

# Breeding biology of the Blue-naped Chlorophonia (*Chlorophonia cyanea*) in the Santa Marta Mountains

Biología reproductiva de la Clorofonia Verdeazul (*Chlorophonia cyanea*) en la  
Sierra Nevada de Santa Marta

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## Abstract

We present the first detailed descriptions of the breeding biology of the Blue-naped Chlorophonia (Fringillidae; *Chlorophonia cyanea*). In the Santa Marta Mountains, the Blue-naped Chlorophonia builds domed nests on vegetated roadbanks or roadside cliffs. They generally used existing vegetation to form the dome; in one case we inferred that a pair actively excavated a nest. This species lays a clutch of three eggs, white with reddish-brown speckling. The incubation period is 18-20 days, while the nestling period lasts 20-21 days. Both adults provision the nestlings equally, feeding regurgitated fruit in a stereotyped pattern, with an overall feeding rate of 3.5 feeding trips/hr. The main breeding season of the Blue-naped Chlorophonia in the Santa Marta Mountains is February to May.

**Key words:** Breeding seasonality, *Chlorophonia cyanea*, nest architecture, nest placement, parental care.

## Resumen

Presentamos las primeras descripciones detalladas sobre la biología reproductiva de la Clorofonia Verdiazul (Fringillidae; *Chlorophonia cyanea*). En la Sierra Nevada de Santa Marta, *C. cyanea* construye nidos en forma de domo en pendientes cubiertas por la vegetación al borde de caminos o carreteras. Las aves utilizaron generalmente la vegetación circundante para la construcción del domo; en uno de los casos, inferimos que una pareja excavó activamente su nido. La nidada de *C. cyanea* consta de tres huevos blancos con un salpicado café-rojizo. El período de incubación es de 18-20 días, mientras que el período de cría dura de 20 a 21 días. Ambos adultos participan en el cuidado parental, alimentando a los polluelos de forma estereotipada mientras regurgitan fruta, con una tasa total de atención de 3.5 viajes/hora. El principal período de reproducción de *C. cyanea* en la Sierra Nevada de Santa Marta es de febrero a mayo.

**Palabras clave:** Arquitectura del nido, *Chlorophonia cyanea*, cuidado parental, período de reproducción, ubicación del nido.

## Introduction

The genus *Chlorophonia* consists of five species of frugivorous finches (Fringillidae) that inhabit humid foothill and subtropical forests from southern Mexico to northern Argentina (Isler & Isler 1987, Burns 1997, Yuri & Mindell 2002). *Chlorophonia* species are sexually dichromatic; although both sexes exhibit a characteristic green and yellow plumage pattern, males are more brightly colored

(Isler & Isler 1987). *Chlorophonia* breeding biology is generally poorly described, with the notable exception of the Golden-browed Chlorophonia (*Chlorophonia callophrys*) studied by Skutch (1954) in the Costa Rican highlands. Other published notes (e.g. Isler & Isler 1987) agree with Skutch's observations on the breeding biology of Golden-browed Chlorophonia; *Chlorophonia* species are socially monogamous, both sexes assist in building a domed nest, complete with side en-

trance, and both sexes provision the nestlings with regurgitated fruit (Skutch 1954). However, the details of parental care and nest architecture remain unknown for most *Chlorophonia* species.

The Blue-naped Chlorophonia (*Chlorophonia cyanea*) is the most widespread species of *Chlorophonia*, with a disjunct distribution in South America; it inhabits Andean slopes from Venezuela to Bolivia, the Pantepui region of Venezuela, and the coastal mountains and Atlantic rainforest of southeastern Brazil, adjacent Paraguay and extreme northeastern Argentina (Isler & Isler 1987). Taxonomists recognize seven subspecies, including *psittacina*, endemic to the foothills (600–2100 m) of the Santa Marta Mountains (Hilty & Brown 1986, Isler & Isler 1987). Todd and Carriker (1922) described three nests of Blue-naped Chlorophonia located on vertical cliffs in these mountains. This contrasts with a nest description from the Atlantic Forest of Paraguay, where Bertoni (1919) described a nest hidden in epiphytes near a tree trunk (Bertoni 1919). Todd and Carriker (1922) also described the eggs of the Blue-naped Chlorophonia on the Santa Marta Mountains, where they lay clutches of three eggs, white with chestnut sprinkling. We are unaware of any further published descriptions of the natural history of the Blue-naped Chlorophonia, and here present the first quantitative observations of parental care in this species, with additional notes on nest architecture and structure.

## Methods

We studied six Blue-naped Chlorophonia nests in the Santa Marta Mountains between March 2008 and February 2010. We found the nests along the road that ascends the San Lorenzo ridge, on the northwest side of the Santa Marta Mountains, at elevations between 1650 and 2070 m. Vegetation in these elevations is predominately mature secondary subtropical forest interspersed with small farms and gardens, with one large patch of scrub-

by (*i.e.*, <5 m tall) regenerating forest dominated by ferns and terrestrial bromeliads.

We found the first (focal) nest under construction on 21 March 2008, in a garden of the ecolodge of El Dorado Nature Reserve (11°06' N, 74°04' W; 1954 m elev.), owned and managed by the Colombian NGO Fundación ProAves. This nest contained one egg on 24 March, and when we returned to check the nest on 28 March the nest contained a complete clutch of three eggs. We monitored the eggs sporadically, and last observed the eggs on 11 April. We found three young nestlings in the nest on 14 April and subsequently used a nearby balcony as a blind to observe the nest, accumulating 17.1 h of nest observations from 15–30 April. Nest observations took place opportunistically; in total, they covered the entire daily period.

We found the second nest, already with two eggs, on 19 April 2008, located near the local school at 1690 m elevation along the road ascending San Lorenzo ridge. Residents reported that this nest originally contained three eggs, but one had been broken, probably by schoolchildren. This nest failed, likely as a result of this human interference. The third and fourth nests were found on 18 April 2008 and 2 May 2008 at 2050 m elevation along the San Lorenzo ridge road; both appeared to be in the incubation stage when discovered but were inaccessible and could not be monitored closely. We found a fifth nest, with two eggs, on 2 June 2008 in the garden of the El Dorado Natural Reserve. This nest was later abandoned under uncertain circumstances; it contained two cold eggs and an additional, broken egg on 12 June. Finally, we found a sixth nest under construction on 12 February 2010, again near the local school. This nest contained one egg at 08:00 h on 14 February, and three eggs on the morning of 16 February. However, when we were able to return to the nest on 26 February, it contained only one cold egg and was abandoned; we again suspect that schoolchil-

dren tampered with the nest. The last five nests, three of which unequivocally failed, were observed opportunistically during the course of other fieldwork.

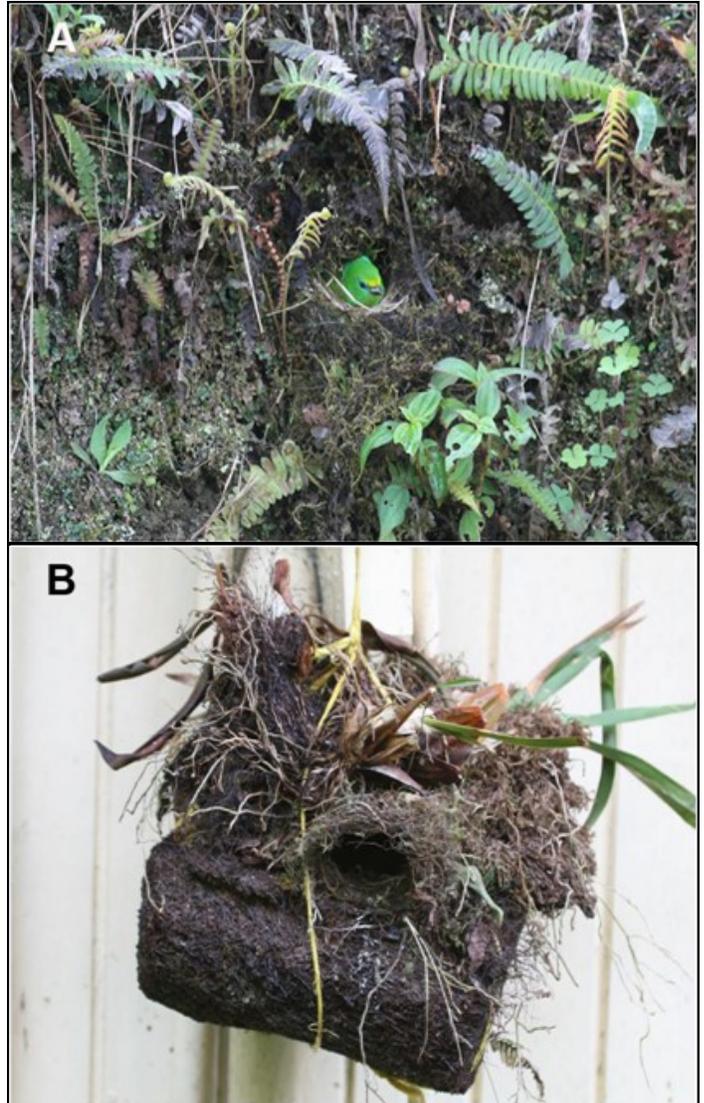
## Results

**NEST LOCATION AND ARCHITECTURE.**- Five of the nests we studied were located on vertical roadbanks and cliffs. Three nests were located 0.9, 1.0 and 1.2 m above the road on small (< 2 m tall) roadbanks, vegetated with a mixture of small ferns, grasses and herbaceous plants (Fig. 1). The other two roadbank nests were located in dense moss at the top of a roadside cliff (7 m tall) where, separated by 12 m, both nests were simultaneously active. Finally, the focal nest was constructed within a hanging orchid basket in the lodge's garden (Fig. 1).

All six nests were domed, and featured horizontal side entrances. Following the standard terminology of Simon & Pacheco (2005), the nests were closed/globular/base nests, although the focal nest, featuring an extended entrance tube, could also be classified as closed/retort/base. The nests were constructed using a mixture of moss and brown rootlets. However, natural concavities and hollows in the roadbank were used in all instances, forming much of the nest's structure (Fig. 1). For example, the walls of the focal nest's interior chamber consisted of packed soil, roots and organic material previously present in the root mass of the hanging orchid. Additionally, while all the nests we studied were domed, the dome appeared to consist of preexisting vegetation for roadbank nests, and was only certainly constructed in the February 2010 roadbank nest.

We were able to measure the four accessible nests in detail (measurements presented are mean  $\pm$  s.d.). When discovered, the entrance openings measured  $4.0 \pm 0.1$  cm wide by  $2.6 \pm 0.9$  cm tall ( $n = 3$ ). The focal nest featured an entrance tube

4.6 cm front-to-back, with an opening measuring 4.1 cm wide by 3.7 cm tall (Fig. 1). This opening became horizontally distended with use during the nestling period, and measured 5.7 cm wide after fledging. All the nests we studied were closed; the



**Figure 1.** Two nests of the Blue-naped *Chlorophonia cyanea* found in the Santa Marta Mountains, Colombia. (A) The nest is a typical roadbank nest, built in a preexisting natural concavity in a vegetated roadbank. Note the female incubating in her normal posture with her head facing out the nest entrance. (B) The focal nest, located in a hanging orchid basket, with an arrow pointing to the nest entrance.

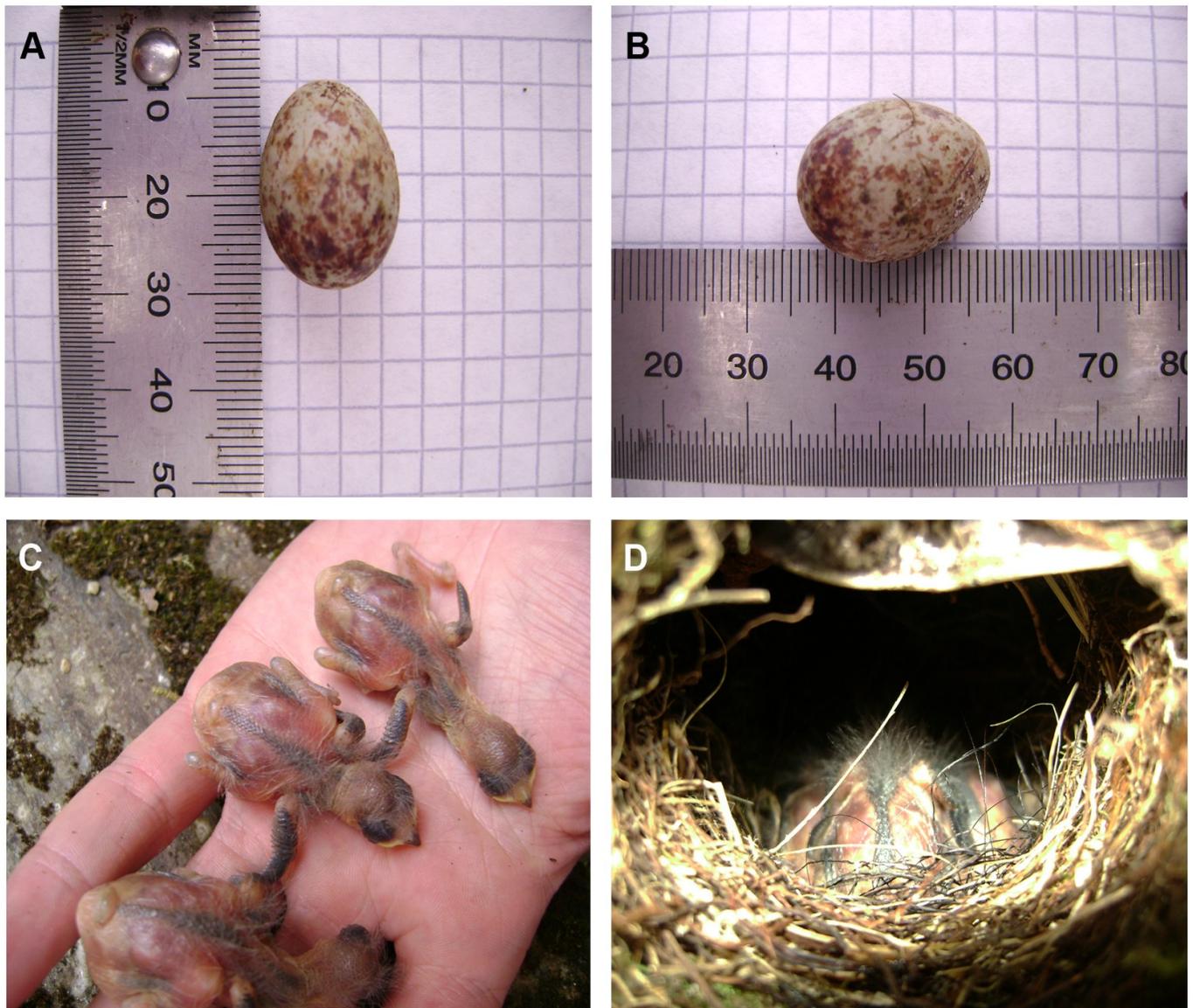
interior space of the nests measured  $5.6 \pm 1.6$  cm tall by  $6.5 \pm 1.9$  cm wide by  $8.2 \pm 0.8$  cm front-to-back ( $n = 4$ ). Two nests were lined with shallow egg cups within the interior space of the nest;

these egg cups were constructed of small brown and very fine black fibers (likely rootlets), and measured 4.6 cm wide by 4.2 cm deep and 4.3 cm wide by 2.1 cm deep.

**EGGS.**- We measured seven eggs from three different nests. Egg size ranged from 16.9 to 20.1 mm long by 12.5 to 14.1 mm wide ( $18.2 \pm 1.2$  mm long by  $13.1 \pm 0.6$  mm wide,  $n=7$ ). All eggs were off-white in color with red-brown speckling, heaviest at the blunt end of the egg (Fig. 2). We did not

collect any nests or eggs.

**PARENTAL CARE.**- We did not quantify incubation or brooding behavior, although we note that the incubation period at our focal nest lasted 18-20 days. We observed female-plumaged birds incubating at five nests; at each nest the female incubated while looking directly out the nest entrance (Fig. 1). In all observations at the focal nest, which included several hours with young nestlings (< 7 days old), we observed just one occasion where



**Figure 2.** Eggs and nestlings of the Blue-naped Chlorophonia (*Chlorophonia cyanea*) found in the Santa Marta Mountains, Colombia. (A & B) Two measured eggs. Note the reddish-brown speckling in both eggs. (C) Nestlings that are approximately five days old, with pink skin and a small amount of grayish down on the head. (D) Nestling near the focal nest entrance, showing dark-grey natal down over the head area.

the female brooded. On this occasion, she brooded for an unrecorded time period following a feeding trip.

When we discovered three nestlings in the focal nest on 14 April 2008, they appeared to be approximately three days old, with closed eyes, yellow gape flanges, pink skin and a small amount of grayish down on the head area (Fig. 2). By 18 April 2008, they had dark-grey natal down on the head and back areas, but their eyes were still closed (Fig. 2). They fledged between 7:00 and 8:00 h on 1 May, suggesting that the nestling period lasted around 20-21 days. During this period, adults made 3.5 feeding trips/h to the nest. This equates to an overall rate of 1.2 feeds/nestling/h, but adults generally fed multiple nestlings on each feeding trip. There was no observed change in feeding rate during the course of this study.

The adults fed nestlings sequentially in a stereotyped fashion. We observed 30 feeding trips by the pair, with minimal variation in the pattern. First, the pair flew together to a set of perches in bushes within 5 m of the nest, and gave soft musical notes. Then, both adults flew silently towards the nest. Halfway to the nest, the female always wheeled away and returned to her perch while the male continued to the nest entrance, where he perched with his body in a vertical position and inserted his head to feed (male time at nest entrance =  $25.2 \pm 6.1$  s,  $n = 23$ ). After feeding, the male left the nest and flew to join the female at the set of perches. Subsequently, both adults flew toward the nest entrance before the male returned to his perch while the female arrived at the nest entrance. The female then inserted her head to feed the nestlings, remaining at the nest entrance for  $64.2 \pm 10.5$  s ( $n = 23$ ). When the nestlings were older (*ca.* 10-12 days), they moved to the nest entrance during a feeding visit, eliminating the need for the feeding adult to insert its head into the nest. During this stage, we could observe that the female generally fed for only 20-30

s. After feeding, she remained at the nest entrance, sometimes glancing around the nest's environs, while the nestlings retreated into the nest chamber and ultimately produced one or more fecal sacs. The female immediately ate the fecal sacs, and then flew into the canopy of nearby trees and began foraging, joined mid-flight by her mate. Both adults always gave typical musical notes as they flew together away from the nest.

It was difficult to determine the food items adults fed to nestlings. Both adults carried food in their throats to the nest, where they regurgitated their meals to the nestlings. We could not discern the identity of the regurgitated food items, but we did observe adults eating *Cecropia* fruit immediately prior to feeding nestlings on two occasions.

OTHER OBSERVATIONS.- On 2 May 2008, we observed an extended confrontation between the two pairs nesting on the same roadside cliff. At this time, the more southerly nest had nestlings, and the more northerly nest, where we never observed nestling provisioning, likely had eggs. When we arrived at the nest cliff at 11:10 h, three male and two female-plumaged individuals were calling agitatedly from a brushy area below the cliff. Although juvenile males are difficult to distinguish from females, we believe that both female-plumaged birds were likely females, and for simplicity refer to these birds as "females." One of the males soon left, and the four remaining birds flew up to the vicinity of the nests, where the two males began to frequently attack each other, making physical contact face-to-face in mid-air. All four individuals gave sharp "chip" notes and frequently flicked their wings; rapid flights made it impossible to follow individuals during the course of this observation.

After nearly ten minutes of repeated bouts of aggressive behavior, one of the females entered the more northerly nest to incubate. On three occasions the second female approached this northern

nest and each time this second female was attacked in mid-air by a male, preventing her from reaching the nest. Later, a male approached the incubating female in the northern nest and landed unmolested at the nest entrance, where he began to forcefully peck the incubating female in the head area. He continued this behavior for roughly 40 s, at which point the female left the nest and flew away while the attacking male continued to peck at her in mid-air. After her departure at 11:30 h, the two males continued to attack each other in flight in short (5-10 s) irregular bouts for several minutes until one male finally left at 11:35 h. At this time the remaining pair appeared to feed their nestlings at the southern nest sequentially, the male feeding first. After feeding, the remaining pair departed the area.

## Discussion

The nests of *C. cyanea* we studied were similar in location, architecture, egg color and clutch size to Todd and Carriker's (1922) observations on the breeding biology of *C. cyanea* in the Santa Marta Mountains. The species' parental care was also broadly similar to the only other *Chlorophonia* with published descriptions of parental care, *C. callophrys* (Skutch 1954). In particular, our observations of the stereotyped pattern of adult arrival to the nest and nestling provisioning, with both adults regurgitating food to the nestlings, the male feeding first and only the female disposing of fecal sacs, are very similar to observations at six nests of *C. callophrys* (Skutch 1954). Our estimated nestling period of 20-21 days, however, is slightly lower than the 23-25 day nestling period documented for *C. callophrys* (Skutch 1954).

Five of the six nests we studied were located in crevices in overhanging cliffs or vertical roadbanks, similar to the three nests previously described (Todd & Carriker 1922). This affinity for using steep cliffs or roadbanks as nesting sites may be a trait specific to *psittacina*. A nest of *C. cyanea* de-

scribed from Paraguay was "pouch-shaped" and hidden among a profusion of mosses and ferns on a heavy tree trunk (Bertoni 1919), and nest sites hidden among epiphytic vegetation in the mid-story and canopy appear to be the norm in other *Chlorophonia* as well (Skutch 1954, Howell & Webb 1995, Strewe 2001, although Chaves *et al.* (2008) described a roadbank nest in the Golden-browed *Chlorophonia*). Although very preliminary, these observations suggest geographical variation in preferred nest site within the Blue-naped *Chlorophonia*.

Perhaps related to their nest-site selection, the individuals we studied appeared to use existing roadbank vegetation to form the dome of their nest; they did not weave the nests' dome as has been observed in the Golden-browed *Chlorophonia* (Skutch 1954, but see Chaves *et al.* 2008). We were able to closely examine four nests; of these, the dome appeared to be pre-existing vegetation in three nests, and was only clearly constructed in one nest.

Our observations suggest that Blue-naped *Chlorophonias* might occasionally excavate their nest. The focal nest we studied was located in a hanging planted orchid with a bulbous root mass. Although the entrance tube was constructed of woven rootlets and moss, the interior chamber of the nest did not include an egg cup or any typical nesting materials. Instead, this interior chamber appeared to be dug out by the adults from a crevice within the orchid's root mass; the remaining root mass formed the bottom, sides, and dome of the chamber. It is unlikely that this hanging orchid contained a preexisting chamber in its root mass; although we did not observe nest construction at this nest site, we infer that the adults excavated the chamber, the first probable record of nest excavation within *Chlorophonia*. There is a record of nine nests of Thick-billed Euphonia (*Euphonia laniirostris*) constructed in hanging baskets around a house (Johnson & Washington *in litt.* in Isler &

Isler 1987), but it is unclear if the individuals excavated their nests.

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