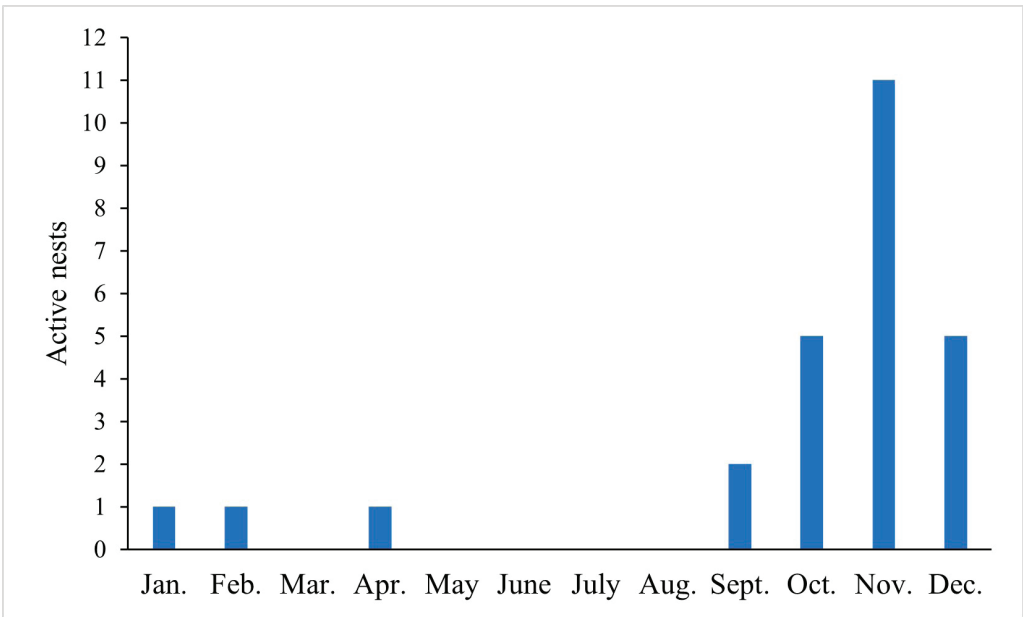


Figure 30. Number of active nests by month (based on date of discovery) of Reddish Hermit *Phaethornis ruber* at Quebrangulo, Alagoas, Brazil.



Figure 31. Adult Reddish Hermit *Phaethornis ruber* feeding a c.21-day-old nestling, Quebrangulo, Alagoas, Brazil, November 2017; note the nestling turning its head to receive food from the flying adult (NORDESTA collection)

All nests were in forested environments, either inside forest ($n = 22$) or at edges and in clearings ($n = 4$). They were sited low, on average 0.9 ± 0.4 m ($0.4\text{--}2.1$ m) above ground

TABLE 10
Measurements of Reddish Hermit *Phaethornis ruber* nests at Quebrangulo, Alagoas, Brazil. NM = not measured.

Date found	External height (cm) ¹	Nest 'tail' (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground or water (m)
22 Oct 1998	NM	NM	NM	NM	NM	NM	1.0
10 Nov 1998	NM	NM	2.0	5	3.0	1.0	0.7
14 Nov 1998	3.0	3.0	2.0	5	3.0	1.0	0.8
24 Nov 1998	5.0	2.0	2.5	5	2.5	1.0	0.8
3 Dec 1998	5.0	5.0	2.5	5	2.5	NM	1.5
10 Jan 2001	4.0	NM	1.5	3	1.5	2.2	0.8
3 Dec 2001	NM	NM	NM	NM	NM	NM	1.0
5 Dec 2001	NM	NM	NM	NM	NM	NM	1.1
30 Sep 2002	NM	NM	NM	NM	NM	NM	2.1
19 Nov 2003	NM	NM	NM	NM	NM	2.0	1.0
10 Sep 2004	5.0	4.0	1.5	5	2.5	1.0	1.2
15 Oct 2004	5.0	3.0	1.5	4	2.5	1.5	1.3
31 Oct 2004	3.0	3.0	2.0	5	3.0	3.0	1.15
9 Nov 2005	3.5	4.5	2.0	4	2.0	3.0	1.0
23 Nov 2005	3.0	4.0	1.5	5	2.5	3.5	0.8
29 Nov 2005	6.0	6.0	2.0	5	3.0	1.0	0.6
9 Dec 2005	NM	NM	NM	NM	NM	NM	1.1
20 Dec 2005	4.0	5.0	2.0	4	2.5	1.0	1.5
20 Oct 2006	5.0	NM	2.0	4	3.0	3.0	1.2
7 Nov 2009	NM	NM	NM	NM	NM	NM	0.55
15 Nov 2017	NM	NM	NM	NM	NM	NM	0.65
17 Nov 2017	NM	NM	NM	NM	NM	NM	0.4
30 Nov 2020	NM	NM	NM	NM	NM	NM	0.8
22 Feb 2022	NM	NM	NM	NM	NM	NM	1.0
11 Oct 2022	NM	NM	NM	NM	NM	NM	0.4
Mean ± SD	4.3 ± 1	4.0 ± 1.2	1.9 ± 0.3	4.5 ± 0.7	2.6 ± 0.4	1.9 ± 1.0	0.9 ± 0.4
Min.–max.	3–6	2–6	1.5–2.5	3–5	1.5–3.0	1.0–3.5	0.4–2.1

¹ Not including the nest 'tail'.

or water ($n = 25$; Table 10) on *Euterpe edulis* (Arecaceae; $n = 6$), *Anaxagorea dolichocarpa* (Annonaceae; $n = 5$), *Thyrsoodium spruceanum* (Anacardiaceae; $n = 4$), *Roupala montana* (Proteaceae; $n = 2$), *Setaria megaphylla* (Poaceae; $n = 2$), *Desmoncus polyacanthos* (Arecaceae; $n = 1$), *Cyathea* sp. (Cyatheaceae; $n = 1$), *Megathyrsus maximus* (Poaceae; $n = 1$), *Eschweilera ovata* (Lecythidaceae; $n = 1$) and *Sorocea guillemianiana* (Moraceae; $n = 1$). Like the previous species, nests are attached to the underside of leaves or the underside of the leaf petiole, suspended with the oological chamber concealed below the leaf (Fig. 31). When the nest 'tail' is considered, the nest is of the 'high cup/lateral' type; otherwise, some can be classified as 'low cup/lateral', 'II Type, 2nd Sub-type'. Lopes *et al.* (2013) considered the species' nest

TABLE 11
Measurements of Reddish Hermit *Phaethornis ruber* eggs at Quebrangulo, Alagoas, Brazil.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
10 Nov 1998	2	0.5	11.5	7.8
		0.5	11.6	8.0
14 Nov 1998	2	0.4	11.0	7.5
		0.4	10.8	7.7
24 Nov 1998	2	0.4	10.9	8.1
		0.4	10.8	7.6
3 Dec 1998	2	0.3	11.6	7.4
		0.3	11.3	7.4
10 Jan 2001	2	0.3	11.2	7.7
		0.3	11.1	7.7
Mean ± SD	2 ± 0	0.4 ± 0.1	11.2 ± 0.3	7.7 ± 0.2
Min.–max.	2	0.3–0.5	10.8–11.6	7.4–8.1



Figure 32. Nestlings of Reddish Hermit *Phaethornis ruber* at c.22 days old, Quebrangulo, Alagoas, Brazil, December 2017; the nestlings remain with their bills pointed towards the base of the leaf (NORDESTA collection)

to be of the ‘high cup/pensile’ type, but it is not necessarily the nest that is pendulous but the leaf on which it is sited. Nests measured as follows: external diameter 4.5 ± 0.7 cm ($n = 13$), internal diameter 2.6 ± 0.4 cm ($n = 13$), external height minus the ‘tail’ 4.3 ± 1.0 cm ($n = 12$), nest ‘tail’ 4.0 ± 1.2 cm ($n = 10$), internal height 1.9 ± 0.3 cm ($n = 13$), and mass 1.9 ± 1.0 g ($n = 13$; Table 10). The nest is similar to prior descriptions (Snethlage 1935, Ruschi 1949e,

1973f, Pinto 1953, Davis 1958, Oniki 1970b, Oniki & Willis 1983). Nests have also been found frequently on Arecaceae leaves in Pará (Oniki & Willis 1983), especially on *Astrocaryum aculeatum* [*A. mumbaca*] (Oniki 1970b).

Externally, materials used in four nests were: domestic wool ($n = 1$), plant wool, lichens, spider webs and unidentified plants ($n = 1$), lichens, small, dry leaves (e.g. *Inga* sp., Fabaceae), feathers, petioles, mosses and webs ($n = 1$), and plant wool, petioles, mosses, plant bark and spider webs ($n = 1$) were used. Internally, only vegetable wool ($n = 3$) or domestic wool, mosses and spider webs ($n = 1$). In general, webs are abundant and help fix the material to the nest support. The most used vegetable wool was that encasing seeds of *Eriotheca macrophylla* (Malvaceae), giving the nest a brownish-buff colour. Many other materials have been described in the species' nest, which must vary regionally and with availability (Ruschi 1949e, Oniki 1970b, Oniki & Willis 1983). In Amazonia, nests have been found with mud cells of Crabronidae and Sphecidae wasps on their outer walls (Oniki 1970a,b, 1975).

Clutch size was always two eggs ($n = 5$), which were white, long-elliptical and measured $11.2 \pm 0.3 \times 7.7 \pm 0.2$ mm; mass 0.4 ± 0.1 g ($n = 10$; Table 11) and, although there was some variation, in accord with the literature (Ruschi 1949e, Oniki 1970b, Oniki & Willis 1983, Schuchmann 1986). At one nest, one egg was laid on 14 November 2017 and the second on 16 November, the same interval as observed by Ruschi (1949e). Oniki & Willis (1983) reported eggs laid up to four days apart. The incubation period was 15, 16 and 17 days in the three nests monitored. In one, hatching was asynchronous, with one chick hatching the day after the first. Ruschi (1949e) mentioned an incubation period of 14 days, Davis (1958) 17 days and Oniki (1970b) 18–22 days. A nest in Pará had a five-day hatch interval (Oniki & Willis 1983).

In the first days of life, the chicks have practically bare, buff-coloured skin, with short, thin down dorsally, whilst the skin on the head, back and belly is brownish. The chicks become darker as the feathers develop, and the bill turns black, with the base of the mandible and the inside of the bill dark yellow. There is a bare grey area around the eyes, and the legs turn dark pink. The nestling period in ten broods was 18 ($n = 1$), 20 ($n = 3$), 21 ($n = 3$), 22 ($n = 2$) and 24 days ($n = 1$), mean 20.9 ± 1.6 days. Ruschi (1949e, 1973f) mentioned 20–25 days, Oniki & Willis (1983) 18–22 days and Muscat *et al.* (2014) 18–19 days. Nestlings always remain with their bills facing the leaf, usually holding them upright (Fig. 32). The adult maintains the same position when in the nest. Feeds almost always occur in flight, the adult approaching the nest while the nestlings bend their necks backwards (Fig. 31), just like the previous species, as observed by Oniki (1970b). Nestlings defecate by ejecting their excrement in a jet-like manner, as also reported by others (Oniki & Willis 1983).

A nest with two newly laid eggs was dismantled by another unidentified hummingbird species, which in just a day and a half removed so much material that the eggs fell to the ground.

We observed four feeding sessions in the years 1998 to 2022. All nests had two chicks. During two morning sessions of 100 minutes each, the female fed the 13-day-old chicks four times and the five-day-old chicks six times, suggesting that younger nestlings are provisioned more frequently. During two morning sessions of 180 minutes each, the female arrived five times at a nest with ten-day-old chicks and four times at one with 11-day-old chicks. Feeds were more frequent in the early morning hours. On hearing the female's wingbeats, seconds before she arrived, the chicks tilted their heads back and opened their bills. Feeding bouts lasted 12–18 seconds. Between feeds, the female often arrived to check the nest environs by flying all around the nest.

PLANALTO HERMIT *Phaethornis pretrei*

P. pretrei occurs in Bolivia, Paraguay and Argentina but is distributed mainly in Brazil outside Amazonia, inhabiting similar environments to the previous species (Sick 1997, Hinkelmann *et al.* 2020c). Although it is common, most breeding data are from anecdotal descriptions, mainly in Brazil (Ihering 1900, Dias da Rocha 1911, Ruschi 1949b,c,f, 1950, 1951, 1973e,g, Mitchell 1957, Grantsau 1988, Sick 1997, Lima *et al.* 2007, Marini *et al.* 2007, Buzzetti & Silva 2008, Lopes *et al.* 2013) with a few from Argentina (Fraga *et al.* 1984, Di Giacomo & Lanús 1998, de la Peña 2019).

Observations were made at 41 nests found between 1979 and 2022 in Quebrangulo, Alagoas (*n* = 22), Arcos, Minas Gerais (*n* = 13), Altamira, Bahia (*n* = 2), Alto Parnaíba, Maranhão (*n* = 2), Camaçari, Bahia (*n* = 1) and Pacoti, Ceará (*n* = 1). Breeding occurred between August and March, mainly in August–December (Fig. 33), corresponding primarily to the start of the rains in Minas Gerais, Maranhão and Ceará, and their end in Alagoas and Bahia. Ruschi (1950) indicated that the species breeds in August–April in south-east Brazil, but extending to almost any month if young from first attempts are lost. This matches the observations of Sick (1997: 444), who indicated that the species can lay up to five clutches per annum.

Most nests were in open areas (*n* = 19), followed by forest fragments (*n* = 11) or edges and clearings (*n* = 10). They were sited low, 1.2 ± 0.8 m (0.4–4 m) above ground or water (*n* = 39; Table 12). Unlike the previous species, *P. pretrei* fixes its nest onto filiform structures, with no supporting leaf cover above it. Thus, the species selects sites with some kind of protection above, such as ravines, caves, inside human constructions and manholes. Of 40 nests, 21 were built in a natural environment: roots or lianas at the edge of a ravine (*n* = 10), roots of fallen trees (*n* = 8), lianas on the edge of forest (*n* = 1), lianas in a cave next to a river (*n* = 1) and dry banana leaves (*n* = 1). The other 19 nests were in man-made structures (Figs. 34–35): under bridges (*n* = 5) or in manholes (*n* = 1), electric wires inside inhabited (*n* = 2) or uninhabited (*n* = 3) buildings, one of them in the ceiling above a busy shop counter, on a rope in an uninhabited building (*n* = 3), in a drainpipe in an uninhabited building (*n* = 1), and on metal hooks in inhabited (*n* = 3) or uninhabited (*n* = 1) houses. Use of man-

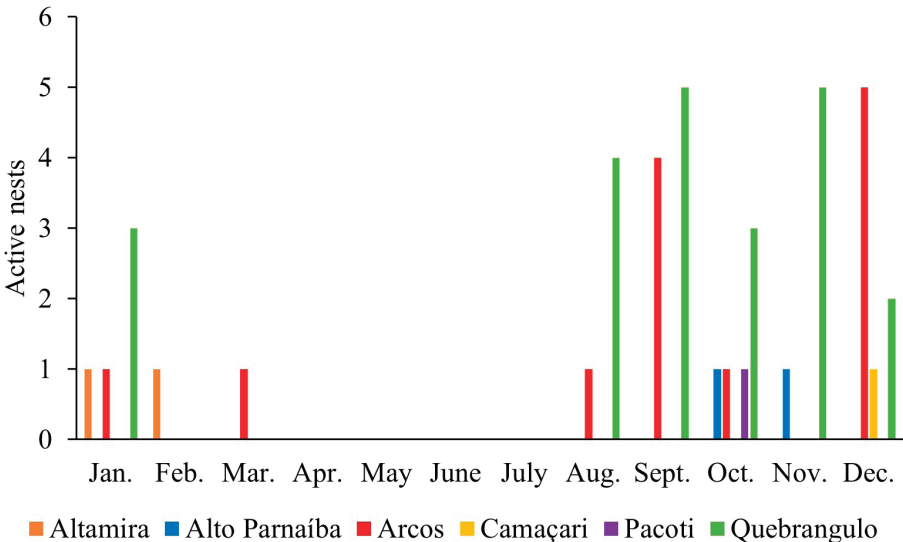


Figure 33. Number of active nests by month (based on date of discovery) of Planalto Hermit *Phaethornis pretrei* at Quebrangulo, Alagoas (*n* = 22), Arcos, Minas Gerais (*n* = 13), Altamira, Bahia (*n* = 2), Alto Parnaíba, Maranhão (*n* = 2), Camaçari, Bahia (*n* = 1) and Pacoti, Ceará (*n* = 1).

TABLE 12
Measurements of Planalto Hermit *Phaethornis pretrei* nests found at various sites in Brazil. NM = not measured.

Locality	Date found	External height (cm) ¹	Nest 'tail' (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground or water (m)
Altamira/BA	18 Jan 1981	NM	NM	NM	NM	NM	NM	1.7
Altamira/BA	5 Feb 1981	7	0	NM	7.0	4.5	NM	1.2
Alto Parnaíba/MA	5 Oct 2004	NM	NM	NM	NM	NM	NM	1.7
Alto Parnaíba/MA	30 Nov 2004	7	0	NM	3.0	3.0	3.0	1.7
Arcos/MG	23 Dec 1980	8	5	NM	8.0	3.5	NM	1.9
Arcos/MG	4 Sep 1990	7	4	3.0	5.0	4.0	3.0	2.0
Arcos/MG	27 Dec 1990	6	0	2.0	6.0	3.0	NM	1.3
Arcos/MG	15 Mar 1991	9	7	2.5	6.0	3.0	14.5 ²	0.8
Arcos/MG	27 Aug 1991	NM	NM	NM	NM	NM	NM	1.0
Arcos/MG	7 Dec 1991	6	9	3.0	6.0	3.0	NM	0.5
Arcos/MG	15 Sep 1994	6	7	2.0	6.0	2.0	NM	1.2
Arcos/MG	13 Oct 1994	5	3	2.0	6.5	3.0	NM	1.6
Arcos/MG	4 Jan 1995	NM	NM	NM	NM	NM	NM	2.0
Arcos/MG	28 Dec 1995	NM	NM	NM	NM	NM	NM	0.65
Arcos/MG	28 Dec 1996	7	6	2.5	6.0	4.0	NM	1.0
Arcos/MG	9 Sep 2016	NM	NM	NM	NM	NM	NM	4.0
Arcos/MG	14 Sep 2016	NM	NM	NM	NM	NM	NM	4.0
Camaçari/BA	15 Dec 1979	NM	NM	NM	NM	NM	NM	1.4
Quebrangulo/AL	14 Sep 1998	NM	NM	NM	NM	NM	NM	1.5
Quebrangulo/AL	23 Oct 2000	7	2	2.5	8.0	4.8	6.0	0.6
Quebrangulo/AL	5 Nov 2000	8	1	2.0	6.0	4.0	5.0	0.7
Quebrangulo/AL	2 Jan 2001	NM	NM	NM	NM	NM	NM	0.75
Quebrangulo/AL	11 Aug 2001	NM	NM	NM	NM	NM	NM	0.8
Quebrangulo/AL	26 Sep 2001	NM	NM	NM	NM	NM	NM	0.85
Quebrangulo/AL	19 Oct 2001	NM	NM	NM	NM	NM	NM	0.4
Quebrangulo/AL	17 Nov 2001	NM	NM	NM	NM	NM	NM	0.8
Quebrangulo/AL	16 Dec 2001	NM	NM	NM	NM	NM	NM	0.9
Quebrangulo/AL	23 Jan 2002	NM	NM	NM	NM	NM	NM	0.6
Quebrangulo/AL	20 Aug 2002	NM	NM	NM	NM	NM	NM	0.75
Quebrangulo/AL	10 Sep 2002	9	4	2.5	6.0	4.0	6.0	0.7
Quebrangulo/AL	22 Oct 2002	NM	NM	NM	NM	NM	NM	0.6
Quebrangulo/AL	19 Dec 2002	NM	NM	NM	NM	NM	6.5	0.8
Quebrangulo/AL	15 Nov 2003	NM	NM	NM	NM	NM	7.0	0.7
Quebrangulo/AL	28 Jan 2004	NM	NM	NM	NM	NM	NM	0.7
Quebrangulo/AL	31 Aug 2004	7	6	2.0	5.5	3.5	6.0	0.7
Quebrangulo/AL	8 Sep 2004	6	3	2.0	6.0	3.0	5.0	1.2

Quebrangulo/AL	12 Sep 2004	9	5	2.0	6.0	4.0	9.0	1.1
Quebrangulo/AL	2 Nov 2004	9	5	2.0	6.0	4.0	8.0	0.7
Quebrangulo/AL	31 Aug 2007	NM	NM	NM	NM	NM	NM	0.65
	Mean ± SD	7.2 ± 1.3	3.9 ± 2.7	2.3 ± 0.4	6.1 ± 1.1	3.5 ± 0.7	6.6 ± 3.1	1.2 ± 0.8
	Min.-max.	5-9	0-9	2-3	3-8	2.0-4.8	3.0-14.5	0.4-4.0

¹ Not including the nest 'tail'.
² This nest was built atop an old one, which made it significantly heavier than the others.



Figure 34. Nests of Planalto Hermit *Phaethornis pretrei* on artificial structures in Brazil. Left on wire with rosary at Arcos, Minas Gerais, December 1990 (NORDESTA collection). Smaller photos, above left, on rope at Arcos, Minas Gerais, December 1990 (NORDESTA collection); above right, on wire in a man-hole, Alto Parnaíba, Maranhão, October 2004 (NORDESTA collection); below left, on a house roof, constructed from Arecaceae leaves, Camaçari, Bahia, December 1979 (NORDESTA collection); and below right, on a toilet flush rope in an abandoned house, Pacoti, Ceará, Brazil, October 2022 (Marco A. Crozariol)

made structures is well known (Ruschi 1950 1973g, Fraga *et al.* 1984, Grantsau 1988, Sick 1997, Di Giacomo & Lanús 1998, Lima *et al.* 2007). Nests are of the ‘high cup/pensile’ type, rarely the ‘low cup/pensile’ type, ‘II Type, 2nd Sub-type’. Although considered by Simon & Pacheco (2005) as ‘pensile’, the nest is fixed to the substrate on only one side and could also be described as the ‘lateral’ type, like the previous species. Nests measured: external diameter 6.1 ± 1.1 cm ($n = 17$), internal diameter 3.5 ± 0.7 cm ($n = 17$), external height minus the caudal appendage 7.2 ± 1.3 cm ($n = 17$), caudal appendage $3.9 \pm$



Figure 35. Old charcoal kiln within which a nest of Planalto Hermit *Phaethornis pretrei* was sited, Arcos, Minas Gerais, Brazil, October 1991 (NORDESTA collection)



Figure 36. Development of Planalto Hermit *Phaethornis pretrei*, Pacoti, Ceará, Brazil, from eggs to fledglings, 17 October to 21 days old, 7 November 2022 (Marco A. Crozariol). Numbers on the images indicate the age of the chicks. See Table 14 and Figs. 37–38.

2.7 cm ($n = 17$), internal height 2.3 ± 0.4 cm ($n = 14$) and mass 6.6 ± 3.1 g ($n = 12$; Table 12). Nest walls can be up to 2 cm thick.

Externally, materials in ten nests were: only plant bark ($n = 1$), only plant wool (e.g. *Eriotheca macrophylla*, Malvaceae) ($n = 1$), lichens and spider webs ($n = 1$), lichens and spider webs with fur ($n = 1$) or with vegetable wool ($n = 1$), plant fibres and plant wool with spider webs ($n = 2$) or with tree bark ($n = 1$), dry tree and grass leaves with spider webs ($n = 1$) and plant wool, mosses, bark and spider webs ($n = 1$). Internally: only vegetable wool ($n = 3$), web, lichen and feathers ($n = 1$) or vegetable wool with vegetable fibres ($n = 3$), webs ($n = 1$), webs and fur ($n = 1$) or lichen ($n = 1$). Many nests were reused more than once in consecutive years. If the nest falls, the bird builds a new one in the same place, or if the nest is partially destroyed, it can be remodelled with new layers. Ruschi (1949c, 1950) mentioned up to five layers in a single nest. The electric wire above a shop counter was used for five consecutive years, sometimes the nest was remodelled and sometimes a new one built. At Pacoti, Ceará, two chicks fledged from a nest on the flush rope of a toilet in an abandoned

TABLE 13
Measurements of Planalto Hermit *Phaethornis pretrei* eggs found at various sites in Brazil. NM = not measured.

Locality	Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
Arcos/MG	23 Dec 1980	1*	NM	NM	NM
Arcos/MG	4 Sep 1990	2	NM	NM	NM
Arcos/MG	27 Dec 1990	2	0.6	14.8	9.4
			0.6	14.8	9.4
Arcos/MG	15 Mar 1991	2	0.6	14.9	9.9
			0.6	14.8	9.9
Arcos/MG	27 Aug 1991	1*	0.7	14.4	9.9
Arcos/MG	7 Dec 1991	2	0.6	14.3	9.0
			0.6	14.6	9.3
Arcos/MG	28 Dec 1996	2	0.6	14.4	9.4
			0.6	14.6	9.0
Pacoti/CE ¹	3 Oct 2022	2	0.57	13.5	9.2
			0.57	13.9	9.2
Quebrangulo/AL	14 Sep 1998	2	0.7	14.4	9.7
			0.7	15.1	9.8
Quebrangulo/AL	23 Oct 2000	2	0.7	14.2	9.4
			0.7	13.6	9.1
Quebrangulo/AL	5 Nov 2000	2	0.8	14.9	9.6
			0.8	14.6	9.7
Quebrangulo/AL	23 Jan 2002	2	0.8	15.6	10.8
			0.7	14.7	10.3
	Mean ± SD	1.8 ± 0.4	0.7 ± 0.1	14.5 ± 0.5	9.6 ± 0.5
	Min.–max.	1–2	0.57–0.8	13.5–15.6	9.0–10.8

¹ Egg mass taken using a high-precision scale, 0.01 g.
* Perhaps an incomplete clutch.

house on 19 September 2022; by 3 October 2022 there were already two new eggs in it. Perhaps the young from the first brood died, encouraging another attempt so quickly. One nest at Quebrangulo took 22 days to build, but no material was brought on three of those days. Ruschi (1950) reported that nestbuilding can take 5–35 days. Our nest data align with previous information (Ihering 1900, Ruschi 1949c, 1950, 1973g, Fraga *et al.* 1984, Sick 1997, Di Giacomo & Lanús 1998).

Most clutches were of two eggs, on average 1.8 ± 0.4 ($n = 12$ nests; Table 13). Lima *et al.* (2007) mentioned a nest with four eggs, but a second female was involved, as observed for *Glaucis hirsutus* by Haverschmidt (1968). Eggs are white, long-oval, and measure $14.5 \pm 0.5 \times 9.6 \pm 0.5$ mm; mass 0.7 ± 0.1 g ($n = 19$; Table 13). The incubation period was 16 ($n = 1$), 17 ($n = 6$) and 18 days ($n = 1$), mean 17 ± 0.5 days. Laying in a Quebrangulo nest occurred on successive days, but documented hatch events were synchronous. Ruschi (1950) indicated that laying occurs one, or rarely two, days apart, and hatching can be synchronous or asynchronous, after 15 (Ruschi 1973g, Grantsau 1988) or 16 days (Lima *et al.* 2007).



Figure 37. Development of Planalto Hermit *Phaethornis pretrei*, Pacoti, Ceará, Brazil, October/November 2022 (Marco A. Crozariol). Numbers on the images indicate the age of the chicks. See Table 14 and Figs. 36 and 38.

TABLE 14		
Development of Planalto Hermit <i>Phaethornis pretrei</i> nestlings at Pacoti, Ceará, Brazil. See Figs. 36–38.		
Date	Age (days)	Observations
18 Oct 2022	1	Naked with their eyes closed. Skin pinkish beige, with a darker back, and bill orange with a slightly paler tip. A few hours after hatching they had already been fed, with food accumulating especially inside the neck-sides. Skin is thin, thus the colour and texture of the contents is visible. From hatching, the chicks face towards the nest support.
19 Oct 2022	2	A slight darkening of the skin in the dorsal region.
20 Oct 2022	3	Increase in dorsal pigmentation continues, including the top of the head. The skin on the wings also darkens. When handled, the nestling tends to close its feet, clinging to the nest material and the researcher's hand.
21 Oct 2022	4	Dorsal pigmentation increases and is also apparent on the wings and the flanks.
22 Oct 2022	5	
23 Oct 2022	6	Few changes. The tip of the bill turns grey.
24 Oct 2022	7	The eye slit is more clearly demarcated and the first pin feathers start to appear, especially on the wings and tail, but also on the rump.
25 Oct 2022	8	Pin feathers larger and cover almost the entire back, wings and tail. The scapulars and feathers on the crown appear below the skin, with a few emerging.
26 Oct 2022	9	Pin feathers visible all over the body. The bill becomes darker orange with a grey tip. The nestlings produce a very quiet vocalisation like a clicking noise.
27 Oct 2022	10	Some pin feathers start to lose their sheaths and feather colouring becomes evident. The bill is darker and the eyes start to open. Ruschi (1950) indicated that the eyes open on day 8.
28 Oct 2022	11	Pin feathers longer and their tips outside the sheaths are visible over almost all the body. Jaw almost entirely brown. The crop of nestling 2 was emptier and slightly smaller, but its eyes were more open than nestling 1, although not completely so. A decrease in mass could suggest a change in diet, the proportion of insects decreasing and that of nectar increasing. Fewer dark spots visible through the skin, probably arthropods. Ruschi (1973g) indicated that in the first few days of life, c.90% of the nestlings' food is arthropods and around the tenth day of life the percentage of nectar gradually increases.
29 Oct 2022	12	Eyes more open. The nest appeared cracked on one side, so the chamber had more space, with a small accumulation of faeces on the edge, which is unusual as the nestlings usually defecate jet-like over the side.

30 Oct 2022	13	Eyes almost fully open, and nestlings more active. Feathers, including those of the wings and tail, had emerged from pin all over the body. Maxilla brown with an orange base; mandible orange. Nestling 1 could turn itself around when left on its stomach. Clicking vocalisation still heard. Crop seemed to contain much more liquid than arthropods. Nestling 1 ruffled its dorsal feathers a few times when touched, reminiscent of a stinging caterpillar, and made small lateral movements with its body while ruffling its feathers. A photo in Lima <i>et al.</i> (2007) of a 14-day-old nestling shows this behaviour.
31 Oct 2022	14	Colour pattern more apparent as the feathers emerge from pin. Maxilla blackens. Again, nestling 1 ruffled its back feathers when handled. One of the adults mobbed a Ferruginous Pygmy Owl <i>Glaucidium brasilianum</i> near the nest. Ruschi (1950) indicated that the female protects the nest from any approaching birds.
01 Nov 2022	15	Nestling 1 again ruffled its dorsal feathers, whereas nestling 2 did so only briefly and with little vigour. Faeces on the nest edge absent, perhaps removed by the female.
02 Nov 2022	16	Dorsal feathers now iridescent. Nestling 1 ruffled its dorsal feathers (youtu.be/pt76peY_Vs8) but nestling 2 did not. For the first time, the chicks flapped their wings while being weighed.
3 Nov 2022	17	Pin feathers no longer visible, except on the rump and forehead.
4 Nov 2022	18	Resembled miniature adults but with much shorter tails.
5 Nov 2022	19	Neither ruffled their back feathers when touched. A mosquito that landed on them was scared off by shaking their heads (youtube.com/shorts/YIFZWEbqc00?feature=share).
6 Nov 2022	20	Weak-looking chicks with empty crops. They gave an adult-like vocalisation for the first time, probably due to the lack of food (youtu.be/fOP2JLaCFoA).
7 Nov 2022	21	At 10.00 h, nestling 1 was on the ground, c.4 m from the nest, whilst nestling 2 was still in it. Both vocalised frequently but seemed weak and had empty crops. At 17.00 h, both were dead on the ground just below the nest.

The nestling period was 20 ($n = 1$), 21 ($n = 4$), 22 ($n = 1$), 23 ($n = 5$), 24 ($n = 2$), 25 ($n = 1$), 26 ($n = 1$) and 27 days ($n = 2$), mean 23.2 ± 2.1 days ($n = 17$). Ruschi (1973g) reported even broader variation (20–35 days), Lima *et al.* (2007) 20–21 days, and Grantsau (1988) only 16 days; see Table 14 for details of nestling development. During parental care, the adult usually vocalises on arriving near the nest, causing the chicks, like those of the previous species, to immediately bend their necks in anticipation of food. Most food is transferred while the adult is in flight (Fig. 34), rarely when perched on the nest edge.

At Quebrangulo during 2002–03 we made two observations lasting 100 and 120 minutes, involving six- and seven-day-old young respectively, and one observation of 120 minutes with a 18-day-old chick. The female visited these nests the same number of times and, despite the differences in age, fed the young for the same amount of time, between 16 and 30 seconds.

At Arcos, during a 100-minute observation of a nest in an old charcoal kiln (Fig. 35) with two 20-day-old chicks, there were eight feeding visits. The nest was falling apart and was replaced with an old nest of the same species, which was accepted by the birds. The two chicks fledged successfully from this replacement nest.

At Alto Parnaíba, Maranhão, on 21 October 2004 between 07.05 and 08.45 h, in a nest with two seven-day-old chicks, the female fed the chicks four times, distributing the food equally between them and brooding the young for c.10 minutes.

At Pacoti, Ceará, a nest with two eggs found on 3 October 2022 was monitored daily until 7 November (Table 14; Figs. 36–37). On 15 October, the bird inserted small fragments of vegetable wool into the egg chamber and the chicks hatched three days later, on 18 October, at c.16.00 h. The chicks were weighed daily and measured for bill length and width, tarsus, wing and tail length, always at 17.00 h, and pertinent morphological data recorded. See the growth curve in Fig. 38 and detailed information on development in Table 14, and compare this with information on nesting development, especially neonatal

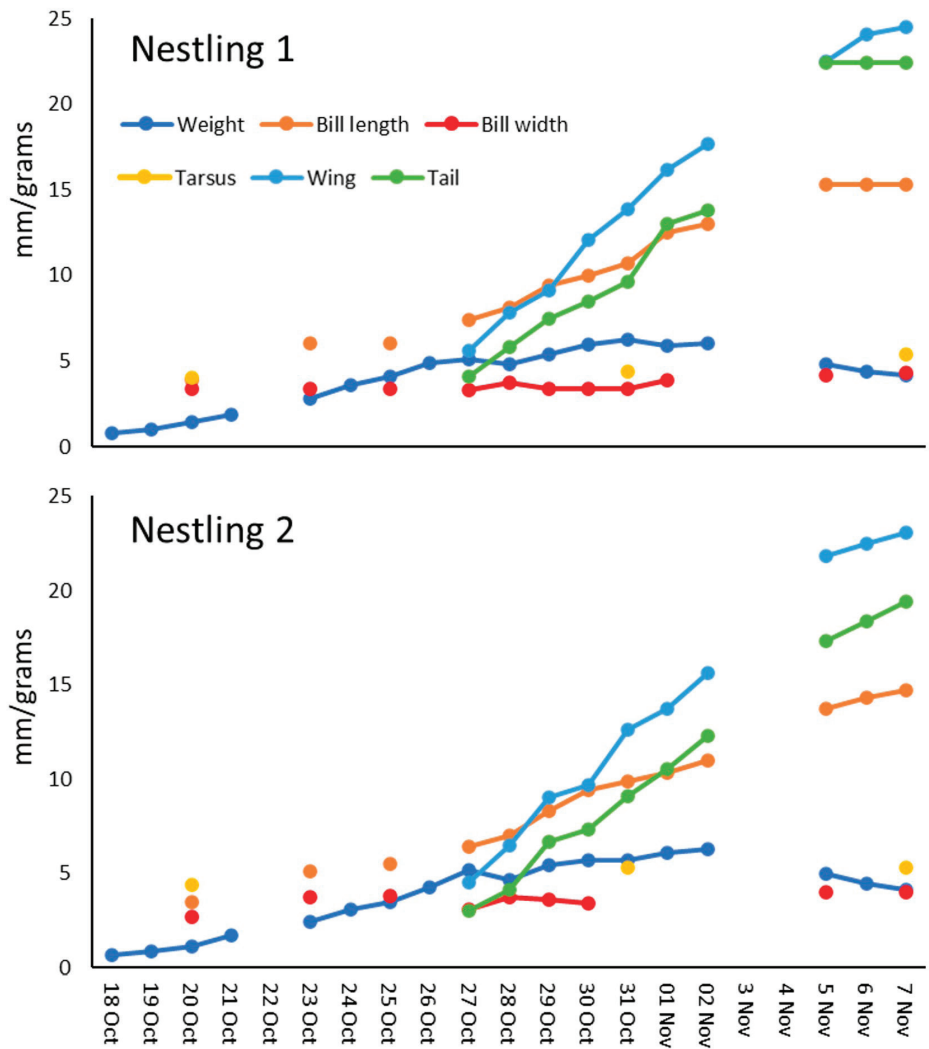


Figure 38. Development of two nestlings of Planalto Hermit *Phaethornis pretrei* in the same nest, Pacoti, Ceará, Brazil, from the day they hatched, 18 October, until age 21 days, 7 November 2022. See Table 14 and Figs. 36–37.

pterylosis, in Ruschi (1951). Around 4 November, the female disappeared and only the male was seen nearby. However, as males do not provide parental care, the chicks died of starvation on 7 November and were deposited in the Museu de História Natural do Ceará Prof. Dias da Rocha, Universidade Estadual do Ceará (MHNCE-AVE-0785 [nestling 1] and 0786 [nestling 2]). On 19 November 2022, two adults were observed in flight together, probably a new female paired with the same male, as the territory appeared to be identical to the previous pair's, including the same perches used by the male. However, breeding was not observed; probably the female chooses the nest site as stated by Ruschi (1950). This seems to be the first time that the behaviour of 'imitating stinging caterpillars' has been reported in the species' nestlings, usually when the nest or bird was handled (youtu.be/pt76peY_Vs8). However, a photo in Lima *et al.* (2007) of a 14-day-old nestling shows the dorsal feathers bristling, suggesting similar behaviour. More observations are needed to

understand this behaviour, especially as only one of the two chicks performed it intensely. More detailed studies of *P. pretrei* have never mentioned it (Ruschi 1949c, 1950, 1951, 1973g), and although similar behaviour has been observed in other birds (Londoño *et al.* 2022) it has probably never been reported previously in the Trochilidae. This family's nest predators are still poorly known and careful assessment of the evolution of down feathers in its nestlings is needed.

BLACK-EARED FAIRY *Heliothryx auritus*

Endemic to South America, this species is found throughout Amazonia, including Brazil, with disjunct populations in the Atlantic Forest, from Pernambuco to Santa Catarina, and in Goiás. It mainly inhabits the interior of forest but can utilise edges, usually in the canopy (Sick 1997, Schuchmann *et al.* 2020b). Very little is known about the species' natural history, with few specific data on breeding from Brazil (Euler 1900, Ruschi 1949e, 1973h, Grantsau 1988, Cintra 1990, Sick 1997) or elsewhere (Ingels 1981).

Two active nests were found in the municipality of Quebrangulo, Alagoas, on 3 November 1997 and 14 October 2004. For Brazil, Grantsau (1988) mentioned that the species breeds from October to March, whilst Cintra (1990) indicated that it runs from June to November, in the dry season, when trees tend to shed their leaves, which would aid the species' distraction behaviour when leaving the nest. The period during which we observed nests at Quebrangulo coincides with the main flowering season, but it is also the period when many trees lose their leaves, after the rains end in mid-August.

Nests had a conical shape and were fixed by the side wall and base in near-vertical forks (Fig. 39). They were built almost entirely of woolly material, externally with occasional lichens and small pieces of bark, all fixed with spider webs, and had a smooth appearance. One nest was 5 m and another 11 m above ground. One nest had an external diameter of 4.5 cm, internal diameter 3 cm, external height 6 cm, internal height 2 cm, and weighed



Figure 39. Nest of Black-eared Fairy *Heliothryx auritus*, Quebrangulo, Alagoas, Brazil, October 2004 (NORDESTA collection)



Figure 40. Adult Black-eared Fairy *Heliophryx auritus* feeding a nestling, Quebrangulo, Alagoas, Brazil, October 2004 (NORDESTA collection)

3 g; it could be considered the 'high cup/lateral' type, 'III Type, 2nd Sub-type'. The nest described by Ruschi (1949e) was similar but was sited on a Lauraceae leaf. Sick (1997: 442) compared the nest to that of *Florisuga*. Our nests and almost all the 51 photographed on the WikiAves website do not agree with their descriptions. Some nests are built on leaf petioles and partially supported by leaves (e.g. WA 3143964 and WA 2403808). Still, they have a very different architecture and fixation to nests of *Florisuga* (see earlier description).

Two long-oval eggs were laid. Two eggs measured 14.6×10.5 mm, 0.8 g and 14.7×10.2 mm, 0.8 g. We were unable to determine the incubation period. Eggs described by Ruschi (1949e) were slightly longer.

At five days old, chicks have a fine beige-ochre down. The skin on the head is brown, that on the back and belly is dull pink. The bill and commissure are pale yellow, the inside of the mouth golden yellow, and the tarsi and toes grey. In one nest, the young stayed 26 days, identical to Ruschi's (1949e) report.

We did not usually see the adult leave the nest, like Cintra (1990), because it simulates a leaf falling from the tree. In our observations, the adult usually allowed very close approach to the nest, only leaving when the supporting branch was touched.

The young in the nest found in November 1997 were predated by unidentified ants when they were c.7 days old.

On 22 October 2004 between 08.50 and 11.50 h, we monitored a nest containing two eight-day-old chicks. The female arrived six times at intervals of 20–30 minutes. Each time she chased away mosquitoes near the nest and only then fed the chicks (Fig. 40). Each chick was fed three or four times per visit. After feeding the young, the female usually brooded the nestlings for c.1 minute. On 28 October, there was only one chick, which the female fed four times between 07.15 and 09.45 h. Each feed lasted 20–40 seconds, but the chick was also seen trying to catch small insects around the nest. On 7 November, it was perched on a branch next to the nest, where it stayed for two days before fledging. Another unidentified

hummingbird species plundered all the nest material from the nest, which was removed in just three hours.

RUBY-TOPAZ HUMMINGBIRD *Chrysolampis mosquitos*

The male is one of the most colourful hummingbirds and in the past was much sought after for its plumage (Sick 1997). It occurs from Panama to Argentina and southern Brazil, inhabiting mainly open areas such as the Caatinga and Cerrado, although it does frequent forest landscapes during local migrations (Sick 1997, Schuchmann & Kirwan 2020a). Very little is still known about its breeding, both in Brazil (Ruschi 1949b, 1973j, Grantsau 1988, Sick 1997) and elsewhere (Penard & Penard 1910, Devicenzi 1925, Belcher & Smooker 1936, Hellebrekers 1942, Junge & Mees 1958).

Observations were made at ten nests found during 1999–2010 in Quebrangulo, Alagoas. The breeding period was well demarcated in the region, in November–February (Table 15), which is the local dry season. Ruschi (1949b) described a nest found in September in Pernambuco. Ruschi (1962), through observations in captivity, indicated that the species, unlike other hummingbirds, moults twice per year in south-east Brazil: pre-breeding in April–May, and post-breeding in October–November. The same could not be true in north-east Brazil, where the pre-nuptial moult must occur prior to November. Ruschi also reported that there is no difference between breeding and non-breeding plumages. Penard & Penard (1910) reported that the species nests during the wet season in Suriname, also unlike in north-east Brazil.

Like other hummingbirds, we observed only females nestbuilding, incubating eggs and caring for the young. Nests were at edges and in clearings ($n = 6$) or in open landscapes ($n = 4$), low above ground, on average 1.3 ± 0.6 m (0.6–2.5 m; Table 15). They were mainly on horizontal branches of shrubs and other low vegetation, including cassava *Manihot esculenta* (Euphorbiaceae) (Table 15). In Trinidad & Tobago, the species has been observed nesting in cassava plantations (Junge & Mees 1958).

The nests (Fig. 41), attached basally to thin branches, were ‘low cup/base’, ‘III Type’ in shape, constructed of plant wool bound very tightly together with the aid of spider webs,

TABLE 15
Measurements of Ruby-topaz Hummingbird *Chrysolampis mosquitos* nests at Quebrangulo, Alagoas, Brazil.
NM = not measured. NI = not identified.

Date found	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)	Supporting plant
12 Dec 1999	NM	NM	NM	NM	NM	2.5	<i>Baccharis pingraea</i>
14 Jan 2000	3.0	1.0	3.0	2.0	NM	1.3	<i>Miconia mirabilis</i>
15 Dec 2002	NM	NM	NM	NM	NM	1.1	NI
26 Dec 2005	2.0	1.0	4.0	2.5	NM	0.6	<i>Byrsonima sericea</i>
5 Jan 2007	3.0	2.0	3.5	2.6	3	1.9	<i>Callianthe pauciflora</i>
3 Nov 2007	3.0	1.5	4.0	3.0	NM	0.9	<i>Manihot esculenta</i>
11 Dec 2008	NM	NM	NM	NM	NM	0.65	<i>Manihot esculenta</i>
5 Dec 2009	3.5	2.0	4.0	3.0	NM	1.5	<i>Manihot esculenta</i>
5 Nov 2010	NM	NM	NM	NM	NM	1.5	<i>Callianthe pauciflora</i>
30 Nov 2010	3.0	1.0	3.0	2.0	NM	1.1	<i>Solanum paniculatum</i>
Mean ± SD	2.9 ± 0.5	1.4 ± 0.5	3.6 ± 0.5	2.5 ± 0.4	3 ± 0	1.3 ± 0.6	
Min.–max.	2.0–3.5	1–2	3–4	2–3	3	0.6–2.5	



41



42



43

Figure 41. Female Ruby-topaz Hummingbird *Chrysolampis mosquitos* at nest, Quebrangulo, Alagoas, Brazil, January 2000 (NORDESTA collection)

Figure 42. Nest of Ruby-topaz Hummingbird *Chrysolampis mosquitos* illustrated in Gould (1861).

Figure 43. Nest of Ruby-topaz Hummingbird *Chrysolampis mosquitos* illustrated in Mulsant & Verreaux (1877).

and externally almost wholly covered with greenish-grey foliose lichens. Nests measured: external diameter 3.6 ± 0.5 cm ($n = 6$), internal diameter 2.5 ± 0.4 cm ($n = 6$), external height 2.9 ± 0.5 cm ($n = 6$), internal height 1.4 ± 0.5 cm ($n = 6$) and one weighed 3 g (Table 15).



Figure 44. Nestling Ruby-topaz Hummingbird *Chrysolampis mosquitos*, Quebrangulo, Alagoas, Brazil, February 2000 (NORDESTA collection)

Gould (1861) illustrated the nest and how it is attached to the support (Fig. 42), whereas that depicted in Mulsant & Verreaux (1877) has fewer lichens and is on a vertical fork (Fig. 43), two characteristics that are apparently less common in the species. Two nests described by Devincenzi (1925) were larger and taller than they are wide, thus the 'high cup/base' type, *sensu* Simon & Pacheco (2005). A nest described in Pernambuco (Ruschi 1949b) was similar to ours.

Two white eggs with a long-elliptical shape were always laid. Two eggs measured 12.1×8.1 mm and 0.5 g, and 12.3×8.2 mm and 0.5 g. Clutch size and egg measurements were slightly smaller than previously described (Devincenzi 1925, Belcher & Smooker 1936, Hellebrekers 1942, Ruschi 1949b), although two eggs from Trinidad & Tobago were a similar size (Junge & Mees 1958). The incubation period at two nests was 13 and 14 days. Ruschi (1949b) indicated 15 days.

On hatching, the chicks had dark grey dorsal skin, paler ventrally, which can even be slightly pink. The gape flanges and bill itself were yellowish, and the inside of the bill was golden yellow. Tarsi and toes grey. The bill becomes black when the nestlings are c.6 days old. By fledging they resemble females. Nestlings remained in the nest 20 ($n = 1$), 25 ($n = 1$) and 28 days ($n = 1$). At another nest with two young, one chick stayed 22 days and the other 25, in alignment with Ruschi (1949b), who mentioned 22–28 days and that the chicks can leave some nests days apart.

On 6 February 2000 between 06.00 and 07.20 h, we monitored two 14-day-old chicks. The female arrived three times at intervals of 20–25 minutes, usually vocalising. She fed the chicks for 30–45 seconds each time. They were fed in various positions: heads turned back with their bills up, heads to one side, or simply facing forwards. On 14 February, the first chick fledged, landing on an adjacent branch. At 07.45 h, the female fed it and then its sibling in the nest. The same day, the nest, which had already been repaired by us before,

began to fall; as it was beyond repair, it was replaced with a nest of the same species (Fig. 44). The adult accepted this and next day, 15 February, she fed the nestling 12 times between 07.20 and 09.00 h, on average every eight minutes, but varying from 4–13 minutes. The second chick fledged on 17 February. In January 2006 and 2007, we observed two nests containing two chicks each, one with two-day-old and the other with eight-day-old young. Observations lasted 120 and 180 minutes, respectively. The younger nestlings were fed five times, and the older ones seven. Feeding bouts lasted 17–61 seconds. On several occasions, the female brooded the nestlings for a few minutes, then perched next to the nest, checked the surroundings, sometimes vocalised, then flew off.

BLACK-THROATED MANGO *Anthracothorax nigricollis*

Widely distributed, from Panama to Argentina and throughout Brazil, it mainly inhabits open areas with sparse trees, forest edges and gardens at various elevations, including *campos rupestres* (Sick 1997, Greeney *et al.* 2022). It is probably the best-known species in terms of breeding among the hummingbirds covered herein (Penard & Penard 1910, Stone 1918, Belcher & Smooker 1936, Hellebrekers 1942, Street 1946, Snow & Snow 1964, Wetmore 1968, Willis 1988, Quesnel 1995, 2002, Greeney & Merino 2006, Vereia *et al.* 2009, Greeney *et al.* 2022). The species' nest was first described from Brazil (Euler 1867, Greeney *et al.* 2022), but relevant data, although abundant, are largely anecdotal (Euler 1900, Ihering 1900, Snethlage 1935, Ruschi 1949b,c, 1973i, Mitchell 1957, Oniki & Willis 1982, 1983, Belton 1984, Grantsau 1988, Sick 1997, Buzzetti & Silva 2008, Kirwan 2009, Pascoal *et al.* 2016).

We observed 16 nests of *A. nigricollis* between 2003 and 2009 in the municipality of Quebrangulo, Alagoas. Nests were found in October ($n = 1$), November ($n = 4$), January ($n = 9$), February ($n = 1$) and April ($n = 1$). The peak, in November–January, coincides with the local dry season. Breeding occurs during the same months in Rio Grande do Sul (Belton 1984), around August in northern Brazil (Snethlage 1935, Oniki & Willis 1983, Kirwan 2009, Pascoal *et al.* 2016) and in March in the south-east (Euler 1900). Penard & Penard (1910) mentioned that in Suriname, it breeds mainly during the wet season and on Barro Colorado Island, Panama, the species nests in December–March (Wetmore 1968).

Nests were found mainly at forest edges or in clearings ($n = 13$) and less commonly inside forest ($n = 3$) on average 2.9 ± 2.2 m (1.1–8.5 m) above ground or water ($n = 16$; Table 16). In the state of Pará, nests were sited much higher, 13–15 m above ground (Oniki & Willis 1983). Most nests were on dry branches of dead trees flooded during



Figure 45. In 2000 this small dam was built in the forest interior in Pedra Talhada Biological Reserve, Quebrangulo, Alagoas, Brazil, and, as a result, several trees died, but were then used by Black-throated Mango *Anthracothorax nigricollis* for nesting (NORDESTA collection)

TABLE 16
Measurements of Black-throated Mango *Anthracothorax nigricollis* nests at Quebrangulo, Alagoas, Brazil. NM
= not measured.

Date found	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground or water (m)
8 Jan 2003	NM	NM	NM	NM	NM	3.8
15 Jan 2003	3.0	1.0	4.0	2.5	1	1.6
16 Jan 2003	NM	NM	NM	NM	NM	1.5
16 Jan 2003	NM	NM	NM	NM	NM	3.6
20 Jan 2003	3.0	1.0	4.0	2.5	1	1.1
12 Nov 2003	NM	NM	NM	NM	NM	1.5
4 Jan 2005	3.0	1.5	5.0	3.0	2	8.5
11 Jan 2005	NM	NM	NM	NM	NM	1.4
7 Nov 2005	3.5	2.0	4.5	2.8	1	2.0
30 Nov 2005	4.0	2.0	6.0	3.0	2	2.8
20 Oct 2007	4.0	2.0	5.0	3.0	2	5.9
17 Jan 2008	NM	NM	NM	NM	NM	6.0
12 Feb 2008	NM	NM	NM	NM	NM	2.1
11 Apr 2008	5.0	3.0	6.0	4.5	1	1.2
16 Nov 2008	3.0	1.5	4.0	3.0	1	1.4
4 Jan 2009	NM	NM	NM	NM	NM	2.2
Mean ± SD	3.6 ± 0.7	1.8 ± 0.7	4.8 ± 0.8	3.0 ± 0.6	1.4 ± 0.5	2.9 ± 2.2
Min.–max.	3–5	1–3	4–6	2.5–4.5	1–2	1.1–8.5

the construction of a dam ($n = 9$), in dead trees in the forest ($n = 1$), or on cashew trees ($n = 3$) and *Ormosia* sp. ($n = 3$). Most nests were completely exposed ($n = 12$). In 2000, a small dam was constructed in the forest interior of Pedra Talhada Biological Reserve and, as a result, some trees died due to the flooding (Fig. 45). From early 2003, we found the first nests of *A. nigricollis* on dry branches over the water in several trees. Probably the same individual nested up to twice in the same season, remodelling an old nest or building a new one nearby. In 2006, all the trees had fallen, so in June 2007 as an experiment we placed some dry branches rising 3–4 m above water, and in just four months there were already two nests of the species, which occurred again in 2008 and 2009. Others have also observed the species nesting on dead branches in water (Snethlage 1935, Kirwan 2009). Some nests are even built on electric wires in urban areas (e.g. WA 5814527, WA 6061955). Materials used were always the same: externally, woolly plant fibres and many lichens, bound with spider webs, and internally vegetal wools and silks.

Nests were supported basally by more or less horizontal forks or thicker single branches and were of the ‘low cup/base’ type, ‘III Type, 2nd sub-type’. Eight nests measured: external diameter 4.8 ± 0.8 cm, internal diameter 3.0 ± 0.6 cm, external height 3.6 ± 0.7 cm, internal height 1.8 ± 0.7 cm; mass 1.4 ± 0.5 g (Table 16). They coincided with that described by Ruschi (1949c), although his was higher and could be classified as ‘high cup/base’, *sensu* Simon & Pacheco (2005), although this type does not exist in their classification. Our nest data generally agree with others available for the species (Quesnel 2002, Greeney & Merino 2006).

TABLE 17
Measurements of Black-throated Mango *Anthracothorax nigricollis* eggs at Quebrangulo, Alagoas, Brazil.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
12 Nov 2003	2	0.8	15.3	10.1
		0.8	16.1	10.0
12 Feb 2008	2	0.8	14.5	9.7
		0.8	14.7	9.8
Mean ± SD	2 ± 0	0.8 ± 0	15.2 ± 0.7	9.9 ± 0.2
Min.–max.	2	0.8	14.5–16.1	9.7–10.1



Figure 46. Adult Black-throated Mango *Anthracothorax nigricollis* feeding two c.11-day-old nestlings, Quebrangulo, Alagoas, Brazil, December 2003 (NORDESTA collection)

All nests we found had two ($n = 15$) white, long-oval eggs. Four eggs measured $15.2 \pm 0.7 \times 9.9 \pm 0.2$ mm; mass 0.8 g (Table 17). Egg measurements were similar to previous reports (Ihering 1900, Snethlage 1935, Belcher & Smooker 1936, Hellebrekers 1942, Ruschi 1949c, Quesnel 2002, Greeney & Merino 2006). The eggs described by Penard & Penard (1910) were smaller and, according to them, slightly greenish, possibly stained by nest material. Incubation lasted 17 days in two nests. Ruschi (1949c, 1973i) mentioned 13–15 days and Quesnel (2002) 16–18 days.

The nestling period was 25 ($n = 2$), 27 ($n = 1$), 28 ($n = 2$) and 29 days ($n = 1$), mean 27.0 ± 1.7 days. Euler (1900) mentioned 20 days, whilst Ruschi (1949c, 1973i) reported 20–23 days and Quesnel (2002) 21–26 days.

Females aggressively defended the area around the nest when other hummingbirds approached. There are records of nesting birds in male plumage in this species (e.g. WA 278862, WA 1671808, WA 290394, WA 2608977, WA 5211685; Quesnel 1995), but since parental care by males is unknown in hummingbirds, it seems that all of these were actually

females (Quesnel 1995, Diamant *et al.* 2021, Falk *et al.* 2021, Clark 2022, Clark *et al.* 2022). The young are provisioned while the adult is perched (Fig. 46).

Of the 16 nests, only five were successful, with at least one chick fledging. Four nests were predated, one by Roadside Hawk *Rupornis magnirostris*, another by Grey-lined Hawk *Buteo nitidus*, and some were destroyed for abiotic reasons ($n = 4$), mainly because many nests were completely exposed. Outcomes for the rest are unknown ($n = 3$).

On 15 January 2003 between 06.40 and 08.40 h, at a nest with young close to fledging, the female arrived four times. Each time, she fed the chicks for 5–10 seconds. On 22 January 2003, in a nest containing two ten-day-old chicks, the female arrived four times during 07.00–09.00 h. This female did not tolerate the presence of any other birds in the same tree as the nest. Four times she was seen to chase another female *A. nigricollis*, as well as three swallows and two other unidentified passerines.

On 23 March 2003 between 07.00 and 09.00 h at a nest with two chicks *c.* 12 days old, the female landed six times on the edge of the nest and fed each young 1–5 times. Feeding bouts lasted 12–28 seconds. She caught insects in flight, returning to the same perch near the nest. This adult vocalised frequently and was extremely aggressive towards any other bird. Once it even flew close to the water surface mobbing a Least Grebe *Tachybaptus dominicus*.

On 13 March 2008, in a nest with a 15-day-old young, the female visited six times at 19–25-minute intervals between 05.50 and 07.50 h. Feeding bouts lasted 12–22 seconds. The female always signalled her arrival by vocalising.

GLITTERING-BELLIED EMERALD *Chlorostilbon lucidus*

This species inhabits forest edges and is often one of the commonest in gardens and other anthropogenic areas in Brazil. *C. lucidus* is distributed from north-east Brazil to Bolivia and south to central Argentina (Sick 1997, Bündgen *et al.* 2020). There are many references to breeding behaviour, both in Brazil (Ihering 1900, Ruschi 1949b,g, 1973e,k, Belton 1984, Grantsau 1988, Sick 1997, Oniki & Antunes 1998, Almeida & Sebaio 2000, Buzzetti & Silva 2008, Baijuk & Jesus 2010, Olmos & Albano 2012, Lopes *et al.* 2013, Nacinovic 2018) or elsewhere (Devicenzi 1925, Wetmore 1926, Smyth 1928, Pereyra 1928, 1931, 1933, 1935, Fraga 1984, Contreras 1987, Azpiroz 2001, Di Giacomo 2005, Gauto Colman & Vetter Hiebert 2019, de la Peña 2019).

We found 21 nests of *C. lucidus* between 1990 and 2010 in Arcos, Minas Gerais ($n = 12$), and Quebrangulo, Alagoas ($n = 9$). On distribution the subspecies involved in both cases is *C. l. pucherani*. Breeding occurred in different periods in the two regions, October–January in Alagoas and February–August in Minas Gerais, with August being the peak in the latter (Fig. 47). These are mainly dry periods in these areas. Grantsau (1988) indicated that *C. l. aureoventris* nests in November–February and *C. l. pucherani* in August–March. De la Peña (2019) stated that the species nests August–March in Argentina.

Nests were found mainly in semi-open landscapes such as *capoeira* and *cerrado* ($n = 11$), but also in forest edges or clearings ($n = 5$), open landscapes ($n = 3$) and in forest ($n = 2$). Nests were on average 2.2 ± 1.0 m (0.3–3.9 m) above ground ($n = 21$; Table 18). A variety of tree species was used for nesting (Table 18), as well as emergent roots in roadcuts ($n = 5$; Fig. 48) and man-made substrates, such as a rafter in a house ($n = 1$) and an electric wire ($n = 1$; Fig. 49). Electricity was implanted in the rural area of Arcos, Minas Gerais, in 1998, since when *C. lucidus* has frequently nested on electric wires. In general, nests were on thin supports and, depending on their thickness, the material can completely cover the support. They can be classified as ‘low cup/base’, ‘low cup/side’, or ‘high cup/side’, ‘III Type’. Lopes *et al.* (2013) considered them to be ‘low cup/pensile’. Nests measured: external diameter 4.3 ± 0.6 cm ($n = 16$), internal diameter 2.8 ± 0.6 cm ($n = 16$), external height 4.5 ± 2.1 cm ($n = 15$),

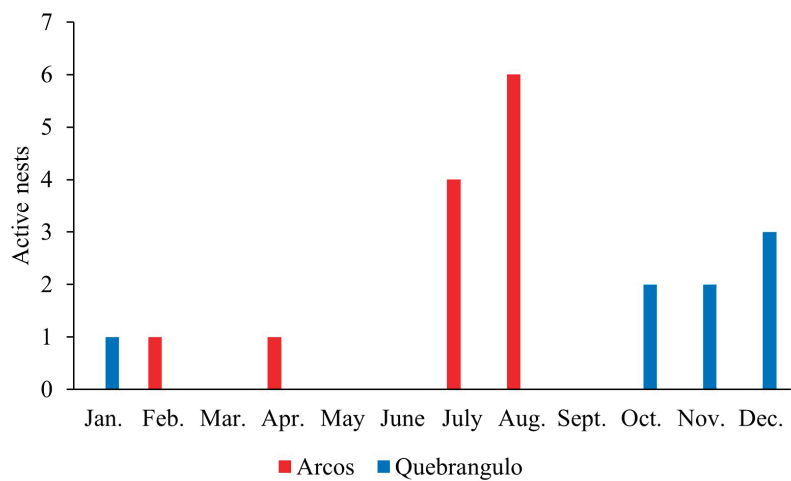


Figure 47. Number of active nests by month (based on date of discovery) of Glittering-bellied Emerald *Chlorostilbon lucidus* at Arcos, Minas Gerais (*n* = 12) and Quebrangulo, Alagoas (*n* = 8).

TABLE 18
Measurements of Glittering-bellied Emerald *Chlorostilbon lucidus* nests found at various sites in Brazil. NM = not measured. NI = not identified.

Date found	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)	Site
13 Apr 1990	3	1.5	4.0	2.5	NM	1.6	<i>Qualea</i> sp.
20 Aug 1990	3	1.5	5.0	4.0	NM	0.3	NI
13 Feb 1991	8	2.0	4.0	3.5	NM	0.7	Wooden rafter in the barn
14 Jul 1993	3	1.5	5.0	3.0	NM	2.1	Electric plug hole
18 Jul 1993	NM	NM	NM	NM	NM	1.9	Roots in a roadside ravine
18 Jul 1993	9	2.0	5.0	3.0	NM	3.4	Roots in a roadside ravine
28 Jul 1993	NM	NM	NM	NM	NM	1.4	Roots in a roadside ravine
1 Aug 1993	3	2.0	4.0	2.5	NM	2.6	<i>Qualea</i> sp.
8 Aug 1993	5	2.0	4.0	3.0	NM	2.7	Roots in a roadside ravine
25 Nov 1995	NM	NM	NM	NM	NM	3.6	<i>Vismia guianensis</i>
19 Aug 1996	7	1.5	5.0	3.0	NM	2.3	Roots in a roadside ravine
22 Aug 1996	5	2.0	4.0	3.0	NM	2.5	<i>Musa</i> sp.
5 Aug 1998	4	1.5	4.0	2.0	2.5	3.0	Electrical wire in house wall
25 Dec 2003	NM	NM	NM	NM	NM	0.65	<i>Qualea</i> sp.
1 Jan 2008	NM	2.0	4.5	2.5	NM	1.5	<i>Casearia arborea</i>
4 Dec 2008	3	1.5	5.0	3.0	NM	3.5	<i>Byrsonima crispa</i>
30 Dec 2008	2	1.0	3.0	2.0	6.0	3.1	<i>Clusia nemorosa</i>
17 Oct 2009	3	1.5	4.0	2.5	NM	2.6	<i>Cupania impressinervia</i>
7 Oct 2010	5	2.0	4.5	3.5	2.0	3.9	<i>Byrsonima crispa</i>
4 Nov 2010	4	1.0	4.0	2.0	3.0	2.3	<i>Baccharis serrulata</i>
?	NM	NM	NM	NM	NM	0.8	<i>Artocarpus heterophyllus</i>
Mean ± SD	4.5 ± 2.1	1.7 ± 0.4	4.3 ± 0.6	2.8 ± 0.6	3.4 ± 1.8	2.2 ± 1.0	
Min.–max.	2–9	1–2	3–5	2–4	2–6	0.3–3.9	

TABLE 19
Measurements of Glittering-bellied Emerald *Chlorostilbon lucidus* eggs found at various sites in Brazil. NM = not measured.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
13 Apr 1990	2	0.4	13.2	8.2
		0.4	12.7	7.7
20 Aug 1990	2	0.4	14.4	9.8
		0.3	14.4	9.8
13 Feb 1991	2	0.4	12.2	8.3
		0.4	12.7	8.3
14 Jul 1993	2	0.3	12.7	8.3
		0.3	12.7	8.3
18 Jul 1993	2	0.4	12.7	8.3
		NM	12.7	8.3
1 Aug 1993	2	0.3	12.7	8.8
		0.3	13.7	8.3
8 Aug 1993	2	NM	12.7	8.0
		NM	12.7	8.5
25 Nov 1995	2	0.4	12.8	8.3
		0.5	12.6	8.5
19 Aug 1996	2	0.4	12.0	8.3
22 Aug 1996	2	0.6	13.4	8.1
		0.5	13.3	8.7
25 Dec 2003	2	0.5	13.2	8.3
17 Oct 2009	2	0.4	11.4	7.1
Mean ± SD	2 ± 0	0.4 ± 0.1	12.9 ± 0.7	8.4 ± 0.6
Min.–max.	2	0.3–0.6	11.4–14.4	7.1–9.8

internal height 1.7 ± 0.4 cm ($n = 16$); mass 3.4 ± 1.8 g ($n = 3$) (Table 18). Our measurements align with previous reports (Devicenzi 1925, Ruschi 1949g, Di Giacomo 2005). Ruschi (1949g) noted that the species commonly uses electric wires and threads as support, as also observed by Fraga (1984), Sick (1997) and Di Giacomo (2005).

Externally, materials used in 12 nests were: plant fragments ($n = 1$), lichen and plant wool ($n = 1$), lichen and moss ($n = 1$), bark and webs ($n = 2$) or plant bark and webs with plant fibres ($n = 2$), with feathers ($n = 1$), with flower seeds ($n = 1$), with dried leaves ($n = 1$) or with lichens ($n = 2$). Internally, 11 nests contained domestic wool ($n = 1$), plant wool ($n = 6$), plant wool with plant fibres ($n = 3$) and plant wool with webs ($n = 1$). There was a preference for plant wool internally (90.9%) and bark with spider webs externally (75%). Materials used also match the prior literature (Devicenzi 1925, Ruschi 1949g, Oniki & Antunes 1998, Di Giacomo 2005). Ruschi (1949g) mentioned that material on the outside varies according to the environment, tending towards a colour that offers camouflage. Di Giacomo (2005) mentioned that near sheep farms, nests can be lined almost exclusively with the species’ wool. A nest at Arcos, in September 1996, mass 2 g, contained 117 pieces of bark and 33 dried leaf fragments. Also at Arcos, on 22 March 1990, we found a female building a nest on



Figure 48. Nest of Glittering-bellied Emerald *Chlorostilbon lucidus* on emergent root in road cut, Arcos, Minas Gerais, Brazil, August 1996 (NORDESTA collection)

a wire. On 26 March, the nest collapsed and a second nest was initiated on the same wire, c.10 cm higher than the previous one. On 1 April, the second nest was completed; between 5 and 11 April, the outer walls were camouflaged with fragments of bark and plant fibres. The first egg was laid on 13 April 1990, but the nest was constantly repaired, and more camouflage was added throughout the incubation period. At Arcos, on 1 July 1993, a female built a new nest on an old structure, suspended from a wire hanging from the ceiling of a room in a farm. The nest was completed on 14 July and the eggs laid on 18 July. Several authors have mentioned that it is common for the species to build a new nest atop an old one (Ruschi 1949g, Sick 1997, Di Giacomo 2005, Baijuk & Jesus 2010). Curiously, also at Arcos between 2 and 15 July 1993, a female built two nests at the same time in the same tree, 2.5 m above ground. After 12 days, she laid an egg in one of them, but a day later both nests were destroyed by a tractor.

Clutches always contained two ($n = 9$), all-white, long-oval eggs ($n = 16$), measuring $12.9 \pm 0.7 \times 8.4 \pm 0.6$ mm ($n = 21$); mass 0.4 ± 0.1 g ($n = 18$) (Table 19), similar to previous reports in the literature (Ruschi 1949g, Oniki & Antunes 1998). The incubation period was 16 ($n = 1$), 18 ($n = 1$) and 19 days ($n = 3$). Ruschi (1949g) mentioned an incubation period of 14 days, Fraga (1984) and Di Giacomo (2005) 15 days.

The nestling period was 21 ($n = 1$) and 22 days ($n = 2$). Pereyra (1931) reported 20 days, Fraga (1984) 21–23 days, and Almeida & Sebaio (2000) and Di Giacomo (2005) 20–22 days. Ruschi (1949g) initially mentioned 29 days, but subsequently he reported a period of 20–22 days (Ruschi 1973k).

Nestlings hatch practically naked, except some low, sparse grey down. The dorsal skin is black, whilst the belly is pink. The bill is yellowish with a reddish mouth.

At Arcos, eggs were laid in a nest on 18 July 1993, and thereafter the female was absent every night until the chicks hatched. Even on the night they hatched, on 6 August, she was

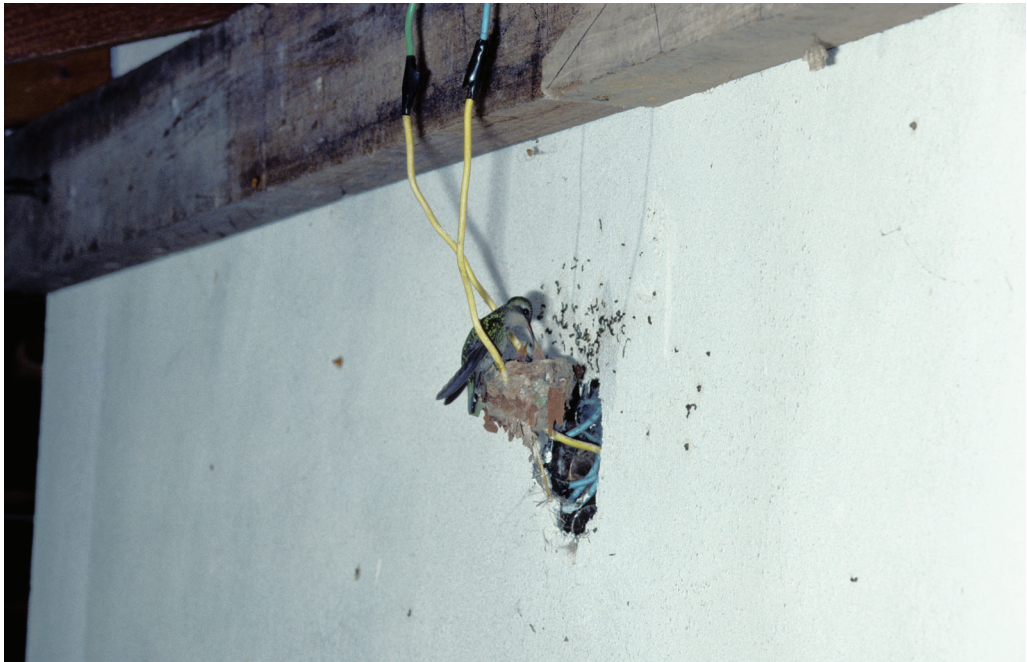


Figure 49. Nest of Glittering-bellied Emerald *Chlorostilbon lucidus* on electric wire in a house, Arcos, Minas Gerais, Brazil, August 1998 (NORDESTA collection)

not present. On the other hand, throughout the nestling phase until the chicks were 15 days old, she remained on the nest every night. The young were fed while the female was perched (Fig. 49). The two young fledged on the morning of 23 August. Almeida & Sebaio (2000) reported that the female spent the night with the chicks during the first week post-hatching but did not return to the nest after 18.00 h in the second week.

FORK-TAILED WOODNYMPH *Thalurania furcata*

Widely distributed in South America, *T. furcata* occurs mainly in humid forest, often visiting gardens, practically throughout Brazil, except the Atlantic Forest and most of the Caatinga (Sick 1997, Meller *et al.* 2019, Stiles *et al.* 2020). Although common in much of its range, breeding is still little known in Brazil (Ruschi 1949b,g, Oniki & Willis 1983, Grantsau 1988, Sick 1997, Guilherme & Lima 2020b) and elsewhere (Penard & Penard 1910, Skutch 1981, Haverschmidt & Mees 1994, Greeney *et al.* 2004, Greeney & Gelis 2008).

We made observations at six nests between 1993 and 2024 in Arcos, Minas Gerais ($n = 5$) and Pacoti, Ceará ($n = 1$). Nests were active between August and December in Minas Gerais and in January in Ceará. Penard & Penard (1910) reported that it nests during the wet season, whereas Skutch (1981) mentioned that nesting starts in the dry season and continues into the wet season, agreeing with our observations in Brazil. Grantsau (1988) indicated that breeding occurs in December and March.

Nests are sited low in forest (0.5–2.0 m; $n = 5$), supported basally and/or laterally on branches or in forks of understorey shrubs (Fig. 50). Ruschi (1949g) mentioned a nest on a vine. One nest in Minas Gerais was measured the day after the chicks fledged: external diameter 4 cm, internal diameter 2 cm, external height 5 cm, internal height 2 cm; mass 1.2 g. It was constructed of 163 pieces of lichen, 33 millet seeds, six unidentified flower fragments, two feathers, one mammal hair, two small stalks of grass and many spider webs. On 9 January 2023, MAC observed a female collecting nest materials at Pacoti, Ceará.



Figure 50. Nest of Fork-tailed Woodnymph *Thalurania furcata*, Arcos, Minas Gerais, Brazil, August 2018 (NORDESTA collection)

Figure 51. Dry leaf of *Inga* sp. (Fabaceae) showing hairy structures on its underside, which are galls formed by Diptera gall-inducing insects of the family Cecidomyiidae and which were collected by a Fork-tailed Woodnymph *Thalurania furcata* for nest construction, Pacoti, Ceará, Brazil, January 2023 (Marco A. Crozariol)

Figure 52. Nest and eggs of Fork-tailed Woodnymph *Thalurania furcata*, Pacoti, Ceará, Brazil, January 2004 (Marco A. Crozariol)

Among them, the bird was seen removing small tufts of hairy material from the underside of a dry *Inga* sp. (Fabaceae) leaf entangled among vines c.2 m above ground. The leaf was collected (Fig. 51) and it was found that the hairy material was galls formed by gall-inducing Diptera of the family Cecidomyiidae. Although MAC was unable to find the nest, the bird's behaviour strongly indicated it was collecting materials for this purpose. We have found no references to the use of galls for nestbuilding in birds and, probably, they are not commonly used. Nests can be classified as 'high cup/base' or 'Type III' in alignment with

TABLE 20
Measurements of Fork-tailed Woodnymph *Thalurania furcata* eggs found at two sites in Brazil. NM = not measured.

Locality	Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
Arcos/MG	01 Oct 1993	2	NM	12.7	10.9
			NM	13.3	10.9
Arcos/MG	22 Oct 1994	2	0.6	13.8	10.9
			0.6	13.4	10.9
Pacoti/CE ¹	29 Jan 2024	2	0.608	14.2	8.7
			0.605	14.3	8.6
Mean ± SD		2 ± 0	0.603 ± 0.0	13.6 ± 0.6	10.2 ± 1.2
Min.–max.		2	0.6–0.608	12.7–14.3	8.6–10.9

¹ Eggs weighed using a high-precision scale, 0.001 g

the literature (Skutch 1949g, 1981, Oniki & Willis 1983, Greeney & Gelis 2008, Guilherme & Lima 2020b). Guilherme & Lima (2020b) classified the nest as the ‘low cup/fork’ type.

Clutches comprised two eggs, white, long-oval in shape (Fig. 52) and measured $13.6 \pm 0.6 \times 10.2 \pm 1.2$ mm ($n = 6$); mass 0.6 ± 0.0 g ($n = 4$; Table 20). The incubation period was 17 days in one nest and the nestling period was 22 days in another nest. Ruschi (1949g) mentioned two eggs, an incubation period of 18 days and a fledging period of 22–25 days. Oniki & Willis (1983) reported periods of 18–19 and 23 days and Grantsau (1988) an incubation period of only 14–15 days and a nestling period of 22–26 days.

On 8 October 1993 at Arcos, we monitored a nest with two seven-day-old chicks between 07.00 and 08.40 h. The female arrived four times at intervals of 11 minutes and twice at intervals of 22 minutes. Each time she landed on the nest edge and immediately fed the nestlings for 5–7 seconds, inserting her bill inside the chick’s and regurgitating the food. On every visit the female brooded the chicks for a few seconds then left. On 10 October from 08.00–09.40 h, now with nine-day-old chicks, the female arrived five times at 14–31-minute intervals. On 13 October from 07.00–07.02 h, we filmed an adult consuming faecal sacs of its young. Trochilids are not regularly observed removing faecal sacs, but there are specific records, e.g., for Sapphire-spangled Emerald *Chionomesa lactea* (Oniki *et al.* 2000).

LONG-TAILED WOODNYMPH *Thalurania watertonii*

Endemic to north-east Brazil, in Pernambuco and Alagoas, *T. watertonii* inhabits the interior and edge of Atlantic Forest (Berryman *et al.* 2023). Very little is known about the species’ ecology, including breeding (see Berryman *et al.* 2023).

We made observations at 60 nests of *T. watertonii* between 1990 and 2023 in Quebrangulo, Alagoas. Active nests were found between September and February, with a peak in October–December (Fig. 53), at the end of the local rainy season.

Nests were mainly in forest ($n = 54$), but a few were at edges or in clearings ($n = 4$) or in forests fragment ($n = 1$). They were on average 1.3 ± 0.6 m (0.45–3.3 m) above ground ($n = 59$; Table 21), on various shrubby plants, e.g. *Eschweilera ovata* (Lecythidaceae, $n = 6$), *Myrcia guianensis* (Myrtaceae, $n = 5$) and *Guapira graciliflora* (Nyctaginaceae, $n = 5$) (Table 21).

Nests were cup-shaped and supported basally by relatively thin horizontal or slightly inclined branches, single or in forks (Fig. 54). Nests measured: external diameter 5.2 ± 0.6 cm ($n = 33$), internal diameter 3.1 ± 0.5 cm ($n = 33$), external height 5.3 ± 0.8 cm ($n = 32$), internal height 1.8 ± 0.4 cm ($n = 33$); mass 1.7 ± 0.6 g ($n = 35$) (Table 21). They can be classified as ‘low

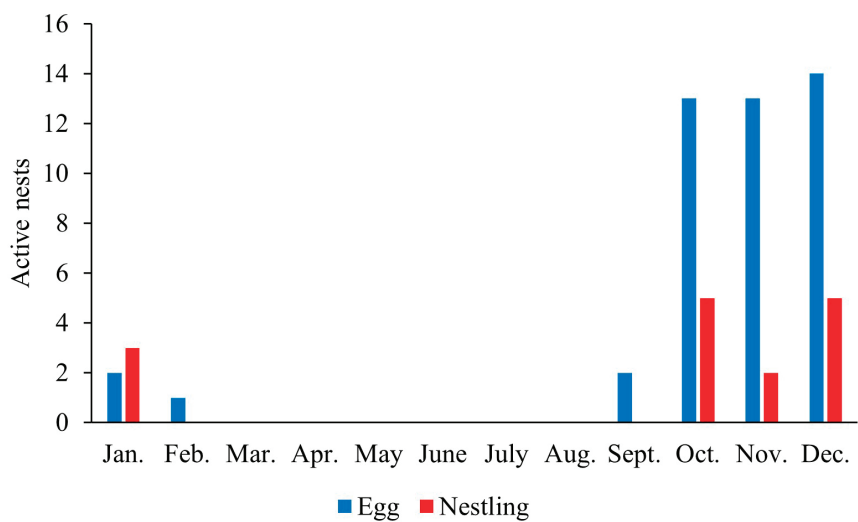


Figure 53. Number of active nests with eggs or nestlings by month (based on date of discovery) of Long-tailed Woodnymph *Thalurania watertonii* at Quebrangulo, Alagoas, Brazil.

TABLE 21
Measurements of Long-tailed Woodnymph *Thalurania watertonii* nests at Quebrangulo, Alagoas, Brazil. NM = not measured. NI = not identified.

Date found	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)	Supporting plant
4 Feb 1990	4.0	1.5	5.0	3.0	3	0.8	NI
7 Oct 1992	4.0	2.0	4.0	3.0	NM	0.75	NI
13 Dec 1993	NM	NM	NM	NM	NM	1.3	NI
3 Oct 1996	NM	NM	NM	NM	NM	1.8	NI
4 Dec 1996	NM	NM	NM	NM	NM	1.8	NI
6 Oct 1998	6.0	2.0	5.0	3.0	1	0.6	<i>Taquara micrantha</i>
29 Oct 1998	4.5	2.0	5.0	3.5	1	0.8	NI
1 Nov 1998	5.0	2.0	5.0	3.0	1	0.8	<i>Genipa americana</i>
24 Nov 1998	7.0	2.0	5.0	3.0	NM	1.8	<i>Myrcia guianensis</i>
5 Jan 1999	NM	NM	NM	NM	NM	0.45	NI
11 Nov 1999	4.0	1.5	5.0	3.0	1	0.85	<i>Erythroxylum squamatum</i>
17 Nov 1999	5.0	2.0	5.0	4.0	2	0.65	<i>Myrcia guianensis</i>
3 Dec 1999	6.0	2.0	5.0	3.0	3	0.65	<i>Monteverdia obtusifolia</i>
6 Dec 1999	5.0	1.5	5.5	3.0	2	1.3	<i>Eschweilera ovata</i>
22 Dec 1999	5.0	2.5	6.0	4.0	2	0.7	<i>Myrcia guianensis</i>
26 Dec 1999	5.0	3.0	5.0	3.0	2	1.2	<i>Myrcia guianensis</i>
26 Jan 2000	5.0	1.5	5.0	3.0	2	0.7	<i>Guapira graciliflora</i>
5 Nov 2001	NM	NM	NM	NM	NM	1.5	NI
5 Dec 2001	NM	NM	NM	NM	NM	1.8	NI
13 Oct 2002	NM	2.0	5.0	2.5	1	1.4	<i>Manihot esculenta</i>

25 Oct 2002	5.0	3.0	5.0	5.0	1	1.6	NI
10 Dec 2002	NM	NM	NM	NM	NM	0.75	NI
20 Dec 2002	NM	NM	NM	NM	NM	1.8	NI
10 Oct 2003	NM	NM	NM	NM	2	1.5	<i>Guapira graciliflora</i>
22 Oct 2003	NM	NM	NM	NM	1	1.8	<i>Guapira graciliflora</i>
5 Nov 2003	NM	NM	NM	NM	1	1.3	<i>Trichilia lepidota</i>
6 Nov 2003	NM	NM	NM	NM	2	1.2	NI
9 Dec 2003	NM	NM	NM	NM	2	1.6	<i>Tachigali densiflora</i>
16 Dec 2003	NM	NM	NM	NM	NM	1.6	NI
18 Dec 2003	NM	NM	NM	NM	NM	1.8	NI
4 Oct 2004	5.5	1.5	5.0	3.0	2	1.2	NI
21 Oct 2004	5.0	1.5	4.5	2.5	2	0.65	<i>Monteverdia obtusifolia</i>
26 Oct 2004	4.5	2.0	5.0	2.5	1	0.75	NI
16 Oct 2005	NM	NM	NM	NM	NM	1.4	NI
8 Nov 2005	5.0	1.5	7.0	3.0	3	1.4	<i>Campomanesia laurifolia</i>
21 Nov 2005	5.0	2.0	4.5	2.5	1	1.5	<i>Guapira graciliflora</i>
19 Dec 2005	6.0	2.0	4.7	3.0	2	1.6	NI
27 Dec 2005	6.0	2.0	5.0	3.0	2	0.65	<i>Guapira graciliflora</i>
1 Dec 2006	5.0	1.5	6.0	3.0	2	1.5	<i>Eschweilera ovata</i>
20 Nov 2007	6.0	2.0	5.0	2.5	1	0.8	<i>Tachigali densiflora</i>
30 Nov 2007	4.5	1.0	5.0	2.5	1	1.2	NI
7 Dec 2007	5.0	1.0	6.0	3.0	1	0.55	<i>Eschweilera ovata</i>
24 Dec 2007	6.5	1.5	4.5	3.0	2	1.6	NI
14 Jan 2008	5.0	1.5	6.0	4.0	NM	0.65	<i>Eschweilera ovata</i>
4 Dec 2008	5.0	1.5	6.0	3.0	1	0.55	<i>Myrcia guianensis</i>
22 Dec 2008	6.0	2.0	5.0	3.0	1	1.4	<i>Eschweilera ovata</i>
6 Nov 2009	7.0	2.0	6.0	3.0	2	1.6	<i>Byrsonima sericea</i>
15 Oct 2010	6.0	2.0	6.0	3.0	2	1.7	NI
31 Jan 2017	NM	NM	NM	NM	NM	1.4	<i>Vochysia dardanoi</i>
23 Sep 2017	NM	NM	NM	NM	NM	1.3	NI
26 Sep 2017	NM	NM	NM	NM	NM	0.7	NI
29 Oct 2017	NM	NM	NM	NM	NM	1.5	NI
27 Nov 2017	NM	NM	NM	NM	NM	3.3	NI
2 Jan 2018	5.0	2.0	5.0	3.5	2	1.2	NI
18 Nov 2020	NM	NM	NM	NM	NM	2.5	<i>Symphonia globulifera</i>
27 Nov 2020	NM	NM	NM	NM	NM	2.5	NI
13 Oct 2022	NM	NM	NM	NM	NM	1.5	<i>Eschweilera ovata</i>
21 Oct 2022	NM	NM	NM	NM	NM	1.5	NI
23 Oct 2023	NM	NM	NM	NM	NM	2.0	NI
Mean ± SD	5.3 ± 0.8	1.8 ± 0.4	5.2 ± 0.6	3.1 ± 0.5	1.7 ± 0.6	1.3 ± 0.6	
Min.-max.	4-7	1-3	4-7	2.5-5.0	1-3	0.45-3.3	

TABLE 22

Measurements of Long-tailed Woodnymph *Thalurania watertonii* eggs at Quebrangulo, Alagoas, Brazil. NM = not measured.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
4 Feb 1990	2	0.5	13.8	9.5
		0.5	13.9	9.4
7 Oct 1992	2	NM	13.3	9.9
		NM	13.7	9.9
4 Dec 1996	2	0.8	14.0	9.2
		0.9	14.3	9.4
6 Oct 1998	2	0.7	14.8	9.5
		0.7	14.9	9.4
29 Oct 1998	2	0.7	14.1	9.5
		0.7	14.1	9.4
1 Nov 1998	2	0.5	13.2	9.1
		0.5	13.3	9.2
5 Jan 1999	2	0.8	14.5	10.2
		0.7	14.4	10.8
11 Nov 1999	2	0.6	14.1	9.5
		0.5	14.7	9.2
22 Dec 1999	2	0.5	14.1	8.9
		0.5	13.6	9.0
26 Jan 2000	2	0.6	14.7	9.6
		0.6	14.4	9.6
Mean ± SD	2 ± 0	0.6 ± 0.1	14.1 ± 0.5	9.5 ± 0.4
Min.–max.	2	0.5–0.9	13.2–14.9	8.9–10.8

cup/base’, ‘low cup/side’, or ‘high cup/base’ and ‘high cup/side’, ‘III Type’. Of 32 nests, 20 were low cup and 12 were high cup (Table 21). Materials used externally in 12 nests were: plant wool ($n = 1$), plant wool and lichen ($n = 2$), plant wool, lichens and spider webs ($n = 3$), plant wool, lichens, spider webs and mosses ($n = 1$), lichens, spider webs and mosses ($n = 2$), lichens, mosses and other unidentified plant fragments ($n = 1$), webs and bark fragments ($n = 1$), and webs, fine roots, feathers and other unidentified plant fragments ($n = 1$). Internally, they incorporated plant wool ($n = 9$), feathers ($n = 1$), webs and small unidentified plant fragments ($n = 1$) and plant wool, lichens, mosses and webs ($n = 1$). Externally the most used materials were lichens (75% of nests), spider webs (66.6%), plant wool (58.3%) and mosses (33.3%); and internally plant wool (83.3%). Externally, the most commonly used lichens were greenish, although reddish lichens were also observed.

We did not observe the species using the same nest more than once, probably because nests are fragile and simply do not survive until the next season. However, it seems faithful to territories, as nests are found close together in different years, *c.*1 m or less, usually on the same plant. One nest took *c.*20 days to finalise, and only after the eggs were laid were the outer walls covered with lichens and other materials.



Figure 54. Female Long-tailed Woodnymph *Thalurania watertonii* on nest with nestlings, Quebrangulo, Alagoas, Brazil (NORDESTA collection)

Clutches comprised two white, long-oval eggs measuring $14.1 \pm 0.5 \times 9.5 \pm 0.4$ mm ($n = 20$); mass 0.6 ± 0.1 g ($n = 18$; Table 22). We were unable to determine the incubation period precisely, but the longest periods were 15 ($n = 1$), 16 ($n = 3$) and 17 ($n = 1$) days.

On hatching, chicks have reddish-brown skin dorsally and reddish skin on the belly, with dark brown down. Bill yellow with a black tip. When they fledge, the young have plumage similar to adult females. Nestlings defecate by positioning their tail outside the nest. They stayed in the nest for 20 ($n = 2$), 21 ($n = 2$), 22 ($n = 2$), 24 ($n = 2$), 25 ($n = 1$), 26 ($n = 2$) and 28 days ($n = 2$). Females feed the nestlings while perched on the edge of the nest (Fig. 54). Generally, the species is aggressive towards other birds approaching its nest and also defends favoured flowers for feeding.

On 18 November 1998 between 05.40 and 07.20 h, we observed a nest with two 23-day-old chicks. At 06.00 h, the female arrived to feed the chicks and chased a White-throated Spadebill *Platyrinchus mystaceus*, during which she emitted a series of rapid, high-pitched *ti ti ti ti* notes several times. When it returned at 06.30 h, before feeding the chicks it chased an East Amazonian Fire-eye *Pyriglena leuconota* and an unidentified hummingbird, vocalising as before. At this point, one of the chicks fledged, landing on a branch c.2 m away. At 07.02 h, the female returned and flew around looking for the young. At 07.05 h, she found and fed them where they were. At 07.20 h, one young flew further away and our observations finished.

Between 1998 and 2004, four other nests were observed during the same morning period of 120 minutes. These each held two chicks, four, 16, ten and nine days old, respectively. Females landed on the edge of the nest to feed the young. Younger chicks were fed less frequently than older ones, but bouts averaged shorter for the latter. Once fed, the female brooded the young, except those that were 16 days old.

SWALLOW-TAILED HUMMINGBIRD *Eupetomena macroura*

E. macroura occurs from Suriname to Argentina including most Brazilian states, although it is absent from much of Amazonia (Sick 1997, Schuchmann & Kirwan 2020b). It is one of the largest hummingbirds in Brazil and the commonest in many urban areas, especially inhabiting open areas (Sick 1997, Schuchmann & Kirwan 2020b). Possibly, the first illustration and description of the nest was published by Mulsant & Verreaux (1874: 113, fig. 53). Except two records of adults with young in Argentina (Bodrati *et al.* 2016, de la Peña 2019), all published breeding data are from Brazil (Ihering 1900, Dias da Rocha 1911, Davis 1945, Ruschi 1949b,c, 1951, Grantsau 1988, Sick 1997, Oniki & Willis 2000, Pizo & Silva 2001, Stenzel 2012, Marini *et al.* 2012, Lopes *et al.* 2013, Nacinovic 2018).

Observations were made at 38 nests between 1988 and 2020 at Arcos, Minas Gerais ($n = 20$), Quebrangulo, Alagoas ($n = 17$) and Jeremoabo, Bahia ($n = 1$). Across the three locations, breeding occurred year-round, but most records were in July–February (Fig. 56).

Nests (Fig. 57) were built 2.6 ± 1.3 m (0.6 – 7.5 m) above ground ($n = 38$; Table 23) and were supported basally on near-horizontal supports, either forks or thicker single branches. They were sited in natural vegetation ($n = 31$) and on man-made substrates ($n = 7$). Plant species used were many: *Mangifera indica* (Anacardiaceae, $n = 11$), *Anacardium occidentale* (Anacardiaceae, $n = 3$), *Qualea* sp. (Vochysiaceae, $n = 3$), *Terminalia argentea* (Combretaceae, $n = 2$), *Psidium guajava* (Myrtaceae, $n = 2$), *Artocarpus heterophyllus* (Moraceae, $n = 2$), *Solanum lycocarpum* (Solanaceae, $n = 2$), *Prunus* sp. (Rosaceae, $n = 1$), *Annona* sp. (Annonaceae, $n = 1$), *Eugenia dysenterica* (Myrtaceae, $n = 1$), *Cinnamomum* sp. (Lauraceae, $n = 1$) and *Myrsine gardneriana* (Primulaceae, $n = 1$). All nests on man-made substrates were in the rafters of balconies or storerooms ($n = 7$) in Arcos, Minas Gerais. Most nests were of the ‘low cup/base’ type ($n = 15$), although ‘high cup/base’, a type not proposed by Simon & Pacheco (2005), was also found ($n = 8$) (Table 23), ‘III Type, 2nd sub-type’. Nests measured: external diameter 5.0 ± 0.8 cm ($n = 24$), internal diameter 3.3 ± 0.6 cm ($n = 25$), external height 4.6 ± 1.1 cm ($n = 24$), internal height 2.3 ± 0.7 cm ($n = 25$); mass 2.5 ± 1.6 g ($n = 11$) (Table 23). Externally, materials used in 17 nests were: only plant wool ($n = 3$), only plant fibres ($n = 1$), plant fibres and lichens ($n = 2$), plant fibres, lichens and spider webs (n

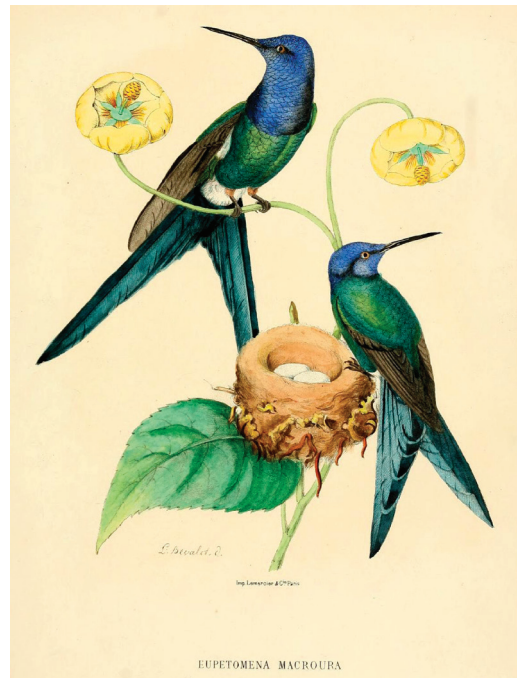


Figure 55. Nest of Swallow-tailed Hummingbird *Eupetomena macroura* illustrated in Mulsant & Verreaux (1874).

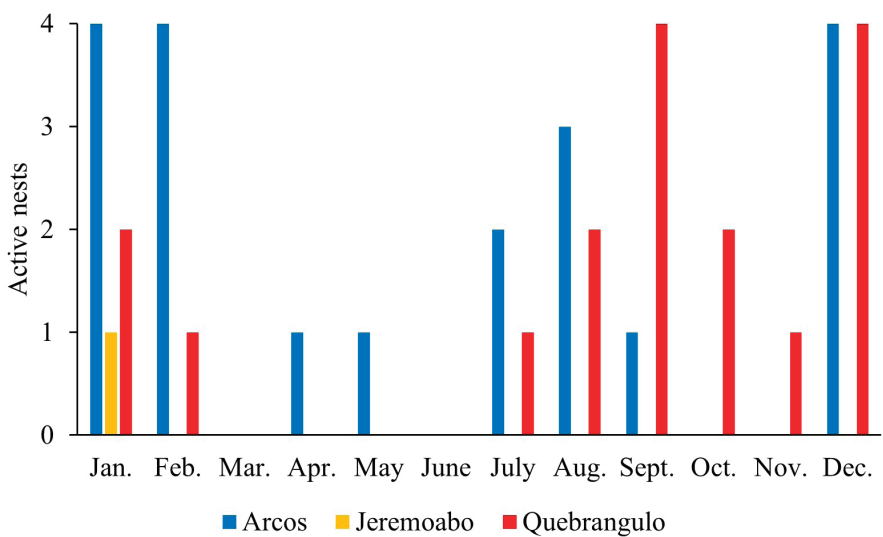


Figure 56. Number of active nests by month (based on date of discovery) of Swallow-tailed Hummingbird *Eupetomena macroura* at Arcos, Minas Gerais ($n = 20$), Quebrangulo, Alagoas ($n = 17$) and Jeremoabo, Bahia ($n = 1$).



Figure 57. Nest of Swallow-tailed Hummingbird *Eupetomena macroura*, Arcos, Minas Gerais, Brazil, December 1996 (NORDESTA collection)

= 2), plant wool with plant bark ($n = 1$), bark and webs ($n = 1$), feathers and webs ($n = 1$), only webs ($n = 1$), webs and mosses ($n = 1$), webs and lichens ($n = 1$), webs, lichens and dry leaves ($n = 1$), webs, lichens and feathers ($n = 1$), as well as nests with only webs, mosses and unidentified plants ($n = 1$) or only feathers and mosses ($n = 1$). Internally, they contained: only plant wool ($n = 6$), only plant fibres ($n = 2$), only cotton ($n = 1$), plant fibres, lichens and

TABLE 23
Measurements of Swallow-tailed Hummingbird *Eupetomena macroura* nests found at three sites in Brazil.
NM = not measured.

Locality	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)
Arcos/MG	3.0	2.5	6.0	4.0	3	3.0
Arcos/MG	4.0	2.0	5.0	3.0	6	0.8
Arcos/MG	4.0	2.5	5.0	4.0	NM	3.0
Arcos/MG	4.0	2.0	5.0	3.5	NM	0.6
Arcos/MG	4.0	1.5	6.0	3.0	NM	1.6
Arcos/MG	4.0	1.5	6.0	2.0	NM	1.6
Arcos/MG	4.5	3.0	4.5	3.5	NM	2.5
Arcos/MG	5.0	2.5	6.0	4.0	NM	1.2
Arcos/MG	5.0	4.0	4.0	3.5	NM	2.3
Arcos/MG	6.0	5.0	4.0	3.0	NM	1.1
Arcos/MG	7.0	2.0	6.0	3.0	3	2.3
Arcos/MG	NM	2.5	6.0	3.0	4	1.9
Arcos/MG	NM	NM	NM	NM	NM	2.0
Arcos/MG	NM	NM	NM	NM	NM	2.0
Arcos/MG	NM	NM	NM	NM	NM	1.1
Arcos/MG	NM	NM	NM	NM	NM	1.6
Arcos/MG	NM	NM	NM	NM	NM	3.0
Arcos/MG	NM	NM	NM	NM	NM	3.3
Arcos/MG	NM	NM	NM	NM	NM	2.2
Arcos/MG	NM	NM	NM	NM	NM	3.0
Jeremoabo/BA	4.0	2.5	3.0	2.5	NM	3.4
Quebrangulo/AL	3.0	2.5	4.5	4.0	1	2.1
Quebrangulo/AL	3.5	2.0	5.0	3.0	1	2.6
Quebrangulo/AL	4.0	2.0	5.0	3.0	NM	2.1
Quebrangulo/AL	4.0	2.5	5.5	4.0	NM	1.65
Quebrangulo/AL	4.0	1.5	5.0	4.0	1	3.6
Quebrangulo/AL	4.0	1.5	5.0	3.0	1	2.2
Quebrangulo/AL	5.0	3.0	5.0	4.3	NM	2.5
Quebrangulo/AL	5.0	2.0	5.0	3.0	2	3.0
Quebrangulo/AL	5.0	2.0	4.0	2.0	NM	4.0
Quebrangulo/AL	5.5	2.0	5.0	3.0	3	2.7
Quebrangulo/AL	6.0	2.0	NM	3.0	NM	2.6
Quebrangulo/AL	7.0	2.0	5.0	3.5	2	4.5
Quebrangulo/AL	NM	NM	NM	NM	NM	5.5
Quebrangulo/AL	NM	NM	NM	NM	NM	4.5
Quebrangulo/AL	NM	NM	NM	NM	NM	7.5
Quebrangulo/AL	NM	NM	NM	NM	NM	2.5
Quebrangulo/AL	NM	NM	NM	NM	NM	3.3
Mean ± SD	4.6 ± 1.1	2.3 ± 0.7	5.0 ± 0.8	3.3 ± 0.6	2.5 ± 1.6	2.6 ± 1.3
Min.–max.	3–7	1.5–5.0	3–6	2.0–4.3	1–6	0.6–7.5

TABLE 24

Measurements of Swallow-tailed Hummingbird *Eupetomena macroura* eggs found at three sites in Brazil.

NM = not measured.

Locality	Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
Arcos/MG	13 Apr 1988	2	0.8	14.2	10.7
			0.8	15.7	10.9
Arcos/MG	20 Jan 1989	2	0.6	16.1	10.5
			0.6	15.5	10.5
Arcos/MG	30 Jul 1989	2	1.0	15.9	10.5
			1.0	15.5	10.9
Arcos/MG	9 May 1990	2	0.6	15.5	10.5
			NM	NM	NM
Arcos/MG	24 Dec 1990	2	0.8	16.0	10.9
			0.8	15.8	10.5
Arcos/MG	9 Aug 1993	2	0.6	15.9	9.5
			0.6	16.0	10.9
Arcos/MG	12 Feb 1996	2	1.0	16.3	11.1
			1.0	16.3	11.0
Arcos/MG	29 Dec 1996	2	0.7	14.9	10.0
			0.6	14.8	9.9
Arcos/MG	15 Feb 1997	2	0.7	14.7	9.9
			0.8	15.7	9.9
Arcos/MG	20 Jul 1998	2	1.0	16.5	10.7
			1.0	16.7	10.7
Jeremoabo/BA	9 Jan 2008	2	NM	14.5	9.8
			NM	14.7	8.5
Quebrangulo/AL	21 Aug 1996	2	0.6	16.8	10.5
			0.6	15.5	10.3
Quebrangulo/AL	16 Dec 1998	2	0.8	15.0	10.0
			0.7	14.4	10.9
Quebrangulo/AL	17 Jan 1999	2	1.0	16.1	11.6
			1.0	16.1	11.6
Quebrangulo/AL	25 Sep 1999	2	1.0	16.8	11.9
			1.0	16.1	11.7
Quebrangulo/AL	29 Feb 2000	2	0.8	15.7	10.4
			0.9	15.2	10.8
Quebrangulo/AL	16 Dec 2000	2	0.8	15.7	10.9
			0.8	14.2	10.7
Quebrangulo/AL	1 Aug 2001	2	0.8	14.2	10.7
			1.0	15.7	10.9
Quebrangulo/AL	6 Nov 2001	2	1.0	15.1	11.2
			1.0	15.2	11.3
	Mean ± SD	2 ± 0	0.8 ± 0.2	15.5 ± 0.7	10.6 ± 0.7
	Min.–max.	2	0.6–1.0	14.2–16.8	8.5–11.9



Figure 58. Adult Swallow-tailed Hummingbird *Eupetomena macroura* feeding nestlings, Arcos, Minas Gerais, Brazil, March 2000 (NORDESTA collection)

spider webs ($n = 1$), plant wool with webs ($n = 1$), webs and feathers ($n = 1$), webs, feathers and mosses ($n = 1$), webs and dry leaves ($n = 1$) and, finally, only unidentified plants ($n = 2$). There was a prevalence of plant wool, both inside ($n = 11$) and outside the nest ($n = 11$), as well as spider webs internally ($n = 5$) but mainly on the outside ($n = 9$). Nests were similar to those described in the literature (Ihering 1900, Ruschi 1949c, Grantsau 1988, Sick 1997).

Clutches always involved two, white, oval or elliptical eggs measuring $15.5 \pm 0.7 \times 10.6 \pm 0.7$ mm ($n = 37$); mass 0.8 ± 0.2 g ($n = 34$) (Table 24). Clutch size agrees with most literature (Ihering 1900, Dias da Rocha 1911, Ruschi 1949c, Grantsau 1988, Marini *et al.* 2012), although Stenzel (2012) reported a nest with three eggs.

Incubation lasted 15 ($n = 1$), 16 ($n = 1$), 17 ($n = 3$) and 18 days ($n = 1$), mean 16.4 ± 1.1 days, in accord with prior observations (Ruschi 1949c, Grantsau 1988, Marini *et al.* 2012). On hatching, chicks were almost entirely naked, except small feathers dorsally. The skin was very dark grey and the bill was buff and slightly pink. Close to fledging, they have plumage similar to the adult (Fig. 58), a black bill with yellowish edges, yellow inside the bill and throat, and grey tarsi. Young remained in the nest 23 ($n = 2$), 24 ($n = 1$), 26 ($n = 2$), 27 ($n = 1$), 29 ($n = 1$) and 32 days ($n = 1$), mean 26.3 ± 3.1 days. Marini *et al.* (2012) indicated 24–25 days, Grantsau (1988) 25 days, whilst Ruschi (1949c) reported 35 days. According to Sick (1997: 444), longer stays occur when foraging opportunities are poor. At Arcos, on 13 April 1988, two young left a nest when 32 days old. They spent the whole day on a nearby branch, where they were fed and, as night approached, returned to the nest. This behaviour continued until they were 38 days old, when they departed the nest for the final time. This datum was not included to calculate the mean nestling period.

Of the 38 nests we found, only eight successfully fledged at least one chick, 20 were predated, four abandoned, three lost due to abiotic reasons, one due to human causes, and the outcomes at two were unknown.

At Arcos, between 2 April and 31 May 1990, we watched a female build a nest in the rafters of an old barn. She half-constructed three nests next to each other, but left all of them unfinished. On 3 June, a fourth nest was started and used for breeding. In the same area, on 10 January 1997, we found an abandoned nest with two eggs. On 15 January, the eggs had disappeared, but on 17th the female returned and laid an egg, completing the clutch next day, but it too was abandoned on 25 January.

Four nests were observed at Quebrangulo between January and March during 1999–2004. Two of these nests held young of 13 and eight days old respectively, another a young of 12 days old, and the last nest two fledglings. Females fed the nestlings 3–4 times in 90–100 minutes. Feeds lasted 28–58 seconds. The fledglings were fed small, winged termites, already reported in the species' diet by Sazima (2008). One female chased away an unidentified hummingbird and a Sayaca Tanager *Thraupis sayaca* that approached the nest. Oniki & Willis (2000) mentioned several species of birds attacked by *E. macroura* when close to the nest, including *T. sayaca*. Once, when it had begun to rain, the female ingested water droplets from the chicks' plumage before brooding them.

VERSICOLOURED EMERALD *Chrysurnia versicolor*

Occurs from Colombia and Venezuela to Argentina and throughout Brazil (Sick 1997, Weller *et al.* 2021a). Although common over most of its range, there are very few breeding data, all from Brazil (Gould 1861, Ruschi 1973l, Grantsau 1988).

We made observations at 15 nests between 1997 and 2022 in Quebrangulo, Alagoas ($n = 13$) and Arcos, Minas Gerais ($n = 2$). Breeding occurred between July and December, peaking in November–December at Quebrangulo (Fig. 59). Grantsau (1988) mentioned breeding between October and March. Belton (1984) collected two males with slightly enlarged testes in October in Rio Grande do Sul.

All nests were in forest, and low, on average 1.3 ± 0.6 m (0.6–3.0 m) above ground or water ($n = 15$; Table 25). The two Arcos nests were close to or above water. Nests were supported basally or laterally, often in three-way forks (Fig. 58). Nests were 'low cup/base', 'low cup/lateral', 'high cup/base' or 'high cup/lateral', and 'III Type'. They had an external

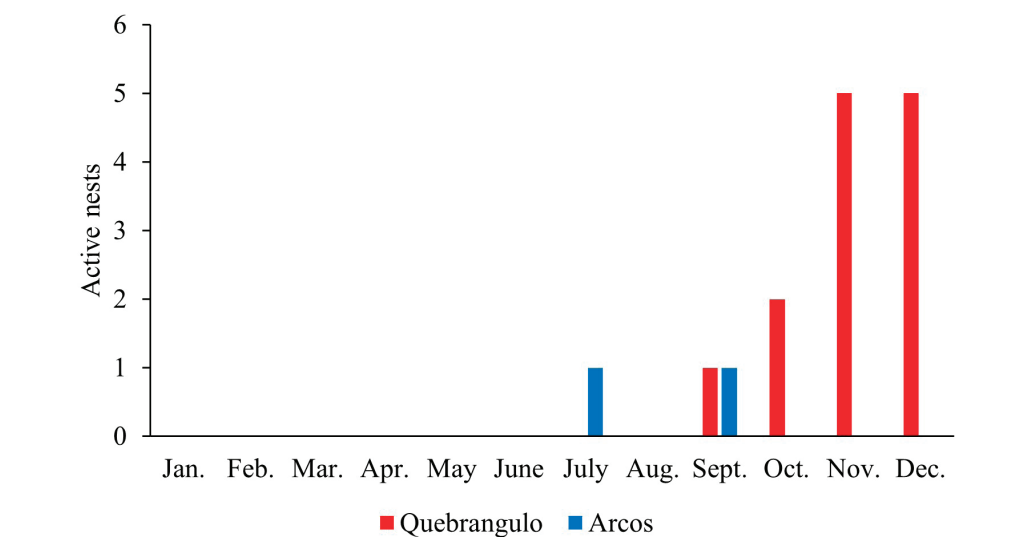


Figure 59. Number of active nests by month (based on date of discovery) of Versicoloured Emerald *Chrysuronia versicolor* at Quebrangulo, Alagoas ($n = 13$) and Arcos, Minas Gerais ($n = 2$).

TABLE 25
Measurements of Versicoloured Emerald *Chrysuronia versicolor* nests found at two sites in Brazil. NM = not measured. NI = not identified.

Locality	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)	Site
Arcos/MG	3	1.5	3.5	2.0	4	1.0	Small tree above a stream
Arcos/MG	7	2.5	4.5	2.5	2	0.7	Bush bordering a stream
Quebrangulo/AL	5	2.0	5.0	3.0	5	0.6	NI
Quebrangulo/AL	5	2.0	5.0	3.0	NM	0.65	NI
Quebrangulo/AL	5	2.5	5.0	4.0	2	0.7	<i>Myrcia guianensis</i>
Quebrangulo/AL	6	2.0	4.5	2.5	2	1.5	<i>Myrcia guianensis</i>
Quebrangulo/AL	NM	NM	NM	NM	NM	1.5	NI
Quebrangulo/AL	6	2.0	5.0	3.0	2	1.5	NI
Quebrangulo/AL	4	2.5	4.7	3.0	1	1.6	<i>Artocarpus heterophyllus</i>
Quebrangulo/AL	6	1.5	3.0	3.0	1	0.8	<i>Eschweilera ovata</i>
Quebrangulo/AL	NM	NM	NM	NM	NM	1.6	<i>Myrcia guianensis</i>
Quebrangulo/AL	NM	NM	NM	NM	NM	3.0	NI
Quebrangulo/AL	NM	NM	NM	NM	NM	1.5	NI
Quebrangulo/AL	NM	NM	NM	NM	NM	1.6	<i>Artocarpus heterophyllus</i>
Quebrangulo/AL	NM	NM	NM	NM	NM	1.7	NI
Mean ± SD	5.2 ± 1.2	2.1 ± 0.4	4.5 ± 0.7	2.9 ± 0.5	2.4 ± 1.4	1.3 ± 0.6	
Min.–max.	3–7	1.5–2.5	3–5	2–4	1–5	0.6–3.0	

diameter of 4.5 ± 0.7 cm ($n = 9$), internal diameter 2.9 ± 0.5 cm ($n = 9$), external height 5.2 ± 1.2 cm ($n = 9$), internal height 2.1 ± 0.4 cm ($n = 9$); mass 2.4 ± 1.4 g ($n = 8$) (Table 25). Externally, materials used in four nests were: tree bark ($n = 1$), plant wool, lichens and spider webs

TABLE 26
Measurements of Versicoloured Emerald *Chrysurnia versicolor* eggs at Quebrangulo, Alagoas, Brazil.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
4 Nov 1997	2	0.5	13.3	9.2
		0.5	13.3	9.1
21 Nov 1997	2	0.5	12.9	9.5
		0.5	13.2	9.2
23 Oct 1998	2	0.6	13.1	9.3
		0.6	13.5	9.7
24 Sep 1999	2	0.7	13.4	9.7
		0.7	13.5	9.6
Mean ± SD	2 ± 0	0.6 ± 0.1	13.3 ± 0.2	9.4 ± 0.2
Min.–max.	2	0.5–0.7	12.9–13.5	9.1–9.7



Figure 60. Adult Versicoloured Emerald *Chrysurnia versicolor* feeding two c.6-day-old nestlings, Quebrangulo, Alagoas, Brazil, December 2022 (NORDESTA collection)

(*n* = 1), plant wool, lichens, spider webs and mosses (*n* = 1) and plant wool, lichens and plant fibres (*n* = 1). Internally, they comprised plant wool (*n* = 3) and plant wool with plant fibres (*n* = 1). Therefore, plant wool and lichens were commonest externally (75% of nests) and plant wool internally (100%).

Clutches always comprised two, white, long-oval eggs measuring $13.3 \pm 0.2 \times 9.4 \pm 0.2$ mm (*n* = 8); mass 0.6 ± 0.1 g (*n* = 8; Table 26). We were unable to follow any nests from the start of egg laying, but the longest incubation periods were 16 (*n* = 2) and 17 days (*n* = 1). Ruschi (1973l) mentioned 14 days.

Nestlings remained in the nest 22 days (*n* = 1) and 23 days (*n* = 3). Ruschi (1973l) mentioned a nestling period of 20–26 days and Grantsau (1988) 23–32 days.

At Arcos, adults vocalised when arriving and leaving the nest, and often flew around the observer, even when some distance from the nest and hidden in the hide. Also there, two nestlings with larvae of *Philornis* sp. were found. On 20 September 1999, three larvae were removed from one chick and two from another. On 23 September, more larvae had appeared, and two more were removed from one chick and one from the other. The fate of this nest is unknown.

On 18 November 2020 between 06.00 and 08.40 h, at Quebrangulo, at a nest with two c.7-day-old chicks, the adult arrived at 06.20 h vocalising; the nestlings immediately opened their bills. She fed each chick once, for c.5 seconds, and flew off, but returned at 07.00 h, again vocalising, and the two chicks raised their bills; each was fed three times in bouts of 5–8 seconds.

GLITTERING-THROATED EMERALD *Chionomesa fimbriata*

Endemic to South America, where it is widely distributed, from Venezuela to Uruguay and throughout Brazil (Sick 1997, Weller *et al.* 2021b). Like the preceding species, Glittering-throated Emerald common over most of its range. Breeding is also little known, both in Brazil (Ruschi 1949b,c,e, Buzzetti & Silva 2008, Marini *et al.* 2012, Maurício *et al.* 2013) and elsewhere (Hellebrekers 1942, Haverschmidt 1952, 1958c, Snow & Snow 1964).

We made observations at 26 nests between 1995 and 2023 at Quebrangulo, Alagoas. Breeding occurred between September and January, peaking in the dry season in October–December (Fig. 61). In central Brazil and Rio Grande do Sul, breeding has been recorded in September–October (Marini *et al.* 2012, Maurício *et al.* 2013). For Suriname, Haverschmidt (1952) initially mentioned that the species nested mainly in July–August, during the late wet season and early dry season, similar to north-east Brazil. However, a few years later, Haverschmidt (1958c) reported nests year-round, with the largest numbers of active nests in single months being in August ($n = 8$) and January ($n = 5$).

Nests were found in forest ($n = 24$) or at edges and in clearings ($n = 2$), low down, 1.0 ± 0.4 m (0.4–2.0 m) above ground ($n = 26$; Table 27). Nests were similar to those of the previous species, supported basally or laterally by relatively thin branches, often in three-way forks.

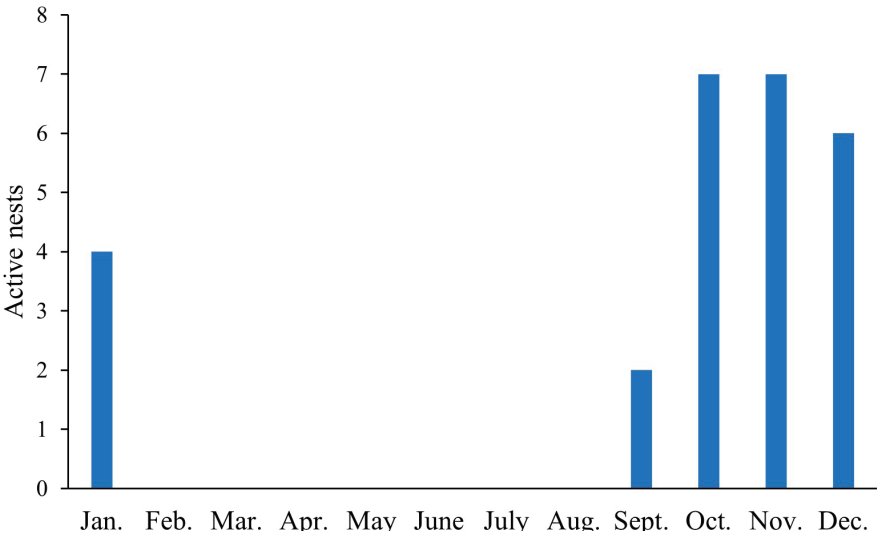


Figure 61. Number of active nests by month (based on date of discovery) of Glittering-throated Emerald *Chionomesa fimbriata* ($n = 26$) at Quebrangulo, Alagoas.

TABLE 27
Measurements of Glittering-throated Emerald *Chionomesa fimbriata* nests at Quebrangulo, Alagoas, Brazil.
NM = not measured. NI = not identified.

Date found	External height (cm)	Internal height (cm)	External diameter (cm)	Internal diameter (cm)	Mass (g)	Height above ground (m)	Supporting plant
20 Nov 1995	6.0	2.0	5.0	3.0	2	1.2	NI
5 Oct 1996	NM	NM	NM	NM	NM	1.4	NI
22 Sep 1997	NM	NM	NM	NM	NM	0.55	NI
16 Jan 1998	4.0	2.0	6.0	3.5	2	0.75	NI
21 Jan 1998	5.0	2.0	5.0	3.0	2	0.7	NI
26 Oct 1998	6.0	2.0	5.0	3.0	1	0.8	<i>Coffea arabica</i>
29 Oct 1998	6.0	2.0	5.0	3.0	2	0.85	<i>Guapira graciliflora</i>
8 Nov 1998	4.0	2.0	5.0	3.0	2	0.75	<i>Manihot esculenta</i>
23 Nov 1998	4.5	2.0	6.0	3.5	1	0.85	NI
1 Dec 1998	4.5	2.0	5.5	3.0	NM	0.6	<i>Eschweilera ovata</i>
18 Dec 1998	4.0	2.0	4.0	2.5	1	0.65	<i>Myrcia guianensis</i>
27 Sep 1999	5.0	2.0	5.0	3.0	1	0.8	<i>Eschweilera ovata</i>
5 Oct 1999	6.0	1.5	4.0	3.0	2	1.3	<i>Erythroxylum squamatum</i>
9 Nov 1999	7.0	2.0	6.0	3.5	3	0.4	<i>Manihot esculenta</i>
16 Nov 1999	NM	NM	NM	NM	NM	1.4	NI
10 Dec 1999	5.0	3.0	5.0	4.0	2	0.85	Vine
16 Jan 2002	4.0	2.0	3.0	2.0	3	1.4	<i>Myrcia guianensis</i>
1 Dec 2003	NM	NM	NM	NM	NM	0.75	<i>Eschweilera ovata</i>
15 Oct 2004	5.0	2.0	4.5	3.0	2	1.1	<i>Musa</i> sp.
20 Jan 2020	NM	NM	NM	NM	NM	1.5	<i>Genipa americana</i>
11 Nov 2020	NM	NM	NM	NM	NM	1.0	NI
8 Dec 2020	NM	NM	NM	NM	NM	2.0	<i>Eschweilera ovata</i>
19 Oct 2022	NM	NM	NM	NM	NM	1.5	NI
26 Dec 2022	NM	NM	NM	NM	NM	1.2	NI
31 Oct 2023	NM	NM	NM	NM	NM	1.85	NI
1 Nov 2023	4.0	2.0	4.0	2.0	NM	0.86	NI
Mean ± SD	5.0 ± 0.9	2.0 ± 0.3	4.9 ± 0.8	3.0 ± 0.5	1.9 ± 0.7	1.0 ± 0.4	
Min.–max.	4–7	1.5–3.0	3–6	2–4	1–3	0.4–2.0	

They were ‘low cup/base’, ‘low cup/lateral’, ‘high cup/base’ or ‘high cup/lateral’, and ‘III Type’. Nests measured: external diameter 4.9 ± 0.8 cm ($n = 16$), internal diameter 3.0 ± 0.5 cm ($n = 16$), external height 5.0 ± 0.9 cm ($n = 16$), internal height 2.0 ± 0.3 cm ($n = 16$); mass 1.9 ± 0.7 g ($n = 14$) (Table 27). Externally, materials used in 13 nests were: plant wool ($n = 3$), plant wool, lichens and mosses ($n = 1$), plant wool, lichens and spider webs ($n = 1$), plant wool, lichens, mosses and spider webs ($n = 2$), plant wool, lichens, mosses, spider webs and bark fragments ($n = 2$), lichens, mosses, spider webs and bark ($n = 1$), spider webs and bark ($n = 2$) and household wool with lichens ($n = 1$). Internally, they incorporated plant wool ($n = 8$), domestic wool ($n = 2$), plant wool, lichens and spider webs ($n = 1$), plant wool, lichens,

TABLE 28
Measurements of Glittering-throated Emerald *Chionomesa fimbriata* eggs at Quebrangulo, Alagoas, Brazil.

Date found	Clutch	Mass (g)	Length (mm)	Width (mm)
20 Nov 1995	2	0.5	13.9	9.0
		0.5	13.8	9.7
5 Oct 1996	2	0.3	14.0	8.7
		0.3	14.9	8.8
21 Jan 1998	2	0.5	14.5	9.2
		0.6	13.7	9.4
16 Jan 1998	2	0.6	13.8	9.5
		0.6	13.6	9.3
22 Sep 1997	2	0.6	13.6	9.5
		0.6	13.3	9.6
29 Oct 1998	2	0.8	14.1	9.2
		0.7	14.2	9.0
26 Oct 1998	2	0.7	14.1	9.4
		0.7	14.9	9.4
8 Nov 1998	2	0.6	13.8	9.6
		0.5	13.7	9.1
1 Dec 1998	2	0.6	13.6	9.0
		0.7	13.2	9.9
18 Dec 1998	2	0.6	13.9	9.9
		0.6	13.7	9.8
23 Nov 1998	2	0.6	13.7	9.4
		0.6	13.6	9.6
9 Nov 1999	2	0.7	14.6	9.2
		0.7	14.3	9.3
10 Dec 1999	2	0.5	13.5	9.0
		0.6	13.8	9.3
27 Sep 1999	2	0.7	13.6	9.4
		0.7	13.2	9.2
5 Oct 1999	2	0.6	13.5	9.2
		0.6	13.1	9.6
Mean ± SD	2 ± 0	0.6 ± 0.1	13.8 ± 0.5	9.3 ± 0.3
Min.–max.	2	0.3–0.8	13.1–14.9	8.7–9.9

spider webs, mosses and bark ($n = 1$) and plant wool, lichens, mosses and bark ($n = 1$). Thus plant wool (69.2%), lichens and webs (61.5%) and mosses (46.2%) are more prevalent externally. Internally, plant wool is predominant (84.6%). Measurements and materials echo the literature (Ruschi 1949c,e, Haverschmidt 1952, 1958c).

Clutches always comprised two, white, long-oval eggs measuring $13.8 \pm 0.5 \times 9.3 \pm 0.3$ mm ($n = 30$); mass 0.6 ± 0.1 g ($n = 30$; Table 28). Our measurements coincide with those

in the literature (Ruschi 1949c,e), although eggs measured in Suriname are slightly less wide (Haverschmidt 1952).

The incubation period at two nests followed from the laying of the first egg was 16 and 17 days. At two other nests with eggs, incubation lasted 16 days. Ruschi (1949c,e) reported 15 days and Haverschmidt (1952) 15 or 16 days. Haverschmidt (1958c) mentioned incubation periods of 15 ($n = 8$), 16 ($n = 5$) and 17 days ($n = 2$) in Suriname.

Young remained in the nest 21 ($n = 2$), 22 ($n = 1$), 23 ($n = 1$) and 26 days ($n = 2$). Ruschi (1949c) reported nestling periods of 22 and 30 days, Ruschi (1949e) 28 days and Haverschmidt (1952) c.20 days. Haverschmidt (1958c) mentioned periods of 19 ($n = 3$), 20 ($n = 5$), 21 ($n = 1$) and 22 days ($n = 1$) in Suriname. Nestlings defecate by thrusting their tails over the nest edge.

On 27 January 2020 between 06.40 and 08.20 h, at a nest with two eight-day-old nestlings, the female arrived at 07.00 h and brooded the chicks for ten minutes but did not feed them. She returned at 07.30 h and fed each nestling three times for 5–10 seconds then brooded them for five minutes. To feed the nestlings, the adult inserted its bill into their bills and shook its head slightly. After feeding the young, the adult cleaned its bill with its tongue. One of the nestlings had ten *Philornis* sp. larvae, and the other four. The nest was predated two days later by an unidentified predator.

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The discovery of Dwarf Tinamou *Taoniscus nanus* in Bolivia, with additional notable records from the country

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SUMMARY.—We provide new information on the status, occurrence and ecology of birds in Bolivia. Although we focus on discoveries made during recent (2024) field work, several records overlooked from previous field work are mentioned herein. We present the first evidence of Dwarf Tinamou *Taoniscus nanus* in Bolivia, approximately 1,500 km from its nearest known population in Goiás, central Brazil. We confirm the presence of Cryptic Flatbill *Rhynchocyclus (olivaceus/aequinoctialis) cryptus* in the country and argue that Eastern Olivaceous Flatbill *R. (o.) guianensis* is also likely to occur in easternmost Bolivia. Four new species for Beni (Rufous-thighed Kite *Harpagus diodon*, Lowland Hepatic Tanager *Piranga flava*, Pied Puffbird *Notharchus tectus*, Cliff Flycatcher *Hirundinea ferruginea*) are reported and one new species for Oruro (Great Kiskadee *Pitangus sulphuratus*).

Bolivia still harbours the potential for significant ornithological discovery, not just in terms of vagrancy, as shown by the relatively large number of recent noteworthy ornithological records reported from the country (e.g., Lane 2014, Martínez 2021, Aponte *et al.* 2022, van Els *et al.* 2023, 2024a,b, Montenegro-Avila *et al.* 2023, 2024). One of the main reasons for this is the relatively large expanses of intact habitat combined with low accessibility due to the still rather limited road network. Particularly valuable in a South American context are Bolivia's largely unspoiled savannas, mainly in the department of Beni. Whereas elsewhere the combined effects of cattle ranching, fires and agricultural land conversion have annihilated native grasslands outside national parks, Bolivia still supports large swathes of well-managed native grassland. Whilst the Bolivian savannas (excluding gallery forests) may not support high levels of endemism per se, they do hold important populations of threatened grassland birds, such as Cock-tailed Tyrant *Alectrurus tricolor*, Sharp-tailed Grass Tyrant *Culicivora caudacuta*, several species of range-restricted *Sporophila* seedeaters and the highly localised White-winged Nightjar *Eleothreptus candicans* (van Els *et al.* 2024a, Jansen 2024).

Here, we provide new information on the status, occurrence and ecology of birds in the country. Although we focus on discoveries made during recent (2024) work, several records were overlooked from reports based on our earlier surveys or required revision due to fresh insights.

Survey sites

Here, we describe only our 2024 survey; previous work was reported in van Els *et al.* (2023, 2024a,b). Our 2024 expedition ran from 16 August until 24 August 2024 and was focused on finding new sites for White-winged Nightjar *Eleothreptus candicans*, but we also explored the Santa Ana de Yacuma area, as well as the Loreto area, both in Beni. During these expeditions, we visited multiple sites more than once (listed and mapped in

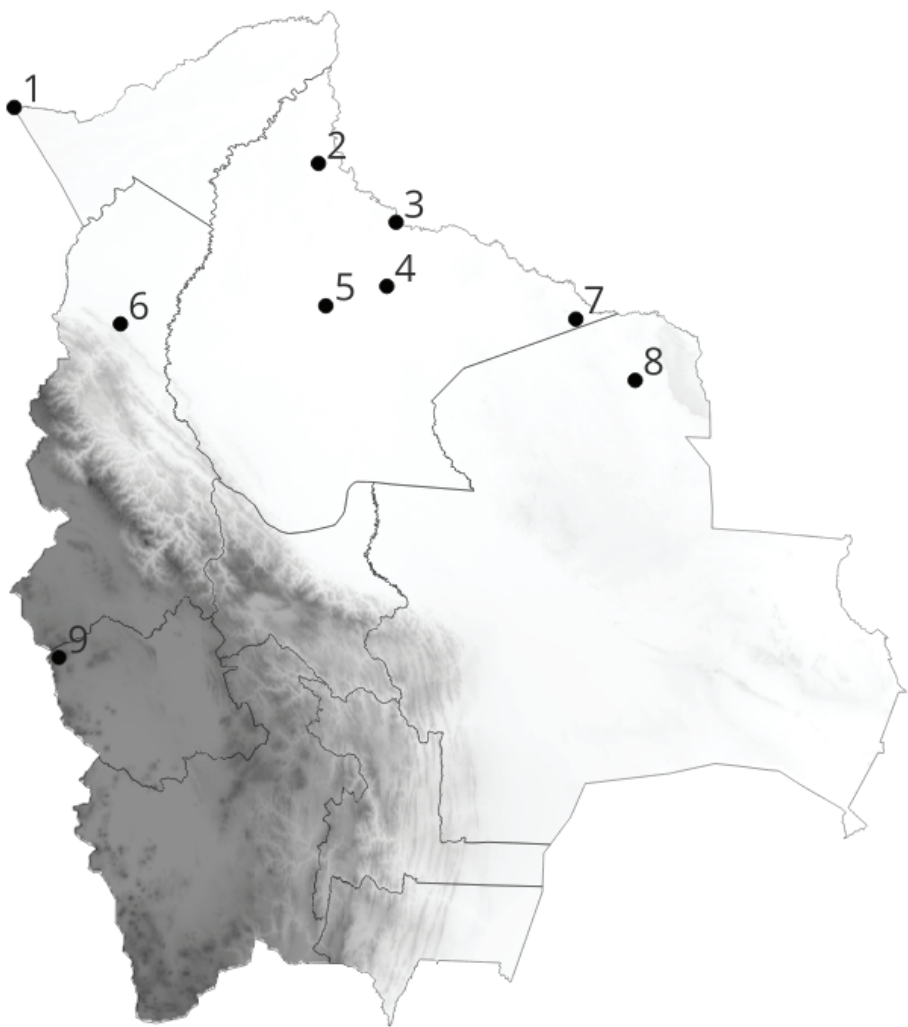


Figure 1. Sites with records reported herein: 1. Bolpebra, Pando; 2. Comunidad 22 de Septiembre, Beni; 3. Puerto Ustarez, Beni; 4. San Ramón, Beni; 5. Palmira, Beni; 6. Ixiamas, La Paz; 7. Cerro San Simón, Beni; 8. Noel Kempff Mercado National Park, Santa Cruz (Huanchaca region); 9. Sajama National Park, Oruro.

Fig. 1). Often, a formal name is not available for these sites, in which case we have chosen a name based on a local village or logging concession. Other sites are mentioned by their geographical coordinates.

Species accounts

We follow the taxonomy of the *Howard and Moore checklist of birds of the world* (Dickinson & Remsen 2013, Dickinson & Christidis 2014). Recordings may be indicated with a ML number, referring to the catalogue number under which the recording is archived at Macaulay Library (accessible by adding the ML number without the letters ‘ML’ to the following URL: <https://macaulaylibrary.org/asset/>, e.g. <https://macaulaylibrary.org/asset/554389071>) or with an XC number, referring to the Xeno-canto accession number (accessible by adding the XC number without the letters to the following URL: <https://>

xeno-canto.org, e.g. <https://xeno-canto.org/688170>). S numbers refer to eBird checklists: accessible by adding the accession number including 'S' to the following URL: <https://ebird.org/checklist/>, e.g. <https://ebird.org/checklist/S251275422>.

DWARF TINAMOU *Taoniscus nanus*

We recorded the song (Fig. 2) of this species at two locations in north-central Beni, initially just south of Palmira (13°30'52.38"S, 65°24'46.70"W) on 17 August 2024 and subsequently on 18 August 2024 at 13°25'20.46"S, 65°22'51.74"W, just north of the first locality. We were unable to obtain photographic evidence. Both sites were extensively managed cattle ranches, with abundant tall, dense grass up to c.50 cm tall (among others the C4 grass *Andropogon* sp.), interspersed with termite mounds and the occasional woody shrub (Fig. 3). These areas are flooded for 3–4 months per year during the rainy season.

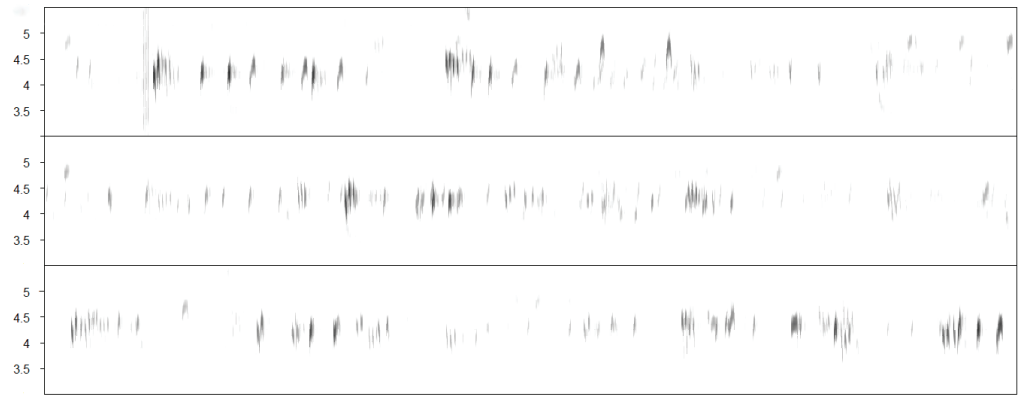


Figure 2. Sonogram of Dwarf Tinamou *Taoniscus nanus*, recorded near Palmira, Beni, Bolivia, 17 August 2024 (Jacob Wijpkema). Three 25-second fragments of a single song bout, produced using full_spectrogram function of warbleR (Araya-Salas & Smith-Vidaurre 2017) with flim= c(3,5.5), collevels = seq(-40,10,0.5) and ovlp=10.



Figure 3. Habitat of Dwarf Tinamou *Taoniscus nanus*, near Palmira, Beni, Bolivia, 17 August 2024 (Tini Wijpkema)

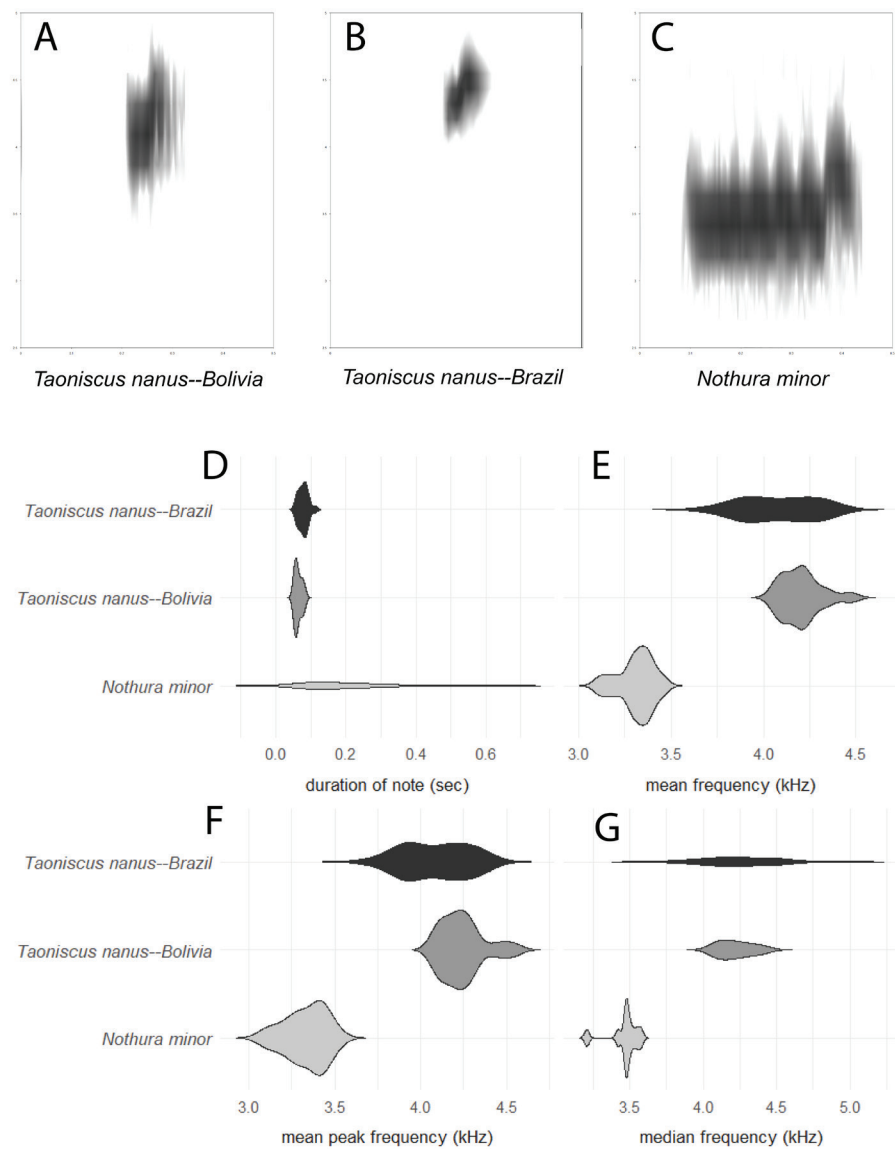


Figure 4. Comparison of sonograms of our sound-recordings of Dwarf Tinamou *Taoniscus nanus*, to recordings of known populations in Brazil and to the vocally similar Lesser Nothura *Nothura minor*: (A) single call note from Bolivia, (B) single call note from Brazil, (C) single call note of Lesser Nothura, (D) duration of note, (E) mean frequency, (F) mean peak frequency and (G) median frequency of Bolivian and Brazilian Dwarf Tinamou and Lesser Nothura, respectively. Sonograms produced using full_spectrogram function of warbleR (Araya-Salas & Smith-Vidaurre 2017) with flim= c(3,5.5), collevels = seq(-40,10,0.5) and ovlp=10.

The species’ vocalisations are subtle and at the two Bolivian sites were given only during brief ten-minute intervals at sunrise and sunset. Elsewhere, the species also sings mainly at dawn and in the evening (Silveira & Silveira 1998). We compared our recordings to recordings of Dwarf Tinamou from Brazil and to a species with similar calls and which may occur sympatrically with *Taoniscus*, namely Lesser Nothura *Nothura minor*. We included the recordings listed in Table 1 in our analysis (which were of sufficient quality to subject to detailed analysis), as well as our own material (not yet accessioned online). We used the

TABLE 1
Vocalisations of Dwarf Tinamou *Taoniscus nanus* and Lesser Nothura *Nothura minor* used in our analysis.

Species	Xeno-canto	Recordist	Country and locality
Dwarf Tinamou	XC 26107	V. J. Silveira	Brazil: Cristalina, Goiás
Dwarf Tinamou	XC 39081	N. D'Acosta	Brazil: Cristalina, Goiá
Dwarf Tinamou	XC 39083	N. D'Acosta	Brazil: Cristalina, Goiás
Dwarf Tinamou	XC 156576	M. A. de Rezende	Brazil: São Roque, Minas Gerais
Dwarf Tinamou	XC 862513	L. N. Kajiki	Brazil: São Roque, Minas Gerais
Lesser Nothura	XC 103528	N. D'Acosta	Brazil: Cristalina, Goiás
Lesser Nothura	XC 973704	D. Buzzetti	Brazil: Mineiros, Goiás

R packages ‘warbleR’ (Araya-Salas & Smith-Vidaurre 2017) and ‘ohun’ (Araya-Salas 2022) in R. v. 4.3.1 to analyse bioacoustics. Vocal information was summarised using the ‘specan’ function of ‘warbleR’ to generate data on frequency and duration of notes. Although vocalisations of Dwarf Tinamou may resemble the stridulations of certain orthopterans, which were not included in our analysis, our recordings exhibit a similar acoustic signature (short note with an upward inflection) to Brazilian recordings of Dwarf Tinamou and are similar in call length and three different measures of frequency. They showed little overlap with vocalisations of Lesser Nothura, both in acoustic signature and statistics (Fig. 4).

Dwarf Tinamou is otherwise found very locally and rarely in central and south-eastern Brazil within intact *campo sujo* grassland (Silveira & Silveira 1998), where it is locally extirpated (e.g. Itapetininga, interior São Paulo). Historical records exist from Paraguay (Pereyra 1950, Silveira & Silveira 1998) and north-east Argentina, where the species is now extinct due to habitat destruction (Collar *et al.* 1992, Monteleone & Pagano 2022).

Clearly, the currently rapid conversion of savannas to agricultural land and associated widespread fires pose a threat to its survival in Bolivia. Urgent action is needed to estimate its population size and to better understand the species’ distribution and ecology in the country. Because Bolivian records are c.1,500 km from the nearest known extant population in Emas National Park, Goiás, Brazil, the taxonomic status of the Bolivian population also merits study.

WHITE-THROATED PIPING GUAN *Pipile grayi* × RED-THROATED PIPING GUAN *P. cujubi*

The hybrid zone between White-throated and Red-throated Piping Guans encompasses easternmost Bolivia and the Brazilian Pantanal (Olmos 1999, Delacour & Amadon 2004). We have recorded *Pipile* with partially red wattles at several localities in extreme north-east Santa Cruz, but none of these had the all-red wattles of *P. cujubi* (Olmos 1999). Our observations were made in and around the northern patches of savanna in Noel Kempff Mercado National Park (14°14′51.7″S, 61°37′11.6″W; 14°06′10.0″S, 61°59′42.6″W; 14°05′38.9″S, 61°27′15.5″W), where birds with all-white wattles also occur (S38849100). Records by other observers from the main easternmost patch of savanna (J. Tobias, S118338400, S118293139) involved birds with full red wattles, whilst in the south-western savanna they had mixed characters (e.g. J. Tobias, S118234301). In Bolivia, pure Red-throated Piping Guan may thus be restricted to the eastern half of Noel Kempff Mercado, whilst northern and western areas of the national park form part of the hybrid zone between *grayi* and *cujubi*. This putative pattern needs verification via a larger sample of records.

SCALED DOVE *Columbina squammata*

For Bolivia, Herzog *et al.* (2016) listed the species only for easternmost Santa Cruz, but Scaled Dove appears to be expanding rapidly into agricultural areas of west-central Santa Cruz and southern Beni (e.g. J. L. Martínez, 17°09'25.8"S, 62°35'39.5"W, ML 554389071; D. Metler, 15°11'30.3"S, 64°43'12.8"W, ML 612645809). We also found the species disjunctly at several sites in Noel Kempff Mercado National Park (14°27'42.3"S, 61°59'48.6"W; 14°17'29.2"S, 61°50'59.6"W, e.g. 6 July 2024, ML 622000196), as well as at the adjacent San Simón cerrado complex in easternmost Beni (13°33'10.5"S, 61°59'48.8"W; 13°28'55.3"S, 61°53'08.4"W, e.g. 17 July 2024, ML 621871796, 12 May 2021, ML 344388391), which the species doubtless reached from Brazil's deforested frontier.

BLUE-TUFTED STARThROAT *Helimaster furcifer*

A presumed female (lacking the dark gorget typical of Long-billed Starthroat *H. longirostris*) photographed on Ruta Nacional 9 near Comunidad 22 de Septiembre in northern Beni (11°39'28.6"S, 65°32'09.1"W; ML 368891351) on 15 August 2021 is the northernmost record of the species in Bolivia of which we are aware.

RUFOUS-THIGHED KITE *Harpagus diodon*

Presumed austral migrant with records in Bolivia restricted to the Chaco and Santa Cruz, north to northern Chiquitania between late May and late December (Hennessey *et al.* 2003, Juhant 2012, Herzog *et al.* 2016). Surprisingly, Hennessey *et al.* (2003) and Herzog *et al.* (2016) did not mention a confirmed record of breeding in October from Concepción, Santa Cruz (Davis 1993). Areta & Juhant (2019) reported regular occurrence during the breeding season in the southern Bolivian lowlands and Yungas. We photographed a juvenile near Puerto Engaño in easternmost Beni (13°34'28.3"S, 61°52'11.8"W, ML 346518451) on 19 May 2021. On a subsequent visit in 2024, we photographed an adult on 14 July 2024 in forest near Hacienda Marisol Cabezas (13°28'54.6"S, 62°01'46.2"W; ML 621999675, Fig. 5) and two days later another in savanna c.4 km south-west of there (13°30'22.4"S, 62°02'22.0"W, ML 621935943), both also in easternmost Beni. To our knowledge, these records are the first for Beni. The species is known to winter north in western Amazonia (Lees & Martin 2014, Areta & Juhant 2019) and can therefore be expected to be more widespread as a passage migrant in central and northern Bolivia, but it is conceivable that some of our records refer to locally bred birds, particularly because the single confirmed case of breeding also occurred in the Cerrado biome in eastern Bolivia.



Figure 5. Rufous-thighed Kite *Harpagus diodon*, Hacienda Marisol Cabezas, Beni, Bolivia, 14 July 2024 (Tini Wijpkema)

PIED PUFFBIRD *Notharchus tectus*

Not known or predicted to occur in Beni (Herzog *et al.* 2016), we found the species at several localities in the south-east, centre-east and north of the department. In south-east Beni, we found it first at Cafetal (13°29'53.2"S, 61°53'07.6"W; ML 623158055) on 17 November 2017, and subsequently at Cerro San Simón (13°36'48.1"S, 62°05'08.3"W; ML 623158205) on 25 December 2019, as well as more recently near Palermo Tres (13°28'54.6"S, 62°01'46.2"W; ML 622303277) on 14 July 2024 and in the nearby *cerrado* near Palestina (13°30'22.4"S, 62°02'22.0"W) on 16 July 2024. In east-central Beni, we found the species on multiple occasions near Puerto Ustarez in 2022: on 27 January near the Brazilian border (12°24'52.0"S, 64°27'21.4"W) and on 28 January (ML 415873111) and 23 April (ML 450420721) c.8 km south-west of Puerto Ustarez (12°24'52.0"S, 64°27'21.4"W). Finally, in northern Beni we found it on 14 August 2015 near Guayaramerín (10°49'11.3"S, 65°22'04.8"W; ML 205694361) and on the same day near Cachuela Esperanza (10°32'16.3"S, 65°35'00.6"W). Others have also found it since at the Pampa San Lorenzo (11°03'30.7"S, 65°44'57.4"W; e.g. V. Vos, ML 611040773). Older records in eBird are undocumented (e.g. D. Pearson, S195377978) so our records represent the first definitive evidence for the department.

OLIVACEOUS FLATBILL *Rhynchocyclus olivaceus*

The status in Bolivia of the taxa in this species complex needs clarification. Traylor (1979) listed only *R. o. aequinoctialis* for Bolivia, and solely for Cochabamba in the west of the country. Dickinson & Christidis (2014) also mentioned this taxon alone. However, according to Simões *et al.* (2021) two taxa should co-occur in western Bolivia including Pando and the Amazon south to the Chapare of Cochabamba: their Clade G (referred to by them as *R. guianensis*) and their clade N (*R. cryptus*). Furthermore, although no taxa were predicted by the same authors to occur in the eastern half of Bolivia, in adjacent Brazil Clade G (or *R. guianensis*) occurs. These taxa were treated as a single species by Dickinson & Christidis (2014) and by the IOC checklist (Gill *et al.* 2024), but as two species in del Hoyo & Collar (2016) and Clements *et al.* (2023), with *guianensis* considered a subspecies of Eastern Olivaceous Flatbill *R. olivaceus* and *cryptus* of Western Olivaceous Flatbill *R. aequinoctialis*. Two species-level taxa are certainly warranted due to the widespread sympatry of Clades N and G in western Amazonia. Herzog *et al.* (2016) considered Olivaceous Flatbill *R. olivaceus* to be a single species, but this publication pre-dated the integrative taxonomic study by Simões *et al.* (2021).

Morphologically, the taxa putatively occurring in Bolivia are inseparable (Simões *et al.* 2021), thus requiring vocal confirmation of these generally silent birds.

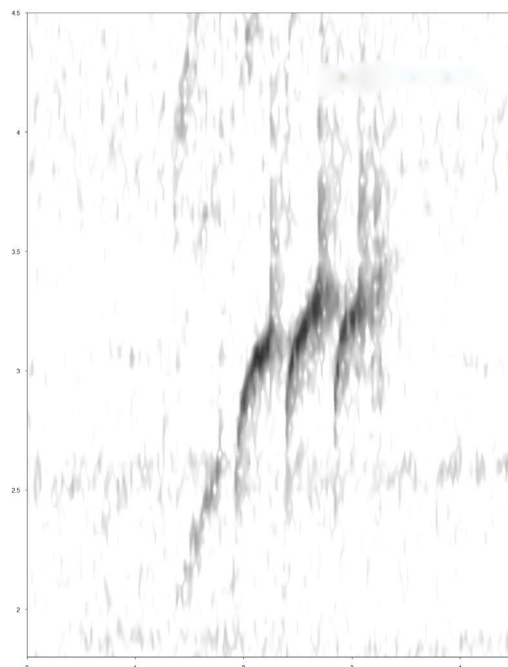


Figure 6. Sonogram of vocalisation of Olivaceous Flatbill *Rhynchocyclus olivaceus cryptus/aequinoctialis*, Ixiamas, La Paz, Bolivia, 21 November 2021 (Jacob T. Wijpkema). Produced using full_spectrogram function of warbleR (Araya-Salas & Smith-Vidaurre 2017) with flim= c(1.8,4.5), collevels = seq(-40,10,0.5) and ovlp=10.

Our recordings of song from Ixiamas, La Paz ($13^{\circ}46'29.6''\text{S}$, $68^{\circ}09'06.8''\text{W}$; XC 688170) and Bolpebra, Pando ($10^{\circ}56'49.6''\text{S}$, $69^{\circ}33'56.8''\text{W}$; ML 625612632, Fig. 6), as well as two recordings of both song and call from Sajta, Cochabamba (S. Mayer, XC 2556, XC 2557) correspond to sonograms for Clade N of Simões *et al.* (2021), thus confirming the occurrence of *cryptus* (or *aequinoctialis*, depending on taxonomy) in the western half of Bolivia. To our knowledge, no recordings of Clade G exist anywhere in the country, so we cannot confirm the presence of this group, at least in western Bolivia.

In eastern Bolivia, Bates *et al.* (1998) reported the occurrence of Olivaceous Flatbill at several localities in Noel Kempff Mercado National Park. We argue that these records probably refer to Clade G in Simões *et al.* (2021), because of their geographic proximity to the mapped distribution of Clade G by these authors. Additionally, the avifauna of Noel Kempff Mercado National Park and its environs is known to be allied biogeographically to populations further east, rather than west of the Beni savanna complex and Chiquitania (Bates *et al.* 1998). We conclude that *R. guianensis* (or *olivaceus*, depending on taxonomy) is most likely the taxon in eastern Bolivia (and may occur sympatrically with *cryptus* in western Bolivia as well).

CLIFF FLYCATCHER *Hirundinea ferruginea*

We found a pair at Cerro San Simón, Beni, on 16 May 2021 ($13^{\circ}36'41.4''\text{S}$, $62^{\circ}02'12.8''\text{W}$; ML 345175441) and subsequently another pair nearby on 13 July 2024 ($13^{\circ}36'39.5''\text{S}$, $62^{\circ}00'20.1''\text{W}$; ML 621999889). These are the first records for Beni, although the species' presence was expected given occurrence in the Huanchaca of Santa Cruz.

GREAT KISKADEE *Pitangus sulphuratus*

An individual (Fig. 7) in *Polylepis* at Sajama National Park, Oruro, on 29 January 2020 ($18^{\circ}08'07.3''\text{S}$, $68^{\circ}58'30.1''\text{W}$; ML 623246439) at approximately 4,500 m is not only the first



Figure 7. Juvenile Great Kiskadee *Pitangus sulphuratus*, Sajama National Park, Oruro, Bolivia, 29 January 2020 (Tini Wijpkema)

in Oruro but probably also represents the highest elevation record in Bolivia. There are documented records of vagrant Great Kiskadees from nearby Lauca National Park in Chile at a similar elevation (F. Schmitt, S9775281; Barros *et al.* 2012), which together with ours must be some of the highest-elevational records anywhere in the broad range of this dispersive species.

LOWLAND HEPATIC TANAGER *Piranga flava flava*

Sparsely distributed in the lowlands of Santa Cruz, the Chaco and eastern Andean foothills of Bolivia (Herzog *et al.* 2016). We report occurrence in Beni for the first time, with repeated records at Cerro San Simón, on 12 July 2024 (Fig. 8), 14 November 2017 and 25 December 2019. These birds may thus represent breeders, rather than austral migrants, given their occurrence during the austral breeding season. The avifauna of the Cerro San Simón has affinities with that of Brazilian *cerrados* in Mato Grosso, and the occurrence of this species fits this biogeographic pattern well. We also recorded Lowland Hepatic Tanager in the Llanos de Moxos, near San Ramón (13°13'11.4"S, 64°28'39.2"W, on 12 February 2023; 13°14'46.1"S, 64°40'09.4"W, on 9 December 2022, sight only), and we found two on 20 April 2022 at 12°01'04.1"S, 65°25'14.9"W near Ruta Nacional 9 in northern Beni (sight only). Although these records may represent austral migrants, at least some of the dates coincide with the austral breeding season.



Figure 8. Male Lowland Hepatic Tanager *Piranga f. flava*, Cerro San Simón, Beni, Bolivia, 12 July 2024 (Tini Wijpkema)

BLUE-GREY TANAGER *Thraupis episcopus*

Known from Amazonian Bolivia, including most of Pando, lowland La Paz and south-west Beni, with occasional records in Cochabamba and central Beni (Herzog *et al.* 2016). We

found it in easternmost Beni (Remanso, 13°31'32.6"S, 61°52'14.1"W, 15 November 2017; Cerro San Simón, 13°36'34.6"S, 62°02'15.7"W, 12 July 2024, ML 623145184, showing white lesser and median wing-coverts separating it from Sayaca Tanager *T. sayaca*), and near Piso Firme, north-easternmost Santa Cruz (13°37'59.5"S, 61°44'04.3"W, 15–16 November 2017). The species may be spreading with deforestation given the lack of historical records in this area, but given that the region is and has always been characterised by open habitat, *T. episcopus* may simply have been overlooked there.

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Taxonomic identities of *Psittacula cyanopygia* Souancé, 1856, *Pachycephala clio* Wallace, 1863, and *Lagonosticta brunneiceps* Sharpe, 1890, fixed through designation of lectotypes held in the Natural History Museum, Tring

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SUMMARY.—During ongoing work in the Natural History Museum, Tring, bird collections to identify and segregate syntype material, three cases have been identified where it is necessary to objectively define the relevant taxa. The first of these is the Mexican Parrotlet *Forpus cyanopygius* (Souancé, 1856), of which the male and female syntypes are identifiable as different species, with the female being a specimen of Cobalt-rumped Parrotlet *F. xanthopterygius*. Although some authors have suggested that the type material of *F. cyanopygius* is from the Tres Mariás Islands, off western Mexico, and thus referable to *F. cyanopygius insularis*, we demonstrate that the male syntype (now lectotype) can be confidently identified as being from the Mexican mainland, obviating the need for any nomenclatural revision. The second case involves *Pachycephala clio* Wallace, 1863, currently treated as a subspecies of Moluccan Whistler *P. macrorhyncha*, which was described from specimens collected in the Sula Islands and on Buru. Subsequently, *Pachycephala melanura buruensis* E. Hartert, 1899, now also a subspecies of *P. macrorhyncha*, was named from specimens collected exclusively on Buru, but without unambiguously restricting Wallace's nomen to the Sula Islands. The final case pertains to *Lagonosticta brunneiceps* Sharpe, 1890, which is currently treated as a subspecies of Red-billed Firefinch *L. senegala*. Specimens of Sharpe's type series originated from a large part of the distribution of *L. senegala* and are representative of multiple currently accepted subspecies. Therefore, lectotype designations are offered to fix the identity on the universally understood taxonomic concept associated with all of these taxa.

In common with many other ornithological collections, the Natural History Museum (NHM) at Tring, formerly the British Museum (Natural History) (BM(NH) and based in London, has segregated its name-bearing type specimens. Although the *identification* of such material in the collection dates from Gray (1844–49) and was afforded a degree of import during the preparation of the *Catalogue of the birds in the British Museum* (Sharpe *et al.* 1874–98), the process of purposefully *segregating* these specimens did not commence until the late 1930s, in response to the looming threat of war and the perceived need to move the most irreplaceable material to the Tring outpost, where it was less likely to be at risk from bombing (Warren 1966: iv). This process was reinvigorated in the late 1940s, culminating in the publication of a three-volume types catalogue (Warren 1966, Warren & Harrison 1971, 1973). However, although Warren identified or confirmed literally thousands of type specimens in the collection, only a single representative example of each taxon was transferred to the museum's type cabinets, whilst only those details associated with the same specimen were recorded in the relevant volume of the catalogue. In cases where

multiple types (syntypes) of a taxon were present in the museum, the remainder of this material was left *in situ* in the main collection, although its presence was usually (but not invariably) noted in the catalogue.

During the past decade, staff at NHM have again devoted effort to the (re-)identification and segregation of the ‘other’ and additional name-bearing type material. In some cases, as a result of the need to objectively define a taxon due to the type series being mixed, the designation of lectotypes has become necessary (e.g., Tennyson *et al.* 2022, Kirwan *et al.* 2024). Here, we deal with three cases in which the available syntypes comprise specimens of different taxa, necessitating a lectotype in each case.

MEXICAN PARROTLET *Forpus cyanopygius*

Souancé (1856: 157) described *Psittacula cyanopygia* from specimens in the collection of his uncle, André Masséna, Prince of Essling, Duke of Rivoli (1758–1817). Although Souancé did not report how many specimens he had seen or their sex, his concise description is of the male alone. Shortly afterwards, Souancé (1857: pl. XLII) published a more detailed account, now including the female, and accompanied by a plate (our Fig. 1) depicting both sexes based on specimens in the Masséna collection. Two specimens from the latter collection are now present in the NHM (see Table 1), a male and a female (Figs. 2–3), and these have always been treated as two syntypes of *cyanopygia* (Salvadori 1891: 250, Warren 1966: 75). The latter author listed details of the male, NHMUK 1859.11.22.38, and reported that ‘there is a female syntype in the collection’.

Multiple notices by the same author concerning new ‘species’ were not uncommon during the 19th century (e.g., McAllan 2016, Kirwan & Kirkconnell 2022, Bruce 2023). As books could take years to produce, authors often chose to quickly publish concise descriptions of new species in journals first. These were based on already



Figure 1. Plate XLII in de Souancé’s *Iconographie des perroquets: non figurés dans les publications de Levaillant et de M. Bourjot Saint-Hilaire* (1857), depicting a male (upper) and female *Psittacula cyanopygia* based on specimens in the former collection of André Masséna, Prince of Essling, Duke of Rivoli (© Hein van Grouw)

TABLE 1
Type material pertaining to *Psittacula cyanopygia* Souancé, 1856, as identified by us in the Natural History Museum, Tring (NHMUK), including their current status following the results of this paper.

NHMUK Reg. no.	Sex	Locality	Other notes concerning provenance	Status following this paper
1859.11.22.38	male	Bolivia [<i>sic.</i> = western Mexico]	Purchased from E. Parzudaki, from the Masséna d’Essling collection	lectotype
1859.11.22.39	female	Bolivia	Purchased from E. Parzudaki, from the Masséna d’Essling collection	paralectotype



Figure 2. Lectotype of *Psittacula cyanopygia* Souancé, 1856, NHMUK 1859.11.22.38, male, Bolivia [*sic*, = western Mexico], formerly part of the Masséna d'Essling collection (Jonathan Jackson, © Trustees of the Natural History Museum, London)



Figure 3. Paralectotype of *Psittacula cyanopygia* Souancé, 1856, NHMUK 1859.11.22.39, female, Bolivia, formerly part of the Masséna d'Essling collection. The locality 'Bolivia' was added later by G. R. Gray as it was assumed the specimen came from there, but originally the specimen lacked a locality. Bolivia may be correct after all as the specimen is, in fact, an example of Cobalt-rumped Parrotlet *Forpus xanthopterygius*; see also Fig. 5 (Jonathan Jackson, © Trustees of the Natural History Museum, London)

prepared, detailed accounts for books published subsequently. Although Souancé (1856: 157) did not mention the sexes, the plate and text in Souancé (1857) can be taken as evidence to satisfy Art. 72.4.1.1 (ICZN 1999) that specimens of both sexes had been seen by Souancé at the time. Therefore, the type series for *cyanopygia* comprised at least two specimens, a male and a female.

Souancé (1856, 1857) also did not ascribe a locality to his new species, presumably because Masséna's specimens lacked any relevant data. No original labels exist, and when both specimens were received at BM(NH) in November 1859 (purchased within a batch of specimens from Emile Parzudaki [1829–99], a well-known dealer in natural history specimens based in Paris) they were registered without a locality. However, at some point they were labelled (incorrectly) as being from Bolivia. This is because a male specimen (NHMUK 1846.9.9.45) (now recognised as a Cobalt-rumped Parrotlet *Forpus xanthopterygius flavescens*) from Bolivia, received in 1846 from the English botanist Thomas Bridges (1807–65), was registered initially as an unidentified '*Psittacus*'. Subsequently, Gray (1859: 86) listed it as Souancé's *Psittacula cyanopygia*, which at the time was the only specimen of this species in the museum's collection.

In the NHM copy of Gray (1859), Masséna's two specimens—without a locality—have been added in Gray's hand; they had been received just after his list was published. As it was then thought that all three specimens involved were the same species, it must have been presumed that Masséna's birds also came from Bolivia. Salvadori (1891: 250) listed the locality of Masséna's specimens as '[Bolivia.]', because he knew (or suspected) that the locality must be incorrect. He also knew that Bridges' specimen represented a different species. Indeed, in his opinion it was a new species, which he described as *Psittacula flavescens* (Salvadori 1891: 248), now *Forpus xanthopterygius flavescens*. Because of the misidentification of Bridges' Cobalt-rumped Parrotlet by Gray (1859: 86), for many years Bolivia was generally believed to form (part of) the distribution of *cyanopygia* (Finsch 1868: 663). Based on birds collected by Andrew Jackson Grayson (1819–69), on the Tres Mariás Islands, 100 km off the coast of Nayarit, Bolivia started to be questioned, and western Mexico was accepted as the true distribution (Finsch 1870: 345).

Some workers believed the insular birds differed from the mainland population. Grayson (1871: 271), who collected several specimens on the Tres Mariás, stated, 'There is a closely allied species on the main land, from which the Tres Maria variety differs in its larger size, especially of the bill, and in its deeper green color'. However, his editor, G. N. Lawrence (1806–95), who plainly contributed much of the paper's text, disagreed; 'There are but two specimens from the Tres Marias, both females: these differ from those of the main land, of which there are eight of both sexes before me, in being of a darker green, as pointed out by Col. Grayson, they are notably darker on the rump and upper tail coverts, in the others there is a greater prevalence of a yellow shade throughout the plumage; in size and the color of the bills, they do not differ materially from the two localities; perhaps the Marias birds may be considered a darker local race' (Lawrence in Grayson 1871: 271–272).

Despite Lawrence not considering the colour differences sufficient to warrant naming the Tres Mariás parrotlet, Robert Ridgway (1850–1929) disagreed and named it *Psittacula insularis*, drawing on at least four specimens, of which he had examined personally only two (Ridgway 1888: 541). These were both females, presumably the same two specimens mentioned by Lawrence (in Grayson 1871: 271), but no males, other than those reported almost 20 years earlier by Finsch (1870: 353); 'I have not been able to examine adult males of this insular form, and have therefore been obliged to translate what Dr. Finsch says concerning that sex.' Salvadori (1891: 249) also did not find the taxa to differ in size, only in colour, and treated *insularis* as a junior synonym of *cyanopygia*. The holotype of *insularis* is in the National Museum

of Natural History, Smithsonian Institution, Washington, DC; USNM 37347, an adult female collected on the Tres Mariás Islands by Grayson in January 1865 (Deignan 1961: 126). The same collection holds one of the paratypes, also an adult female, from the same collector (USNM 39973; Ridgway 1888). Evidently, Finsch (1870: 353) had four specimens: two males, including a young male (in ‘transitional plumage’ as translated by Ridgway) and two females, all collected by Grayson and of which the males at least are paratypes. Although not mentioned by Sánchez Osés (2010), one of these paratypes survives in the Übersee-Museum Bremen; UMB 6397349, an adult male, and so does UMB 6397345, a female (M. Stiller *in litt.* 2025), but the whereabouts of the other two specimens, which also were originally presumably at UMB, is unknown.

Based on minor differences with mainland *cyanopygia*, William Brewster (1851–1919) described a new subspecies from north-western Mexico, *Psittacula cyanopygia* [sic] *pallida* (Brewster 1889: 85), from two syntypes in the Museum of Comparative Zoology, Cambridge, MA: MCZ 14.389 (adult male) and MCZ 14.390 (adult female), collected at Alamos, southern Sonora, Mexico, on 8 March 1888 by Marston Abbott Frazar (1860–1925) (Bangs 1930: 203). Griscom (1933: 55), who reported near-verbatim much of the collector’s correspondence with Brewster, clarified that Frazar’s specimens from this region were taken at a ‘Hacienda Mercedes’ c.3 ‘miles’ from the town of Alamos. Salvadori (1891: 249) treated *pallida* as a junior synonym of *cyanopygia*, and Brewster’s name has usually been regarded as a synonym ever since (e.g., Dickinson & Remsen 2013: 326, del Hoyo & Collar 2014: 718), with the notable exception of Cory (1918: 76) and Peters (1937: 203).

Salvin & Godman (1897: 581) noted that ‘island birds are a little darker, but the difference is very slight’ and remarked that the types in the British Museum ‘are quite as dark as the birds from the Tres Marias Islands...’. They too treated *insularis* and *pallida* as junior synonyms of *cyanopygia*, but van Rossem (1939: 70) followed Ridgway in recognising *insularis* from the Tres Mariás as a separate taxon. By doing so, based on the assumption that the types of *cyanopygia* came from the Tres Mariás Islands, van Rossem argued that Ridgway’s *insularis* is a junior synonym of Souancé’s nomen, and that the mainland form therefore lacked a name. He proposed *Forpus cyanopygius lutescens*, based on a specimen (Fig. 4) from Colima, north-west Mexico (van Rossem 1939: 70), being unaware of, or forgetting, Brewster’s Sonoran *pallida*. The holotype of *lutescens* is NHMUK 1889.1.30.475, an adult female collected at Manzanillo Bay, Colima, Mexico, in February 1863 by John



Figure 4. Holotype of *Forpus cyanopygius lutescens* van Rossem, 1939, NHMUK 1889.1.30.475, female collected at Manzanillo Bay, Colima, Mexico, in February 1863 by John Xantus de Vesey, formerly part of the Salvin & Godman collection (Jonathan Jackson, © Trustees of the Natural History Museum, London)

Xantus de Vesey (1825–94), and was formerly part of the Salvin & Godman collection (Warren 1966: 168).

Currently, two subspecies are generally recognised (e.g., Dickinson & Remsen 2013: 326, del Hoyo & Collar 2014: 718): *cyanopygius* from the mainland, with *pallida* as a junior synonym, and *insularis* from the Tres Mariás Islands. However, van Rossem’s (1939: 70) publication was overlooked, or ignored, by the two global checklists mentioned. Grant (1965) and Gómez de Silva *et al.* (2020) also used the name *insularis* for the Tres Mariás population, but the latter authors argued that it should be treated at species rank based on morphology, whilst also noting the degree of genetic divergence between mainland and insular populations reported by Smith *et al.* (2013).

The hypothesis that Souancé’s *cyanopygius* is from the Tres Mariás, and therefore the mainland taxon should take the name *pallidus* (with *lutescens* as its junior synonym) is, in our opinion, unlikely. Only males of the two populations differ in colour (Grant 1965: 17, Gómez de Silva *et al.* 2020: 21–22) and there is considerable overlap in measurements between the two taxa (Grant 1965: 78). Some authors (notably Juniper & Parr 1998) have claimed that they differ in bill colour (all dark on the Tres Mariás), but this suggestion is belied by all of the primary literature (e.g., Grayson 1871, Grant 1965, Gómez de Silva *et al.* 2020) and photographs of live birds on Macaulay Library (www.macaulaylibrary.org) and iNaturalist (www.inaturalist.org). Measurements of Souancé’s male *cyanopygius* taken by HvG (wing 89.1 mm, tail 41.9 mm, bill 12.9 mm) fall mainly within the range of overlap, but in coloration and bill length it agrees more with the mainland form. The underparts lack any glaucous tones and there is no contrast between the cheeks/ear-coverts/upper throat and the rest of the underparts; in classic individuals of *insularis*, the head is brighter and yellower than the duller underparts (see, for example, <https://macaulaylibrary.org/asset/633446908>). Furthermore, there is no evidence that anyone had collected birds on the Tres Mariás prior to 1865 (Stager 1957: 416). Consequently, we are confident that Souancé’s *cyanopygius* can indeed be applied to the mainland taxon.

More important here, however, is that the female syntype of *cyanopygia* belongs to another species. None of those authors mentioned above who had examined the specimens (e.g., Finsch 1868, Salvin & Godman 1879, Salvadori 1891, van Rossem 1939) noticed that NHMUK 1859.11.22.39 is actually an example of *Forpus xanthopterygius* (see Fig. 5 for details and Table 2 for measurements) and therefore may well have come from Bolivia after all. In light of the discovery that the two syntypes represent different species, it is necessary to fix the identity on the universally understood taxonomic concept associated with *Psittacula cyanopygia*, via designation as its lectotype the unambiguously identified male specimen (NHMUK 1859.11.22.38; Fig. 2) with unknown locality from the Masséna collection. This designation satisfies Arts. 74.7.1, 74.7.2 and 74.7.3 (both original and amended versions; ICZN 1999, 2003), as well

TABLE 2
Mensural data (in mm) from three female specimens of Mexican Parrotlet *Forpus cyanopygius*, three female Cobalt-rumped Parrotlets *F. xanthopterygius* and the paralectotype (female) of *Psittacula cyanopygia* Souancé, 1856, all held at the Natural History Museum, Tring (NHMUK) and taken by HvG. In size, the paralectotype is clearly in closer accord with *F. xanthopterygius* and herein is reidentified as an example of the latter species.

	Wing	Tail	Bill
<i>Forpus cyanopygius</i>			
NHMUK 1896.12.1.118	84.0	39	13.0
NHMUK 1896.12.1.119	85.1	39	12.9
NHMUK 1889.1.30.478	85.2	40	13.0
Mean	84.8	39.3	12.97
<i>Forpus xanthopterygius</i>			
NHMUK 1895.4.1.437	83.0	43	12.1
NHMUK 1904.7.8.34	83.2	43	10.6
NHMUK 1905.10.12.45	82.9	44	10.8
Mean	83.0	43.3	11.2
Paralectotype	83.2	44	11.9

Figure 5. Dorsal (A), ventral (B) and lateral (C) views of the paralectotype of *Psittacula cyanopygia* Souancé, 1856, NHMUK 1859.11.22.39, female, in the middle in each image, compared to females of Mexican Parrotlet *Forpus cyanopygius* NHMUK 1889.1.30.478 from Río Presidio, Durango/Sinaloa, western Mexico (left) and Cobalt-rumped Parrotlet *Forpus xanthopterygius*, NHMUK 1895.4.1.437, from Rio de Janeiro, south-east Brazil (right). The smaller bill, generally darker green upperparts and wings, with a hint of blue in the primaries, and the characteristic bright emerald-green ‘stripe’ formed by the tips to the greater coverts confirm that the paralectotype of *Psittacula cyanopygia* Souancé, 1856, is a *Forpus xanthopterygius* rather than *Forpus cyanopygius*; see also Table 2 for comparative mensural data, which also help to establish the species identity (Jonathan Jackson, © Trustees of the Natural History Museum, London)

as being in accord with Recommendations 74A and 74C. It results in NHMUK 1859.11.22.39 (Fig. 3) becoming a paralectotype of *Psittacula cyanopygia*, irrespective of its taxonomic identity.

MOLUCCAN WHISTLER *Pachycephala macrorhyncha clio*

Wallace (1863a: 341–342) described *Pachycephala clio*—currently treated as a subspecies of Moluccan Whistler *P. macrorhyncha*—based on an unstated number of specimens. However, he clearly must have possessed more than one because he mentioned both sexes *and* he considered its *terra typica* to be the ‘Sula Islands and Bouru’ [= Sula Islands, just east of Sulawesi, and Buru in the northern Moluccas]. Warren & Harrison (1971: 122) remarked that *clio* was known from multiple syntypes involving both sexes collected by Alfred Russel Wallace (1823–1913), from which they selected an adult male taken in 1861 on the Sula Islands (NHMUK 1873.5.12.528) as their representative syntype. In total, we have identified 19 syntypes of *Pachycephala clio* Wallace, 1863, housed at NHMUK (Table 3), but it seems that there were originally an additional four specimens belonging to the type series, which are now either lost or, in two cases, exchanged with another museum (for details see Table 3). Rookmaaker & van Wyhe’s (2018) discovery of a price list of birds collected by Alfred Russel Wallace revealed



TABLE 3

Type material pertaining to *Pachycephala clio* Wallace, 1863, as identified by us in the Natural History Museum, Tring (NHMUK) and Museum für Naturkunde, Berlin (ZMB), including their current status following the results of this paper. To the best of our knowledge, all of the specimens listed herein were collected by A. R. Wallace (Buru) or (on the Sula Islands) his assistant, Charles Allen (1839–92), during 1861, except NHMUK 1862.12.21.16 and 1862.12.21.17, which were only probably collected in that year. According to Baker (2001), Wallace visited Buru during May and June 1861, whilst Allen collected on southern and eastern islands of the Sula group around August and September 1861. In addition, NHMUK 1862.12.21.15 (sex unknown, from the Sula Islands) and NHMUK 1873.5.12.30 (female, from Buru), were exchanged with the Zoological Survey India, Kolkata, at some point, although the specimens were not mentioned by Sclater (1892) or Sakthivel *et al.* (2011). According to the relevant registration book, two other specimens (both from Buru) were also received as part of the 1873 accession (NHMUK 1873.5.12.529, sex unknown, and NHMUK 1873.5.12.534, male), but can no longer be found in the collection.

Reg. no. (all NHMUK except last)	Sex	Locality	Other notes concerning provenance	Status following this paper
1862.12.21.16	male	Sula	Purchased from Stevens (no original Wallace label)	paralectotype
1862.12.21.17	female	Sula	Purchased from Stevens (no original Wallace label)	paralectotype
1873.5.12.528	male	Sula	Purchased from Wallace	lectotype
1873.5.12.531	male	Sula	Purchased from Wallace	paralectotype
1873.5.12.537	male	Sula	Purchased from Wallace	paralectotype
1873.5.12.538	female	Sula	Purchased from Wallace	paralectotype
1873.5.12.539	female	Sula	Purchased from Wallace	paralectotype
1881.5.1.71	male	Sula	Received with the Gould collection	paralectotype
1898.9.20.1059	female	Sula	Received with the Seeböhm collection	paralectotype
1873.5.12.532	male	Buru	Purchased from Wallace	paralectotype
1873.5.12.533	female	Buru	Purchased from Wallace	paralectotype
1873.5.12.535	female	Buru	Purchased from Wallace	paralectotype
1873.5.12.536	female	Buru	Purchased from Wallace	paralectotype
1873.5.12.544	male	Buru	Purchased from Wallace	paralectotype
1881.5.1.91	female	Buru	Received with the Gould collection	paralectotype
1888.5.30.271	male	Buru	Received with the Tweeddale collection	paralectotype
1888.5.30.272	female	Buru	Received with the Tweeddale collection	paralectotype
1888.5.30.273	female	Buru	Received with the Tweeddale collection	paralectotype
1888.5.30.280	male	Buru	Received with the Tweeddale collection	paralectotype
ZMB 25510	male	Sula	Purchased	paralectotype

that two specimens of *clio*, one from each of the two island groups, were offered for general sale by his dealer Stevens. There is a specimen, labelled as a syntype, collected in 1861 on the Sula Islands, with an original but damaged Wallace label indicating a sale price, held in the Museum für Naturkunde, Berlin (ZMB 25510) (GMK pers. obs., July 2025). There is no evidence that this specimen was ever in the British Museum, and it is perhaps one of those mentioned in the price list. At the time of publication of the relevant volume of the *Catalogue of the birds in the British Museum* (Gadow 1883), six specimens collected by Wallace on Buru and eight from the Sula Islands had been identified in the collection, although their type status was not noted therein, perhaps because the name *clio* was treated in the synonymy of what is now Black-tailed Whistler *P. melanura*. That subsequent writers were in no doubt as to the dual localities is exemplified by Salvadori (1876: 377), wherein a young male of this *Pachycephala* from Buru was assigned to *clio*.

Almost 40 years later, Hartert (1899: 32) described a new subspecies of *Pachycephala* from the island of Buru based on specimens collected by Joannes Maximiliaan Dumas (1856–1931). Although he specifically diagnosed his new taxon, *Pachycephala melanura*

buruensis, from Wallace's *clio*, his only comments concerning the latter was to twice refer to '*P. clio* of the Sula Islands' (Hartert 1899: 32–33). A year later, in his more comprehensive report, Hartert (1900: 237) mentioned only that *clio* occurs on the Sula Islands and failed to acknowledge that Wallace (1863a) had material from Buru that he had also explicitly included when describing his new 'species'. On neither occasion did Hartert designate a type for *buruensis*; only much later did he (Hartert 1920: 448) list as the type an adult male collected at 3,000 ft., on 'Mt. Mada' [= Kapalatmada], during August–September 1898. However, as noted by LeCroy (2010: 23), there are three specimens with label data identical to the above in the American Museum of Natural History, New York, so she selected AMNH 657483 to serve as the lectotype of Hartert's name.

There is general acceptance in the relevant literature that *clio* (endemic to the Sula Islands) and *buruensis* can be separated subspecifically, as males of the first-named taxon have the upperparts brighter and yellower, and females have the throat whitish with darker barring and the rest of the underparts slightly washed yellow (White & Bruce 1986, Eaton *et al.* 2016, del Hoyo & Collar 2016, Boles *et al.* 2024). Wallace (1863b: 30) himself had noted that Buru specimens 'have a more yellow tinge on the back, and the black pectoral band is generally broader than in those from Sula.' As a result of the original series being mixed, it is necessary to fix the name *Pachycephala clio* Wallace, 1863, to the Sula population, via designation of a lectotype. Although Hartert's (1899: 33) reference to '*P. clio* of the Sula Islands' was rather 'generously' considered to represent a formal restriction of the type locality by Galbraith (1956: 202) and Mayr (1967: 21), the lack of clarity as to the type series in Warren & Harrison (1971) means that the issue is not completely resolved. To settle the matter, we select as the lectotype of *Pachycephala clio* the adult male specimen (NHMUK 1873.5.12.528; Fig. 6) collected on the Sula Islands in 1861 that was listed by Warren & Harrison (1971: 122). This designation satisfies Arts. 74.7.1, 74.7.2 and 74.7.3, as well as being in accord with Recommendations 74A, 74C and 74E. It results in all 18 of the additional specimens listed in Table 3 becoming paralectotypes of *P. clio*, irrespective of their taxonomic identity.



Figure 6. Lectotype of *Pachycephala clio* Wallace, 1863, NHMUK 1873.5.12.528, male collected on the Sula Islands by A. R. Wallace in 1861 (Jonathan Jackson, © Trustees of the Natural History Museum, London)

RED-BILLED FIREFINCH *Lagonosticta senegala brunneiceps*

Sharpe (1890: 277) described *Lagonosticta brunneiceps*, currently treated as a subspecies of Red-billed Firefinch *L. senegala*, based on an unstated number of specimens. Warren & Harrison (1971: 78) stated rather imprecisely 'there are several other syntypes in the collection' but, as the original description was based on all specimens present at that time in the British Museum's bird collection, the type series can be considered to comprise 33

specimens (Sharpe 1890: 277–278); 31 of these listed specimens are still present (see Table 4). They originate from ‘North-eastern Africa throughout Eastern Africa and the south-east and south-west portions of the continent’, which, according to Sharpe (1890: 277), constituted the distribution of *brunneiceps*.

The number of subspecies currently recognised in *L. senegala* is six (del Hoyo & Collar 2016: 710, Payne 2020) or seven (Dickinson & Christidis 2014: 290), due to at least some geographic variation being clinal and not well marked (Dowsett *et al.* 2008: 497). With respect to the distribution ascribed to *L. s. brunneiceps*, there also appears to be no consensus: it has been considered to be restricted to parts of Eritrea and Ethiopia (Mayr *et al.* 1968: 327); to South Sudan and Ethiopia alone (Dickinson & Christidis 2014: 290); South Sudan, Ethiopia and Eritrea (Fry & Keith 2004: 362); or in Sudan, South Sudan, Eritrea, Ethiopia and northern Kenya (del Hoyo & Collar 2016: 710, Payne 2020). Even if we consider the widest distribution for *L. s. brunneiceps*, this still excludes most of the range given by Sharpe (1890: 277), and Sharpe’s type series includes specimens now ascribed to another three or four generally accepted subspecies—*L. s. rhodopsis* (von Heuglin, 1863), *L. s. ruberrima* Reichenow, 1903; *L. s. rendalli* E. Hartert, 1898; and *L. s. pallidicrissa* von Zedlitz, 1910 (some authors consider the latter a synonym of *rendalli*).

Based on specimens collected at Bahr el Ghazal (in what is now the north-west of South Sudan), von Heuglin (1863: 166) had described *Estrela rhodopsis* as a new species. Sharpe (1890: 279) mentioned this taxon but without listing any specimens in the British Museum collection. Instead, presumably inadvertently, he included two specimens that might have been ascribed to *rhodopsis* within his new taxon *brunneiceps*. *L. s. rhodopsis* is variously considered to occur from extreme northern Senegal and Mali east to Sudan, through the lowlands of western Eritrea and Ethiopia, north-west Kenya and southern Ethiopia (Mayr *et al.* 1968: 327); from eastern Mali to Sudan (except the south-east) and the lowlands of western Eritrea and Ethiopia (Fry & Keith 2004: 361); in eastern Nigeria and southern Chad to Sudan, northern and western South Sudan, western Ethiopia and Eritrea (Dickinson & Christidis 2014: 290); or in eastern Nigeria, southern Chad, northern Cameroon, northern Central African Republic, western Sudan, northern and western South Sudan, and the lowlands of western Eritrea and western Ethiopia (del Hoyo & Collar 2016: 710, Payne 2020). One syntype of *Estrela rhodopsis* von Heuglin, 1863, is held in the Naturalis Biodiversity Center, Leiden, an adult female collected in February 1863 (RMNH.AVES.90888) (Dekker & Quaiser 2006: 42). Another syntype, an adult male also collected in February 1863, is in the Staatliches Museum für Naturkunde, Stuttgart (SMNS-Z-ORN-5380) (F. Woog *in litt.* 2025).

Reichenow (1903: 24) described *ruberrima* as a subspecies of Sharpe’s *L. brunneiceps* as, in his opinion, this is overall more reddish than the other taxa already known at the time. He stated that *ruberrima* occurs in areas west, north and east of Lake Victoria (‘Gebiete in Westen, Norden und Osten des Victoria Niansa’). As this distribution falls within that Sharpe (1890: 277) delimited for *brunneiceps*, one can assume this informed Reichenow’s decision to describe *ruberrima* as a subspecies. Nowadays, *ruberrima* is considered to occur in parts of the Democratic Republic of Congo, Uganda, Kenya, Tanzania, Zambia and Malawi (Dickinson & Christidis 2014: 290, Payne 2020), with some authors adding north-east Angola to its range (Mayr *et al.* 1968: 328, Dean 2000: 325, del Hoyo & Collar 2016: 710). As the distribution of *ruberrima* given by Reichenow is rather imprecise, it is not necessarily clear which specimens then in the Museum für Naturkunde, Berlin, he used for his description. Lake Victoria lies within Tanzania (in its west and south), Uganda (north) and Kenya (east), and of these countries only Tanzanian specimens were in the Berlin collection at the time of the original description. ZMB 29203, an adult male collected at Bokoba, Kagera, Tanzania [on the west side of Lake Victoria], on 18 December 1890 by Emin Pasha (1840–92)

TABLE 4

Type material pertaining to *Lagonosticta brunneiceps* Sharpe, 1890, as identified by us in the Natural History Museum, Tring (NHMUK), including their current status following the results of this paper. Two specimens can no longer be found in the collection. These are NHMUK 1889.7.20.331, female, Lamu [Kenya] and NHMUK 1889.7.20.332, male, Pangani, E. Africa [Tanzania], both collected by J. Kirk and received with the Shelley collection.

NHMUK Reg. no.	Sex	Locality	Other notes concerning provenance	Status following this paper
1845.6.6.52	male	Shoa [Shewa, Ethiopia]	Presented by the India Museum	paralectotype
1845.7.6.144	male	South Africa	Presented by Sir A. Smith	paralectotype
1845.7.6.145	female	South Africa	Presented by Sir A. Smith	paralectotype
1859.5.21.8	male	Mozambique	W. Gueinzus collection	paralectotype
1859.5.21.19	female	Mozambique	W. Gueinzus collection	paralectotype
1860.12.31.146	male	Tete, Zambesi [Mozambique]	Collected during Livingstone expedition by J. Kirk	paralectotype
1860.12.31.167	female	Tete, Zambesi [Mozambique]	Collected during Livingstone expedition by J. Kirk	paralectotype
1861.5.8.119	?	Shoa [Shewa, Ethiopia]	Presented by the India Museum	paralectotype
1869.10.16.184	male	Dongolo [Eritrea]	Collected by W. T. Blanford	paralectotype
1873.12.10.95	male	Katenbella, Benguela [Angola]	R. B. Sharpe collection	paralectotype
1877.7.11.350	male	Maragaz [Meraguz, Eritrea]	R. B. Sharpe collection, collected by W. Jesse	lectotype
1877.7.11.412	juv.	Keren [Eritrea]	R. B. Sharpe collection, collected by Esler	paralectotype
1877.7.11.441	male	Keren [Eritrea]	R. B. Sharpe collection, collected by Esler	paralectotype
1877.7.11.490	male	Keren [Eritrea]	R. B. Sharpe collection, collected by Esler	paralectotype
1877.7.11.495	female	Bejook [Bedjook, Eritrea]	R. B. Sharpe collection, collected by W. Jesse	paralectotype
1877.7.11.497	male	Ondonga [Namibia]	R. B. Sharpe collection, collected by C. J. Andersson	paralectotype
1877.7.11.498	female	Damara Land [Namibia]	R. B. Sharpe collection, collected by C. J. Andersson	paralectotype
1877.7.11.499	female	Transvaal [South Africa]	R. B. Sharpe collection, collected by T. Ayres	paralectotype
1878.12.31.895	female	Transvaal [South Africa]	R. B. Sharpe collection, collected by T. Ayres	paralectotype
1879.9.7.273	male	Crocodile River [South Africa]	Presented by W. E. & C. G. Oates, collected by F. Oates	paralectotype
1879.9.7.274	male	Crocodile River [South Africa]	Presented by W. E. & C. G. Oates, collected by F. Oates	paralectotype
1884.2.6.11	male	Zambesi [Mozambique]	Presented by J. Kirk	paralectotype
1887.8.12.8	male	Ujiji, Upper Congo [Tanzania]	Bohndorff collection	paralectotype
1887.8.12.9	male	Ujiji, Upper Congo [Tanzania]	Bohndorff collection	paralectotype
1887.9.28.127	male	Kibiro, Equatorial Africa [Uganda]	Collected and presented by Emin Pasha	paralectotype
1888.9.20.740	male	Bejook [Bedjook, Eritrea]	Received with the Tweedale collection, collected by W. Jesse	paralectotype
1888.9.20.741	female	Maragaz [Meraguz, Eritrea]	Received with the Tweedale collection, collected by W. Jesse	paralectotype

1889.7.20.329	female	Soudan [Sudan]	Received with the Shelley collection, collected by Capt. Verner	paralectotype
1889.7.20.333	female	Pangani, E. Africa [Tanzania]	Received with the Shelley collection, collected by J. Kirk	paralectotype
1889.7.20.334	female	Rustenberg, E. Transvaal [South Africa]	Received with the Shelley collection, collected by W. Lucas	paralectotype
18889.7.20.335	male	Pretoria [South Africa]	Received with the Shelley collection, collected by Pratt	paralectotype

is labelled as a type. Because Reichenow described both sexes, this specimen should be treated as a syntype, and two other specimens taken at the same locality by Pasha can also be considered syntypes; ZMB 29203 and ZMB 2000.39128, both adult females collected on 10 November 1890. In addition, two specimens from Lake Kivu, Western Province, Rwanda, and one from Niangabo, Orientale, Democratic Republic of Congo collected on 21 July 1891, may also prove to be syntypes, as these localities lie west of Lake Victoria and their accession dates indicate that they would have been available to Reichenow (P. Eckhoff *in litt.* 2025). Further syntypes may yet be identified in other collections (S. Frahnert *in litt.* 2025).

Five years earlier, based on two specimens collected in Malawi by Percy Rendall, Hartert (1898: 72) had described *rendalli*—in honour of the collector—as a subspecies of *L. senegala* (Linnaeus, 1766). He stated that it was very similar to *senegala*, differing only by having slightly shorter wings and darker upperparts. Compared to *brunneiceps*, ‘the distinct reddish crown and reddish back of the male seem to separate it easily from that species’. In his opinion *Lagonosticta brunneiceps* was a different species and, presumably as a result, he did not mention the overlapping distributions of *rendalli* and *brunneiceps*. Nowadays, *rendalli* is considered to occur in southern Africa, south of a line from southern Angola to southern Tanzania (Dickinson & Christidis 2014: 290, del Hoyo & Collar 2016: 710). Hartert’s original description was very clearly based on two specimens (i.e., syntypes) collected by Rendall, an adult male and female. Much later he (Hartert 1919: 147) listed the adult male bearing Rendall’s collection number 13 as the ‘type’, which LeCroy (2013: 90) considered to represent a lectotype designation, presumably under Art. 74.5. Type material held in the American Museum of Natural History, New York: lectotype, AMNH 451195, a male collected on the upper Shire River south of Lake Nyasa, Malawi, on 9 May 1895 by Percy J. Rendall (1861–1948), and paralectotype, AMNH 451196, a female collected at the same location on 4 March 1896 also by Rendall (LeCroy 2013: 90).



Figure 7. Lectotype of *Lagonosticta brunneiceps* Sharpe, 1890, NHMUK 1877.7.11.350, male collected at Maragaz [= Meraguz, in the late 19th century a region in the former administrative district of Hamasien surrounding Asmara], Eritrea, on 27 July 1868, by W. Jesse during the Zoological Society’s Abyssinian Expedition (1867–68) (Jonathan Jackson, © Trustees of the Natural History Museum, London)

Subspecies *L. s. pallidicrissa* von Zedlitz, 1910, was generally considered to be a synonym of *rendalli*, but some global and regional checklists (e.g., Dowsett *et al.* 2008: 497, Dickinson & Christidis 2014: 290) do recognise it. Von Zedlitz (1910: 173) described this subspecies from material collected in Angola, and distinguished it based on the brighter coloured undertail-coverts. The distribution of *pallidicrissa* is within that of *rendalli* as mentioned above, but mainly in the east (Dickinson & Christidis 2014: 290). Von Zedlitz designated a holotype from Rothschild's collection now held in the American Museum of Natural History, New York: AMNH 451204, a male, collected at Humpata, Huíla, Angola (14°57'S, 13°16'E), on 16 February 1906 by William J. Ansorge (1850–1913) (LeCroy 2013). In the same publication—on the different subspecies of *L. senegala*—von Zedlitz (1910: 173) mentioned *brunneiceps* Sharpe and stated, incorrectly, that no type specimen existed. As the distribution for *brunneiceps* given by Sharpe (1890: 277) included different subspecies, but Sharpe was the first to mention South Africa, Zedlitz allocated the name *brunneiceps* to the birds from South Africa to Mozambique, a distribution nowadays generally accepted for subspecies *rendalli*.

Among the type series of *brunneiceps*, ten are from the currently recognised distribution of this subspecies, including eight from Eritrea (Table 4). That country, therefore, can be considered the *terra typica* within the type series. The remaining 21 specimens belong to subspecies *rhodopsis* ($n = 2$), *ruberrima* ($n = 3$), and *rendalli* and/or *pallidicrissa* ($n = 16$). As a result of the original type series being mixed, and the lack of consensus regarding the distribution of this taxon (see above), it is necessary to fix the name *Lagonosticta brunneiceps* Sharpe, 1890, to the population from Eritrea via designation of a lectotype. We select as the lectotype the adult male (NHMUK 1877.7.11.350; Fig. 7) collected at Maragaz [= Meraguz, a historical region in the former administrative district of Hamasien surrounding Asmara in the late 19th century], Eritrea, on 27 July 1868, by W. Jesse (dates unknown) during the Zoological Society's Abyssinian Expedition (1867–68). This was Warren & Harrison's (1971: 78) selected syntype, who were presumably influenced in this choice because Sharpe himself had labelled the specimen as his type and Shelley (1905: 258) also listed it as such. This designation satisfies Arts. 74.7.1, 74.7.2 and 74.7.3, as well as being in accord with Recommendations 74A and 74C. It results in all 30 of the additional specimens listed in Table 4 becoming paralectotypes of *L. brunneiceps*, irrespective of their taxonomic identity.

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Quantitative description of the nest of Fawn-throated Foliage-gleaner *Automolus cervinigularis* with other notes on breeding

by Luis Sandoval 

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SUMMARY.—I provide the first description of the nest and eggs of Fawn-throated Foliage-gleaner *Automolus cervinigularis*, based on observations over a 13-year period at El Copal Reserve, Jiménez, Cartago province, Costa Rica. I studied six nests; all were built at the end of a tunnel with a stick platform inside like other foliage-gleaner nests. Based on citizen science data ($n = 8$) and my own observations ($n = 6$) the species' breeding season occurs between February and July.

The Furnariidae (ovenbirds and woodcreepers) comprises 71 genera and 318 bird species (Winkler *et al.* 2020) known for their remarkable diversity in nest architecture, ranging from tunnels in the ground to tree cavities, moss 'balls', tangles of dry branches and clay 'ovens' (Zyskowski & Prum 1999). Reproductive information for most species is limited (Remsen 2003, Winkler *et al.* 2020, Barros-Leite & Francisco 2025), due to their secretive behaviour and use of dense vegetation like thickets, dense grasses, forest understorey and forest canopy (Van Tyne 1926, Skutch 1952, 1969, Stiles & Skutch 1989).

The taxonomy of Fawn-throated Foliage-gleaner *Automolus cervinigularis* has been complex, and here I follow the arrangement in Clements *et al.* (2024). Described as a species in the mid-19th century (Sclater 1856), it was later treated as a subspecies of Ochre-throated Foliage-gleaner *A. ochrolaemus* in the mid-20th century (Peters 1951). However, it was recognised as a full species again recently (Chesser *et al.* 2018) based on genetic (Smith *et al.* 2014) and vocal differences (Freeman & Montgomery 2017). The split also highlighted the need to review available information for each newly constituted species, particularly their natural history and ecology. For example, although Ochre-throated Foliage-gleaner's breeding biology appeared well studied, the available knowledge pertained mostly to Chiriqui Foliage-gleaner *A. exsertus* (Skutch 1952, Stiles & Skutch 1989). In response to this knowledge gap, I present a quantitative description of Fawn-throated Foliage-gleaner's nest characteristics, breeding phenology and egg morphology. The species is distributed along the Caribbean slope from southern Mexico to north-west Panama, from sea level to 1,500 m (Greeney *et al.* 2023), typically in secondary forest edges, riverine forest and thickets (Stiles & Skutch 1989).

Materials and Methods

The description of the nest of Fawn-throated Foliage-gleaner is based on six nests found at El Copal Reserve, Jiménez, Cartago province, Costa Rica (09°46'56"N, 83°45'02"W) at 1,000 m, between 2011 and 2024. The site comprises premontane rainforest, mainly young to mature secondary forest and thickets, as well as open areas around the lodge and trails. For each nest I measured: diameter of the tunnel entrance (width and height), tunnel length, tunnel angle and nest cavity length (Fig. 1A). Tunnel length and nest cavity length were measured by introducing a flexible stick or metal wire into the tunnel and marking where

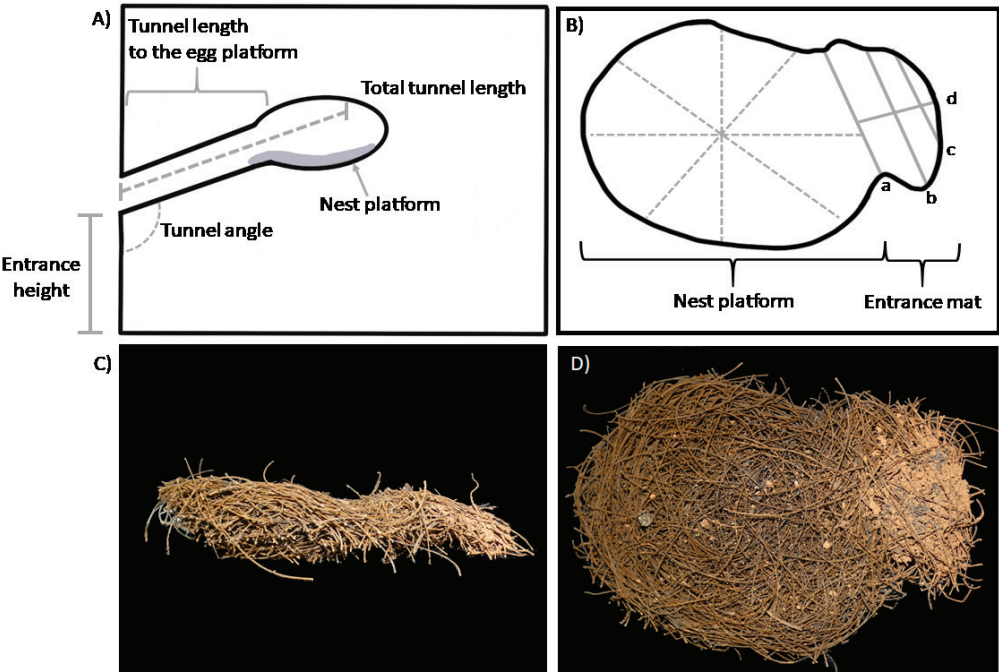


Figure 1. Nest and nest measurements of Fawn-throated Foliage-gleaner *Automolus cervinigularis*. (A) Access tunnel and nest platform cavity with measurements of nest entrance, both tunnel measurements, and tunnel angle. (B) Diagram of nest platform measurements and cross-section of the nest: broken lines show how the platform diameter was calculated/measured, solid line (a) denotes where ‘waist’ length was measured, solid line (b) ‘the ‘mat’ width in its middle, solid line (c) the width at the front, and solid line (d) the entrance ‘mat’ length. (C) Lateral view of nest platform showing the slight separation between the main nest platform and the entrance ‘mat’. (D) Upper view of the nest platform with ‘mat’ at right (Luis Sandoval)

each part finished (Fig. 1A). Tunnel entrance diameter was measured using a metal ruler. To measure the angle of the tunnel, I placed a stick along the floor of the tunnel, extending it outwards to create a reference line. I then positioned a protractor perpendicular to the ground, aligning it with the stick (Fig. 1A). I described the nest internal platform based on a single nest collected in the study area. Egg description was based on a single egg found in a nest on 2 June 2023.

To calculate breeding season, I used my own information and available data (i.e., photographs of nests, juveniles, adults carrying nest materials or food) in citizen science databases such as eBird, iNaturalist and GBIF (all of which were searched on 19 October 2024). In the case of duplicate records involving the same observation, I used the link provided in the first database where I located the record.

Results

All six nests were sited in earth banks along forest trails. Mean nest entrance height was 118.3 ± 28.6 cm above ground (Table 1, Fig. 1A). Nest entrances were oval, wider (9.7 ± 0.8 cm) than they were tall (6.6 ± 1.4 cm; Table 1). Mean tunnel length to the egg platform was 41.2 ± 20.0 cm, with a total length from the entrance of 55.2 ± 23.1 cm (Fig. 1A, Table 1). The average tunnel angle was $7.8 \pm 5.1^\circ$.

The collected nest platform was deposited in the collection of nests and eggs at the Museo de Zoología, CIBET, Universidad de Costa Rica, Montes de Oca (MZUCR-AN-651). The nest was oval-shaped with an entrance ‘mat’ (Fig. 1B). Its diameter measured $15.6 \pm$

TABLE 1
Nests (*n* = 6) of Fawn-throated of Foliage-gleaner *Automolus cervinigularis* found and measured at El Copal Reserve, Costa Rica.

Date found	Entrance height from ground (cm)	Cavity entrance width (cm)	Cavity entrance height (cm)	Total tunnel length (cm)	Tunnel length to egg platform (cm)	Tunnel angle (°)
25 April 2011	100	11	5.0	100	80	10
6 May 2023	100	10	7.0	40	25	7
6 May 2023	150	9	8.0	38	30	15
6 May 2023	160	10	6.5	44	36	5
6 May 2023	100	9	8.0	56	43	0
4 June 2024	100	9	5.0	53	33	10

TABLE 2
Records (*n* = 8) indicating breeding of Fawn-throated of Foliage-gleaner *Automolus cervinigularis* found in citizen science databases.

Location	State	Country	Date	Type of observation	Database	Reference
Reserva de la Biosfera Los Tuxtlá	Veracruz	Mexico	5 June 2019	Adult with food	eBird	S57230679
Selva San Martin Tuxtla	Veracruz	Mexico	5 June 2019	Juvenile	eBird	S57240901
Tapir Valley	Alajuela	Costa Rica	8 April 2022	Adult with food	eBird	S106624049
Tapir Valley	Alajuela	Costa Rica	7 June 2023	Chick at nest	eBird	S140809469
Tapir Valley	Alajuela	Costa Rica	13 June 2023	Adult with nest material	eBird	S141465021
Lago Cote	Alajuela	Costa Rica	13 June 2023	Juvenile	eBird	S142225507
Arenal Observatory Lodge & Spa	Alajuela	Costa Rica	3 March 2024	Juvenile	iNaturalist	203545748
Area de Protección de Flora y Fauna Nahá	Chiapas	Mexico	23 May 2024	Adult with food	eBird	S176665442

0.9 cm (*n* = 4, Fig. 1B), with a depth of 1.1 cm in the centre. External height was 4.2 cm at the back and 3.3 cm at the front (Fig. 1C). Between the platform and entrance ‘mat’, there was a 7.5 cm ‘waist’ area (Fig. 1B). The entrance ‘mat’ measured 5.8 cm long, with a width of 10.0 cm in the middle and 9.1 cm at the front (Fig. 1B). The platform consisted mainly of tree-fern rachises and rootlets, and dry leaf rachises from species like an *Inga* sp., along with pine needles, cypress twigs and unidentified sticks (Fig. 1D). The only egg measured was 2.4 × 2.0 cm and had an all-white surface.

Juveniles, nests and nest-building activities have been observed from March to June in both Costa Rica and Mexico (Tables 1–2). This suggests that the breeding season extends at least from February to July, as a juvenile was observed in early March, and adults were seen carrying nest materials in mid-June, but with a peak in May and June (Table 2).

Discussion

As expected, given that Fawn-throated Foliage-gleaner and Chiriqui Foliage-gleaner are congeners, their nests are very similar in structure, tunnel dimensions and nest height (Skutch 1952, this work). Both species build nests in tunnels in earth banks, with a larger cavity at the end that contains a stick platform (Skutch 1952, 1969, Cockle & Bodrati 2017,

Junqueira *et al.* 2019). This pattern is also observed in seven other species of *Automolus* whose nests have been described (Van Tyne 1926, Zyskowski & Prum 1999, Marini *et al.* 2007, Junqueira *et al.* 2019, Conejo-Barboza *et al.* 2020, del Hoyo *et al.* 2020, Remsen & Kirwan 2020), as well as other species in the family like *Thripadectes* treehunters (Zyskowski & Greeney 2010) and *Clibanornis* foliage-gleaners (Zyskowski & Prum 1999, Cockle & Bodrati 2017). The breeding season is in the first half of the year, based on observations of populations at the species' range extremes, coincident with lower levels of rainfall in humid forests on the Caribbean slope of Middle America during this period (Porting 1965). This timing likely permits easier tunnel excavation due to moist (Sandoval 2008), yet not overly saturated, soil, which could otherwise create unfavourable, wet and cold, nest conditions that increase the risk of fungal and bacterial infection and thereby decrease breeding success (Sandoval & Barrantes 2006). Additionally, food availability may be greater during this period due to better weather conditions than in the second half of the year when it rains most (Wolda 1988). Egg colour matches that reported for congeners (Skutch 1952, Conejo-Barboza *et al.* 2020) and is consistent with the coloration of those of other species that nest in dirt cavities, such as kingfishers and motmots (Stiles & Skutch 1989, Baicich & Harrison 1997).

This study offers new insights into the breeding biology of a species that, while common and widespread in humid forests of Middle America, has been overlooked perhaps because it was presumed to be well known based on studies of a previously conspecific taxon. However, given the recent trend of reclassifying subspecies as species in this family (Claramunt *et al.* 2013, Schultz *et al.* 2017, Chesser *et al.* 2018), it is important to revisit and update natural history information for all subspecies to address existing knowledge gaps.

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On the natural history of West African Rock Dove *Columba gymnocycla*

by Hein van Grouw  & Germán Hernández-Alonso 

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SUMMARY.—Named in 1856, West African Rock Dove *Columba livia gymnocycla* differs markedly in appearance from other Rock Dove subspecies. Recent DNA analyses have revealed that *gymnocycla* is also genetically very different from *Columba livia*, warranting species status for this taxon. The species was never abundant in its small distribution, and only a small number of specimens are present in museum collections. A search for the species in Senegambia in 2024 was unsuccessful and *C. gymnocycla* may have already vanished from much or all of its distribution.

‘Our knowledge of Columba gymnocyclus is very small, and there is no reliable evidence of its distribution’ (Hartert 1899: 406).

West African Rock Dove was named by G. R. Gray (1856: 28) based on a description of rock doves in Senegal by Hartlaub (1854: 205–206). Gray named the species ‘The Western African Pigeon’ *Columba gymnocyclus*. Due to its remarkably dark coloration (Fig. 1), later authorities (e.g., Hartert 1912–21: 1471) questioned whether Gray’s *gymnocyclus* was a Feral Pigeon *Columba livia* rather than a separate taxon, and Hartert (1916: 84) included *gymnocyclus* as a subspecies of *Columba livia*. Similar dark-coloured rock dove populations



Figure 1. West African Rock Dove *Columba gymnocycla* (right-hand image of each pair, NHMUK 1855.12.19.299, adult, Senegal) compared with Rock Dove *C. l. livia* (NHMUK 1965.M.4564, adult, 22 January 1918, Taranto, southern Italy). *C. gymnocycla* is smaller (see Table 2) and much darker than any of the *C. livia* subspecies, see also Fig. 7. It also has a large, bare patch of red skin around the eyes unlike any *C. livia* subspecies (see also Fig. 3) (Jonathan Jackson, © Trustees of the Natural History Museum, London)



Figure 2. All earlier museum specimens of West African Rock Dove *Columba gymnocyclus* (see Table 1) came from ‘Senegal’ but without any further locality and/or habitat details. A: MNHN-ZO-MO-1880-3685, adult, Senegal (Patrick Boussès, © Museum national d’Histoire naturelle, Paris). B: RMNH.AVES.216826, adult, Senegal [Senegambia on later label] (Pepijn Kamminga, © Naturalis Biodiversity Centre, Leiden)

from Mali and Ghana were described as *Columba livia lividior* by Bates (1932: 12) but subsequently this taxon was synonymised with *gymnocyclus* by White (1965: 153). Based on gender agreement between Latinised adjectival species-group names and the genus name with which they are combined (ICZN 1999: xxvi), the name *gymnocyclus*—Latinised from the Greek *gumnokuklos* (bare-ringed)—had to be changed to *gymnocyclus* (David & Gosselin 2002: 29).

Recent genomic analyses have demonstrated that Senegalese *gymnocyclus* is indeed closely related to populations in Mali and Ghana (*lividior*), despite moderate genetic differentiation ($F_{st} = 0.15$), probably due to geographic isolation (Hernández-Alonso *et al.* in press). More importantly, together with earlier analyses it was found that *gymnocyclus* is basal and highly differentiated ($F_{st} > 0.3$) compared to other *livia* populations (Hernández-Alonso *et al.* 2023, in press). Another key finding of these analyses is that, unlike *livia*, West African *gymnocyclus* shows no evidence of genetic introgression from the closely related Hill Pigeon *C. rupestris* in Central Asia from Turkestan to north-east China (Gibbs *et al.* 2001), indicating distinct evolutionary histories. For these reasons, in combination with the morphological differences, Hernández-Alonso *et al.* (2023, in press) argued that West African populations should be considered a full species.

To explain the genetic divergence of West African *gymnocyclus*, an evolutionary model based on the Refugia Theory has been proposed (Hernández-Alonso *et al.* 2023). According to this model, West African *gymnocyclus* represents an ancestral lineage that diverged due to allopatric cycles associated with Pleistocene glacial and interglacial periods. The West African lineage likely survived in refugia south of the Sahel during hyper-arid Sahara periods, whereas the *livia* lineage may have survived in refugia in Central Asia, where admixture with Hill Pigeon occurred.

In this paper we emphasise the importance of West African Rock Dove being treated as a species to galvanise conservation efforts. *C. gymnocyclus* has always been rather rare with a limited distribution, and only a small number of specimens—all with few or no locality data—exist in museum collections (Table 1, Fig. 2), but currently it seems to have become

TABLE 1

Skin/mounted specimens of West African Rock Dove *Columba gymnocyclus* present in museum collections and known to the authors. NHMUK = Natural History Museum, Tring; MNHN = Museum national d’Histoire naturelle, Paris; ZMB = Museum für Naturkunde, Berlin; NHMO = Natural History Museum, University of Oslo; RMNH = Naturalis Biodiversity Center, Leiden; AMNH = American Museum of Natural History, New York.

Reg. number	Locality	Date	Sex	Skin/mount
NHMUK 1837.5.13.199	Unknown (= Senegal)	Pre-1837	ad.	ex-mount
NHMUK 1855.12.19.299 **	West Africa (Senegal, died in captivity)	Pre-1855	ad.	ex-mount
NHMUK 1855.12.19.327	West Africa (Senegal, died in captivity)	Pre-1855	ad.	ex-mount
NHMUK 1920.6.8.150	Senegal, Dakar	3 June 1920	f	skin
NHMUK 1920.6.8.151 **	Senegal, Dakar	3 June 1920	f	skin
NHMUK 1932.8.6.1 * (holotype of <i>lividior</i>)	Mali, Mopti, Fiko	9 January 1932	m	skin
NHMUK 1932.8.6.35 (paratype of <i>lividior</i>)	Mali, Mopti, Fiko	4 January 1932	m	skin
NHMUK 1932.8.6.36 * (paratype of <i>lividior</i>)	Mali, Mopti, Fiko	9 January 1932	m	skin
NHMUK 1938.3.18.30	Mali, Hombori	15 January 1938	f?	skin
NHMUK 1911.12.23.135	Ghana, Gambaga	18 April 1901	m	skin
NHMUK 1936.2.21.356 *	Ghana, Gambaga	13 April 1901	m	skin
MNHN-ZO-MO-1936-935	Mali, Koulikoro, Kati, Kati	8 August 1920	f	skin
MNHN-ZO-MO-1880-3685	Senegal (died in captivity)	20 December 1880	ad.	mount
MNHN-ZO-MO-1938-1161	Mali, Mopti, Douentza, Hombori	18 January 1938	m	skin
MNHN-ZO-MO-1933-1512 (paratype of <i>lividior</i>)	Mali, Mopti, Fiko	6 January 1932	f	skin
MNHN-ZO-MO-1947-452	Mali, Kayes, Bafoulabé	1888–89	ad.	skin
MNHN-ZO-MO-1947-453	Mali, Kayes, Bafoulabé	1888–89	ad.	skin
MNHN-ZO-MO-1947-454	Mali, Kayes, Bafoulabé	1888–89	ad.	skin
MNHN-ZO-MO-1966-391	Mali, Mopti, Douentza, Hombori	5 September 1959	f	skin
ZMB 11158 (holotype of <i>gymnocyclus</i>)	Senegal	Pre-1853	ad.	ex-mount
ZMB 2000.18337	Togo, Savanes, Bogou	16 July 1901	ad.	skin
NHMO-BI-59310	Unknown (= Senegal)	unknown	ad.	ex-mount
RMNH.AVES.216826	Senegal (Senegambia on later label)	Pre-1850	ad.	mount
AMNH 612028	Ghana, Gambaga	28 August 1898	f	skin
AMNH 612029	West Africa, Senegal	unknown	ad.	skin

* Samples used in Hernández Alonso *et al.* (2023).
** Samples used in Hernández Alonso *et al.* (submitted).

even rarer and may already have disappeared from parts of its distribution (e.g. Dowsett-Lemaire & Dowsett 2014: 160, 2019: 168–169). Loss of habitat and/or hybridisation with feral *C. livia* are believed to be contributory factors in its decline.

Taxonomic history of *gymnocycla*

West African Rock Dove *C. gymnocycla* differs from Rock Dove *C. livia* subspecies in being smaller but with a heavier bill (Table 2, Fig. 3), overall much darker plumage, and especially in having a broad, bare red patch of skin around the eyes. Despite these marked

TABLE 2
Measurements (in mm) of West African Rock Dove *Columba gymnocycla*, Sahara Rock Dove *C. livia targia* and Rock Dove *C. l. livia*. In addition to the differences in colour between *C. gymnocycla* and subspecies of *C. livia* (see Figs. 1, 3 and 7), *C. gymnocycla* is also smaller than either *C. livia* subspecies but has a much heavier bill.

	NHMUK reg. nos.	wing	tail	bill (depth)
<i>Columba gymnocycla</i>	1837.5.13.199	214	114	5.9
	1855.12.19.299	211	113	5.9
	1855.12.19.327	215	115	6.0
	1920.6.8.150	196	102	5.7
	1920.6.8.151	198	102	5.7
<i>Columba gymnocycla</i> (former <i>lividior</i>)	1911.12.23.135	214	108	6.4
	1932.8.6.35	205	107	6.5
	1932.8.6.36	206	107	6.1
	1936.2.21.356	210	105	6.0
	1938.3.18.30	198	101	6.0
Mean of <i>C. gymnocycla</i>		206.7	107.4	6.02
<i>Columba livia targia</i> (Hoggar, Sahara)	1965.M.4617	214	111	4.6
	1965.M.4620	210	112	4.8
	1965.M.4621	212	110	4.8
	1965.M.4622	215	116	4.7
	1965.M.4624	210	106	4.5
<i>Columba livia targia</i> (Sudan)	1922.12.8.76	210	112	5.1
	1922.12.8.83	207	109	4.4
	1922.12.8.90	215	111	4.9
	1922.12.8.91	216	114	4.9
	1947.26.1	215	113	4.9
Mean of <i>C. livia targia</i>		214.4	111.4	4.76
<i>Columba livia livia</i> (Shetlands)	1868.11.28.45 *	231	121	5.0
	1934.1.1.1802	224	116	4.6
	2021.1.88	218	115	4.7
<i>Columba livia livia</i> (Outer Hebrides)	1953.76.100	224	118	4.8
	1965.M.4558	220	116	5.0
	1965.M.4561	212	116	4.5
<i>Columba livia livia</i> (Orkney)	1897.11.10.171	230	120	4.8
	1897.11.10.172	217	120	4.8
	1907.12.20.16	219	116	4.9
	1965.M.4562	223	119	4.7
Mean of <i>C. l. livia</i>		221.8	117.7	4.78

* Darwin’s specimen which he used as his reference for wild Rock Doves



Figure 3. West African Rock Dove *Columba gymnocyclus* (left, NHMUK 1855.12.19.299, adult, Senegal) has a heavier bill (see also Table 2) than Rock Dove *C. livia* (right, NHMUK 1965.M.4564, adult, Taranto, southern Italy, 22 January 1918), perhaps indicating a diet slightly different to that of *C. livia*, including more fruit and leaves, potentially suggesting West African Rock Dove is more arboreal (Hein van Grouw, © Trustees of the Natural History Museum, London)



Figure 4. Holotype of *Columba gymnocyclus* G. R. Gray, 1856, ZMB 11158, adult, Senegal, collected and/or presented by S. Delbrück (Pascal Eckhoff, © Museum für Naturkunde, Berlin)



differences, Hartert (1916: 84) was the first to classify it as a subspecies of Rock Dove. Prior to this, West African Rock Dove was generally considered a species.

The species was first mentioned, but not named taxonomically, by Hartlaub (1854: 205–206) as '*Columba livia*' in his synopsis of the birds of West Africa. Hartlaub's description, based on a specimen from Senegal held in Berlin (Fig. 4), is not especially detailed and could apply to any *C. livia* with a white rump: the dark colour is not emphasised, and he also did not mention the red orbital ring, presumably because its colour had faded in the specimen. In fact, he did not mention the broad, bare patch around the eyes at all. This characteristic, however, must have been noticed by Gray (1856: 28), as he named the bird *gymnocyclus* (now *gymnocyclus*) for its large naked eye-ring. As no description was given by

Gray, his *gymnocycla* would have been a *nomen nudum* if it had not been for the fact that he referred to Hartlaub's '*Columba livia*' as being the same species. As Hartlaub (1854: 205) *did* give a description and, despite it being not very accurate, the specimen in Berlin is thus the holotype of *C. gymnocycla*, and the four specimens then present in the British Museum and seen by Gray have no name-bearing status but are paratypes.

Three years after he had discussed '*Columba livia*' from Senegal, Hartlaub (1857: 193) mentioned the naked orbital ring and that it was 'flesh-coloured'—*periophthalmiis nudis, carneis*—and that Gray had suggested to separate them from *C. livia* under the name *C. gymnocyclus*. Four years later, having examined the specimens seen by Gray in the British Museum, Hartlaub (1861: 266) confirmed that the dark-coloured birds from Senegambia were distinct from *C. livia*.

Until c.1900 the taxon was still recognised as a separate species (e.g. Shelley 1896: 135, Hartert 1899: 406, Reichenow 1901: 400, Alexander 1902: 368). The bird Hartert referred to was collected by Lieutenant-Colonel William Carter Giffard (1859–1921) at Gambaga, Ghana, and is now in the American Museum of Natural History, New York (AMNH 612028; Table 1). He stated, 'This interesting pigeon looks very much like some domesticated races of *C. livia*, and agrees perfectly with the types of *C. gymnocyclus*, except that it is of a lighter grey...'. Because of their coloration Hartert speculated 'possibly the Gambaga birds are a paler sub-species.' Almost two decades later, by which time the concept of subspecies was more accepted, Hartert (1916: 84, 1912–21: 1471) seems to have abandoned the idea of *C. gymnocycla* possibly being a species and classified it as a subspecies of *C. livia* instead. He was, however, conscious that it could represent a population of feral pigeons rather than a



Figure 5 (left three). Holotype of *Columba livia lividior*, NHMUK 1932.8.6.1, male, collected at Fiko, east of Mopti, Mali, 9 January 1932 by G. L. Bates (Jonathan Jackson, © Trustees of the Natural History Museum, London)

Figure 6 (right two). Near-adult male *Columba gymnocycla* specimens, NHMUK 1911.12.23.135 (left) and NHMUK 1936.2.21.356 (right), collected at Gambaga, Ghana in April 1901 by Boyd Alexander (Jonathan Jackson, © Trustees of the Natural History Museum, London)

wild bird; 'The very rare *Columba livia gymnocyclus* (not *gymnocycla*!), ..., is insufficiently known, and the possibility of its being feral requires consideration.' (Hartert 1916) and, translated from German, 'it remains to be determined whether these are not the offspring of feral domestic pigeons' (Hartert 1912–21). Bannerman (1931) followed Hartert in recognising *gymnocycla* as a subspecies of *livia*, but had no doubt it was a wild bird.

In 1932, George Griswold Latimer Bates (1863–1940) collected four rock doves in French Sudan [Mali] with a 'wide ring of bare red skin around the eye.' As these were less dark than *C. l. gymnocycla*, Bates (1932: 12) considered them a different taxon, which he named *C. l. lividior* (Fig. 5). He referred to Alexander, who 30 years earlier had collected two *C. gymnocycla* in Ghana (Fig. 6) which, according to Alexander (1902: 368), were a little paler on the upperparts than *C. gymnocycla* specimens in the British Museum and which in Bates' (1932: 12) opinion are 'more like my new specimens.' He did not mention Giffard's bird or Hartert's earlier suggestion that the paler pigeons may be a different taxon. Vaurie (1961: 11) was first to suggest that *lividior* may be a synonym of *gymnocycla*, presumably because he did not consider the slight differences in colour significant. White (1965: 153) must have agreed, as he treated *lividior* as a junior synonym of *gymnocycla*. Bates' name has usually been regarded as a synonym ever since, and molecular analyses have recently shown this treatment to be correct (Hernández-Alonso *et al.* submitted). But, as described above, the genetic analyses also warranted treating *Columba gymnocycla* as a separate monotypic species.

Distribution and biology of *Columba gymnocycla*

Hartert's statement (1899: 406) 'Our knowledge of *Columba gymnocyclus* is very small, and there is no reliable evidence of its distribution' is, after nearly 130 years, still valid. Even today there appears to be still no consensus concerning the distribution of *C. gymnocycla*. It is variously considered to occur in Senegal and Guinea to Ghana and Nigeria (Gibbs *et al.* 2001: 179); in Mauritania, coastal Senegal, Guinea, Mali, Burkina Faso, northern Ghana and northern Togo (Borrow & Demey 2001: 475); in Mauritania, Mali, Gambaga (Ghana), coasts of Senegambia and Guinea (Urban *et al.* 1986: 477); from Senegal to southern Mali and Nigeria (Dickinson & Remsen 2013: 52); and in coastal Senegambia and Guinea patchily to central Mauritania, southern Mali and Ghana (del Hoyo & Collar 2014). In all these cases it is unclear on what information these distributions are based.

Establishing the (former) distribution of *gymnocycla* via published records has proven difficult, as often only '*Columba livia*' is mentioned without explicit reference to *gymnocycla*. Despite the remarkable differences in appearance, without clear reference to *gymnocycla*, the pigeons recorded could have been subspecies *targia* (Fig. 7) or feral *livia*. Therefore, the presence of *gymnocycla* in Guinea (Morel & Morel 1988: 162), Mali (Moulin *et al.* 2001: 529,



Figure 7. Sahara Rock Dove *Columba livia targia* (NHMUK 1965.M.4622, adult, Taharanet, Hoggar, southern Algeria, 9 March 1931) is similar in overall colour to nominate *livia* but has a grey rump, and is remarkably different from the dark, white-rumped West African Rock Dove which is also smaller (see Table 2). *C. l. targia* lacks a bare eye patch, like all *livia* subspecies, which together with the smaller bill also distinguishes it from *C. gymnocycla* (Jonathan Jackson, © Trustees of the Natural History Museum, London)

Dowsett-Lemaire & Dowsett 2004: 6) and Niger (Giraudoux *et al.* 1986: 59) cannot be confirmed. For Mauritania (Isenmann *et al.* 2010: 217–218) and Senegal (Morel 1985: 116–117, Morel & Morel 1990: 79) *gymnocycla* was specified. In Ghana (Dowsett-Lemaire & Dowsett 2014: 160) and Togo (Dowsett-Lemaire & Dowsett 2019: 168–169), the (sub)species is recorded as now ‘probably extinct’.

The species was also reported from the Los Islands (Îles de Los) off Conakry, Guinea (Reichenow 1900–01: 400, Bannerman 1931: 317, White 1965: 153), based on a single specimen mentioned by the French naturalist Jean-Frédéric Émile Oustalet (1844–1905), and identified by him as *C. l. schimperi* (Oustalet 1879: 156). The identification appears unlikely as *schimperi* occurs only in East Africa and is remarkably paler than most other *C. livia* subspecies. Oustalet remarked

‘A specimen from the Loss Islands appeared to me to belong to this variety [*schimperi*], rather than to any other race of our Rock Dove’ (translated from French). Based on the locality, later authorities must have assumed that the specimen was *gymnocycla*. It is no longer present in the Museum national Histoire naturelle, Paris (P. Boussès *in litt.* 2025) and its true identity is unknown. Even Ethiopia was considered to form part of its distribution (Shelley 1896: 135), based erroneously on a specimen held in the British Museum, received from the Zoological Society of London and supposedly originating from ‘Abyssinia’. The specimen, however, was incorrectly identified as *C. gymnocycla* and is, in fact, a dark-coloured domestic *C. livia* (Fig. 8).

In search of greater clarity regarding the species’ distribution, van Grouw (2024) queried whether members of the West African Ornithological Society had seen this pigeon, but received no responses. The same question was posed directly of several ornithologists who visit Senegal regularly (see Acknowledgements), but the answer was the same; no one could recall seeing it. Based on museum specimens (see Table 1), we know that the species occurs, or at least did occur, in Senegal, Mali, Ghana and Togo, but what are the reasons for the recent lack of records? Borrow & Demey (2001: 475) stated that the species is a ‘locally common to not uncommon resident’, but that appears no longer true, unless it is overlooked. Perhaps they occur in unexpected habitat? For Senegal, many authorities (e.g., Bannerman 1931: 316, White 1965: 153, Urban *et al.* 1986: 477) have stated that it occurs on coastal cliffs, presumably based on the assumption that *livia* prefers cliffs. The only detailed record we are aware of is from Cohel, Senegal (13°39′02.5″N, 15°37′48.9″W) (Fig. 9), far from the coast in a river valley with secondary riparian vegetation, surrounded by grazed savanna (C. Moning *in litt.* 2024). West African Rock Dove may occupy habitat different



Figure 8. Domesticated *Columba livia* specimen (NHMUK 1855.12.19.328) formerly misidentified as *gymnocycla*, from Abyssinia, (Jonathan Jackson, © Trustees of the Natural History Museum, London)



Figure 9. West African Rock Dove *Columba gymnocyclus*, Cohel, Senegal (13°39'02.5"N, 15°37'48.9"W), 13 January 2014. Based on the lack of iridescent neck plumage, these appear to be immatures, but the bare, red patch of skin around the eyes is nevertheless already well developed. Perched in a dead tree in a savanna, the species may occur in habitat different from that of *C. livia*. This may be the only photograph of live West African Rock Dove ever published (© Christoph Moning)

from that of *livia* after all. Arboreal habits have also been recorded in Mali (Urban *et al.* 1986: 478) and this may apply to *gymnocyclus* populations elsewhere too. The heavier bill (see Fig. 3, Table 2) may indicate a slightly different diet from *C. livia*, including more fruit and leaves, which also suggests it being more arboreal.

Another reason why this pigeon is not recorded may be because, due to its dark colour, the species is confused with feral *C. livia*, which has many different colour varieties. Besides being simply overlooked, we should not rule out the possibility that the species has become extremely rare and may even be on the brink of extinction.

Not only the habitat requirements of West African Rock Dove are unsure, we also know almost nothing about its habits. Only two brief first-hand observations are known to us, both from Ghana. The first is from W. C. Giffard, cited in Hartert (1899: 406), who collected a specimen: 'The little blue rock-pigeon is a wild bird. These birds live in a big 800-foot scarp, about six miles from Gambaga, and some come down in fair numbers at sowing and harvest time, at other times they are seldom seen.' Alexander (1902: 368), who collected two specimens, stated 'We only observed these Pigeons at Gambaga, where they were very wild. They breed in holes in steep rocky declivities. About the middle of April they appear in small flocks, in company with *Columba guinea*, on the newly sown grain-plots outside the village.'

Discussion

C. livia does not occur naturally within the supposed distribution of *C. gymnocyclus*. The nearest wild *livia* population involves *C. l. targia* in the mountains of the Sahara, Hoggar and Aïr, east to Sudan (Gibbs *et al.* 2001: 179) (Fig. 7), which is currently isolated from West

African Rock Dove by the Sahara. However, during the Holocene Green Sahara Period (c.5,000–11,000 years ago), a hybrid zone may have become established between the two lineages, given signals of admixture identified in West African Rock Dove. Possibly due to the latter being able to occupy a distinct ecological niche associated with more tropical, forested and flatter regions, homogenisation with *C. l. targia* was prevented, whereas the divergence and speciation processes were likely promoted (Hernández-Alonso *et al.* in press).

As shown above, little is known about the ecology, behaviour and distribution of *C. gymnocyclus*, and further research is necessary to enable future conservation efforts. There is, however, no doubt that they can and will hybridise with *C. livia* in areas where they may meet. Importantly, no signals of admixture have been found with domestic/feral *livia* (Hernández-Alonso *et al.* 2023, in press), confirming that *gymnocyclus* is indeed a distinct taxon and not an isolated population of feral *livia*, as suggested in the past (e.g. Hartert 1899, 1916). However, these findings are based on a historical dataset, and it is possible that admixture with feral *livia* has occurred more recently, due to the significant increase in rural and urban development in West Africa that promotes the presence of feral pigeons.

C. gymnocyclus populations are fragmented, and exhibit very high inbreeding, similar to many endangered species (Hernández-Alonso *et al.* in press). In addition to the effects of inbreeding such as loss of genetic diversity, habitat loss caused by climate change, urbanisation and environmental deterioration increases pressure on these populations, accelerating their collapse and eventual extinction. Urbanisation also increases the threat of admixture with feral *livia*, genetically diluting or even wiping out *C. gymnocyclus* populations. Currently, *C. gymnocyclus* is not recognised as a species by the IUCN but is included within *C. livia* on the Red List (IUCN 2025), with the latter species being categorised as Least Concern. For all these reasons and given that West African Rock Dove represents a well-differentiated taxon, it would be wise to re-evaluate its conservation status as a first step to ensure the species' protection.

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Confirmation of use of *Myrmecodia* for a nest site by Dusky-cheeked Fig Parrot *Cyclopsitta melanogenia*, in Wasur National Park, Indonesia

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<http://zoobank.org/urn:lsid:zoobank.org:pub:4A0CCF7B-D335-4E07-9773-D0D09A35D9A6>

SUMMARY.—We describe the location and characteristics of a Dusky-cheeked Fig Parrot *Cyclopsitta melanogenia* nest in Wasur National Park, South Papua, Indonesia. The nest's presence was confirmed by our observation of a nestling poking its head from a hole in an epiphytic ant-plant *Myrmecodia* sp., attached to a paperbark tree *Melaleuca cajuputi* in swamp forest. The ant-plant nest was subsequently removed for measuring and to describe its characteristics.

Wasur National Park straddles the districts of Sota, Naukenjerai and Merauke, in South Papua province, Indonesia, and covers an area of 431,425.12 ha. The diversity of vegetation in Wasur National Park includes *Melaleuca* forest, co-dominant *Melaleuca-Eucalyptus* forest, coastal forest, monsoon forest, riparian forest, mangrove, savanna, grassland, swampy grassland, *Eucalyptus* forest, lowland forest and *Exocaria* forest (Wasur National Park 2021).

Ten species of fig parrots (genera *Psittaculirostris* and *Cyclopsitta*) occur in New Guinea including adjacent islands (del Hoyo & Collar 2014), one of which is Dusky-cheeked Fig Parrot *Cyclopsitta melanogenia*, distributed on the Aru Islands and in southern Papua. This species was formerly considered conspecific with Blue-fronted Fig Parrot *C. guliemitertii* and Black-fronted Fig Parrot *C. nigrifrons* under the name Orange-breasted Fig Parrot (Forshaw 2010, Gregory 2017, Collar *et al.* 2024).

Dusky-cheeked Fig Parrot inhabits rainforest, monsoon savanna woodland, *Melaleuca* swamp forest and partially cleared areas in the lowlands and hills up to 1,100 m, but is rarely seen above 800 m (Collar *et al.* 2024). In the wild the main breeding season is between December and June (Hoppmann & Neumann 2012, Collar *et al.* 2024).

Its nest site and nest characteristics in the wild are very little known. Blue-fronted Fig Parrot nests in a hole excavated in arboreal termitarium, with two or more active nests found in the same mound, but is also reported to nest in epiphytes (Forshaw 2010, Collar *et al.* 2024), and it was assumed that *C. melanogenia* might be similar. Forshaw & Cooper (1978) reported that Donaghey observed what may have been a nest site of the wider Orange-breasted Fig Parrot species complex. While the male perched nearby, the female entered a hole in a 'bulbous growth protruding from a topmost branch. This appeared to be an epiphyte or an abnormality of the bark.' The female remained in the hollow for several minutes before flying off with the male.

Our field observations were made between December 2024 and February 2025 using binoculars. Ant-plants *Myrmecodia* sp. were removed from trees by climbing and using a bamboo stick. A machete was used to cut open the ant-plants and a ruler to measure them.

On 1 December 2024 at 08.05 h, LHH was making observations around Biras water pump facility in Wasur National Park (08.522423°S, 140.540613°E), when two adult fig parrots landed on a paperbark tree. Perched, the two birds vocalised as if in alarm, walked on the branches, before flying around and returning to the same tree. After a while, a young individual was seen sticking its head out from a hole in an epiphytic plant *Myrmecodia* sp.

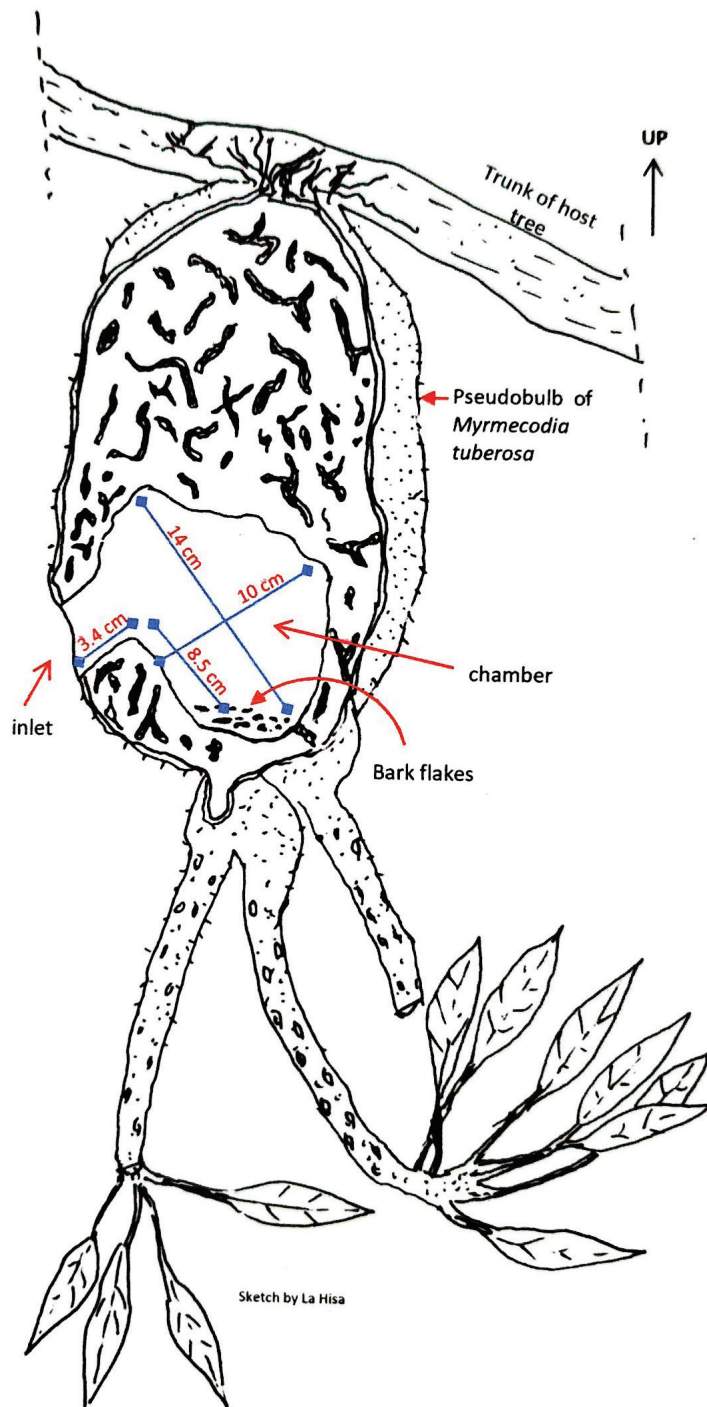


Figure 1. Diagrammatic representation of the nest of Dusky-cheeked Fig Parrot *Cyclopsitta melanogenia* found in Wasur National Park, South Papua province, Indonesia, showing how different measurements were taken (see also Table 1) (La Hisa Hesco)



Figure 2. Nest of Dusky-cheeked Fig Parrot *Cyclopsitta melanogenia* in ant-plant *Myrmecodia* sp., with a young visible at the entrance hole, Wasur National Park, South Papua province, Indonesia (La Hisa Hesco)

LHH took photographs (Fig. 2) and more notes on the birds' behaviour for c.1 hour at a distance of 10 m from the tree.

Myrmecodia is an epiphyte that has a symbiotic relationship with ants. It does not damage its host plant. The *Myrmecodia* with the fig parrot nest was in the lower canopy of the tree where the two adults perched. The host tree was just 11 m above sea level.

The individual in the hole was identified as a nestling by the colour of its bill, yellowish pink, the colour of its forehead (not yet dark blue), and its yellowish, not white, cheeks (Gregory 2017, Collar *et al.* 2024). The young stuck its head in and out of the hole twice, each time for ten minutes. Although the adults returned to the same tree, they remained in the canopy and were not seen to visit the *Myrmecodia* with the nest.

On 5 December 2024 at 15.41 h, in the same *Myrmecodia*, young were still visible from time to time at the hole entrance. However, no adults were seen or heard. On 10 February 2025, LHH returned but saw no fig parrots in the paperbark tree or the *Myrmecodia*. However, an exploration of the surrounding area (08.529425°S, 140.497676°E) identified four other *Myrmecodia* with holes like that of the nest, attached to four different paperbark trees within a radius of 50 m of each other. No fig parrots were observed, so to establish whether these *Myrmecodia* were or had been used as nests by fig parrots, three of the *Myrmecodia* were cut down by climbing the host trees. The *Myrmecodia* were measured externally and split open transversely. The shape of the cavities, their dimensions and other characteristics of the nests are presented in Table 1; measurements were taken as shown diagrammatically in Fig. 1. From the round entrance, a short tunnel of 3 cm slopes upward to a chamber

TABLE 1
Characteristics of nests of Dusky-cheeked Fig Parrot *Cyclopsitta melanogenia* found in Wasur National Park, Indonesia.

Nest no.	Measurements (in cm)				Height above ground	Entrance shape	Internal shape	Host tree
	Outer dimensions	Internal dimensions	Inner dimensions	Depth				
1 (with juvenile)	32 cm (height) × 17.7 cm (diameter)	3.3 cm (depth) × 3.4 cm (diameter)	longest diameter 14 cm; shortest 10 cm	8.5 cm	10.0 m	Round	Oval	Paperbark tree <i>Melaleuca cajuputi</i>
2	37 cm (height) × 19 cm (diameter)	4.0 cm (depth) × 3.3 cm (diameter)	longest diameter 17.5 cm; shortest 13.5 cm	6.0 cm	11.5 m	Round	Oval	Paperbark tree <i>Melaleuca cajuputi</i>
3	31 cm (height) × 19 cm (diameter)	4 cm (depth) × 4 cm (diameter)	Longest diameter 16.5 cm; shortest 12.0 cm	7.0 cm	10.0 m	Round	Oval	Paperbark tree <i>Melaleuca cajuputi</i>

measuring 14 × 10 × 8 cm. In two of the *Myrmecodia*, on the floor of the chamber there was a pile of small, short, smooth wood flakes.

Discussion

Based on our findings, we believe that *Myrmecodia* are indeed used as nest sites by Dusky-cheeked Fig Parrot. Both the entrance hole and tunnel were the same round 3 cm diameter, indicating they were made by fig parrots, because the mean diameter of entrance holes in *Myrmecodia* made by ants is only 0.2–0.8 cm (Huxley & Jebb 1993).

The entrance hole was not always sited at the base of the *Myrmecodia*, but was sometimes at the top, near where the ant-plant is attached to the tree, presumably based on which part of the epiphyte is largest and therefore most suitable for the cavity. The entrances tended to face south, perhaps to avoid direct sunlight entering the nest hole at either sunrise or sunset. The tunnel consistently sloped upwards to the main cavity, presumably to prevent water permeating the nest during rainstorms.

The abnormally large cavities within the *Myrmecodia* labyrinths indicate excavation by fig parrots, in accordance with the behavior reported by Forshaw (2010) who said that *Cyclopsitta* fig parrots, *Geoffroyus* parrots and Red-breasted Pygmy Parrot *Micropsitta bruijnii* are among the few parrots known to excavate nest holes. The cavities presumably needed to accommodate both one adult and its offspring.

The bark fragments on the floor of the cavity of the first nest with the young seemed to be of the host paperbark tree, but was not as thin.

All of the *Myrmecodia* were in swamp forest dominated by paperbark trees *Melaleuca* spp., *Asteromyrthus symphyocarpa*, *Nauclea orientalis*, *Dillenia alata* and *Lophostemon suaveolens*. December–February is the middle of the wet season in Wasur National Park, so much of the ground is waterlogged.

We believe this is the first confirmation of Dusky-cheeked Fig Parrot using *Myrmecodia* sp. to nest, but this leaves a significant question: how did the fig parrots cope with ant bites? *Myrmecodia* usually has a mutualistic symbiosis with the ant *Iridomyrmex cordatus* (Huxley 1978), which makes many tunnels and cavities inside the *Myrmecodia* (Fig. 3). Hundreds



Figure 3. (Left) Two halves of the same ant-plant *Myrmecodia* sp. to show the interior, with (right) a close up of one half (La Hisa Hesco)

of ants exited one of the epiphytes we cut open and attacked us with painful bites, so they could presumably kill newly hatched chicks.

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