

Description of the nest, eggs and nestling of the Black-breasted Gnateater, *Conopophaga snethlageae* (Aves: Conopophagidae), with emphasis on nesting behavior

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ABSTRACT

Knowledge regarding the reproductive biology of the *Conopophaga* genus remains limited, particularly concerning nesting behavior, parental care, and division of tasks between parents. In this study, we present the first description of the nest, eggs, and nestlings of the Black-breasted Gnateater, *Conopophaga snethlageae*, alongside monitoring nest activity using a camera trap in forests of the Tapajós region, in the Brazilian Amazon. Over 32 days, we recorded 502 nest activities, of which only one of the two eggs successfully hatched, which was preyed on by a snake on its 13th day of life. Our observations shed light on distinctive parental roles, with the female actively involved in incubation and the male taking on a more significant role in caring for the nestling. These findings enhance our understanding of reproductive strategies within *Conopophaga* and provide a foundation for future studies on the breeding biology and conservation of the genus.

KEYWORDS: Amazon, camera trapping, Neotropical birds, nest predation, reproductive biology

Registros e comportamento reprodutivos do chupa-dente-de-peito-preto, *Conopophaga snethlageae* (Aves: Conopophagidae)

RESUMO

O conhecimento sobre a biologia reprodutiva do gênero *Conopophaga* ainda é escasso, especialmente no que se refere ao comportamento de nidificação, cuidados parentais e divisão de tarefas entre os pais. Neste estudo, apresentamos a primeira descrição do ninho, ovos e filhotes do chupa-dente-de-peito-preto, *Conopophaga snethlageae*, além de resultados do monitoramento da atividade no ninho utilizando uma armadilha fotográfica em uma floresta da região do Tapajós, na Amazônia brasileira. Durante 32 dias, registramos 502 atividades no ninho, onde apenas um de dois ovos eclodiu, no entanto, o ninhego foi predado por uma serpente em seu 13º dia de vida. Nossas observações destacaram diferenças no papel dos pais: a fêmea está envolvida majoritariamente com a incubação dos ovos e o macho assume função mais significativa no cuidado parental. Esses achados aprimoram o conhecimento sobre as estratégias reprodutivas do gênero *Conopophaga* e fornecem base para futuros estudos sobre a biologia reprodutiva e conservação do gênero.

PALAVRAS-CHAVE: Amazônia, armadilhas fotográficas, aves neotropicais, predação de ninhos, biologia reprodutiva

Research on Neotropical bird breeding biology is essential for understanding ecological and evolutionary processes but is particularly challenging in the Amazon due to dense forests and logistical constraints (Fierro-Calderón et al. 2021). Advances in passive monitoring, such as camera traps, offer non-invasive alternatives for studying nesting behavior and reproductive ecology (Caravaggi et al. 2020).

The genus *Conopophaga* Vieillot, 1816 includes small, sexually dimorphic insectivorous birds inhabiting the understory

of South American forests (Winkler et al. 2020). Despite the existence of general descriptions of their reproductive biology, observations of reproductive behavior in *Conopophaga* are limited to sporadic studies (Vieira et al. 2023). The Black-breasted Gnateater, *Conopophaga snethlageae* Berlepsch, 1912, is endemic to the Amazon, occurring between the Tapajós and Tocantins Rivers (Greeney and Boesman 2022). Recently reclassified as a full species (Clements et al. 2022, Gill et al. 2023), no data on its breeding biology has been published. We

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provide the first description of its nest, eggs, and young, using a camera trap to document reproductive behavior.

We found one nest during the incubation stage on January 8, 2023, in the understory of a primary *terra firme* forest (6°57'32.7"S, 55°13'56.7"W) in Novo Progresso, Pará. We installed one camera trap (Trail Camera HC801; Suntek) to record 15-second videos triggered by motion detection, and to record the ambient temperature. We inspected the camera trap every two or three days. We took measures of the nest, eggs, and nestling body mass. We used the *lubridate* (Grolemund and Wickham 2011) package in *R* (RStudio Team 2020) for processing the dates and times. We used the *easynls* package (Arnhold 2017) to fit the nestling mass data to nonlinear growth rate function (Gompertz curve).

We monitored the nest through the camera trap for 32 days (from January 8, 2023, to February 9, 2023.), resulting in 502 nest activity records, totaling 125 minutes and 30 seconds of documented footage. We observed a total of 12 days of incubation and 13 days of nestling development, until it was preyed upon by a snake.

The nest was composed of small twigs and dry leaves in its general structure and lined with small dry fibers. It exhibited an elliptical low/cup shape (following Simon and Pacheco 2005) and was located 65.5 cm above the ground on a *Bactris* sp. palm (Figure 1a,b). The nest measurements were as follows: minimum diameter of 11.6 mm, maximum diameter of 13.2 mm, depth of 4.7 mm and height of 14 mm. The nest contained two eggs, beige in color with small brown spots, slightly varying in shape and color pattern (Figure 1c). They measured 23.26 mm x 18.07 mm, 3.6 g and 23.10 mm x 16.99 mm, 3.5 g.

Only one chick hatched. On the 1st day, it weighed 3 grams, had black, bare skin, closed eyes (Figure 1d) and a short beak with yellowish-white commissures and a vibrant yellow-orange interior. By the 3rd day, black pterylae were visible on the back. Feather sheaths appeared on the 5th day, and by the 7th day, brown plumage and sparse down feathers covered the body. By the 13th day, the nestling had opened its eyes, was fully feathered, and displayed brown upper parts with black streaks, a buff postocular tuft, and a black chest contrasting with a white vent, identifying it as male (Figure 1e). The nestling's weight gain followed a sigmoidal function (Gompertz curve) with a coefficient of determination of 0.99, characterized by the following equation: $Mass(day) = 22.93282 * \exp(-2.403228 * \exp(-0.16699347 * day))$.

Both sexes participated in incubation and parental care (Figure 2a), with the female exclusively occupying the nest during the nights. During incubation, the female was significantly more present in the nest than the male (107/24 records, respectively), engaging in various activities during the night, such as scratching, preening feathers, and snuggling, and then sleeping with feathers fluffed and the bill tucked under one wing. Nest exchanges occurred throughout the diurnal period (Figure 2b), with no clear interval patterns. The male took over the nest as early as 6:41 AM and as late as 6:03 PM. Only the female was observed rotating the eggs.

The first hatching occurred around noon; the nestling broke the egg in half transversely. Then the female removed both halves of the eggshell from the nest, one at a time. No traces of eggshell were found near the nest. The other egg remained without signs of hatching and was consumed by the male around 48 hours after the first hatching, as he broke it with his beak and swallowed large pieces until the nest was completely clean.

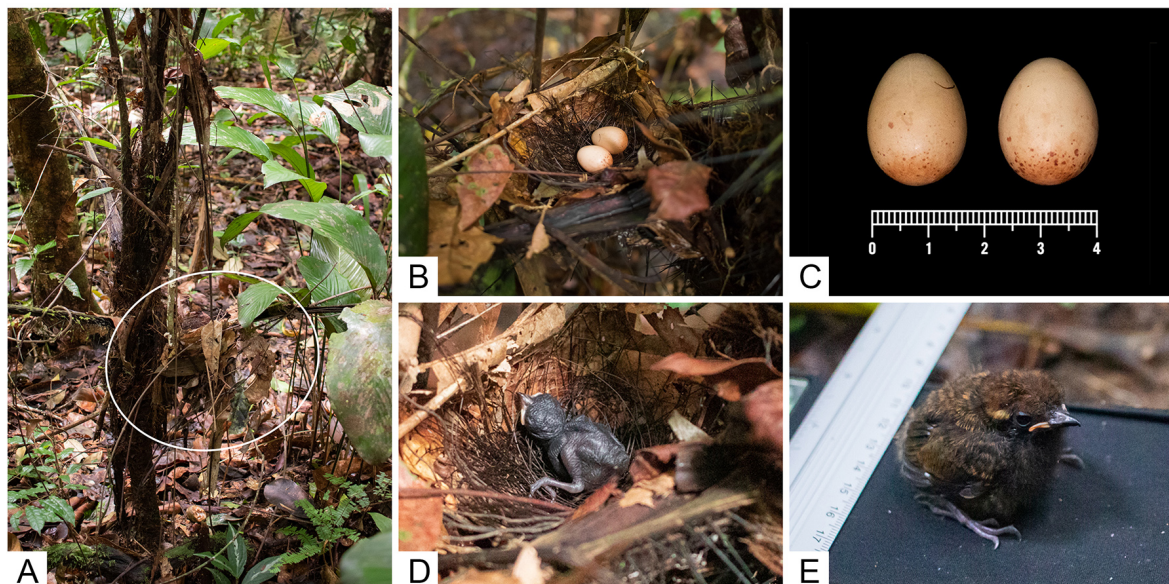


Figure 1. Black-breasted Gnatcatcher (*Conopophaga snethlageae*) nest site (A), nest (B), eggs (C), Nestling 2nd-day-old (D) and Nestling 13th-day-old (E).

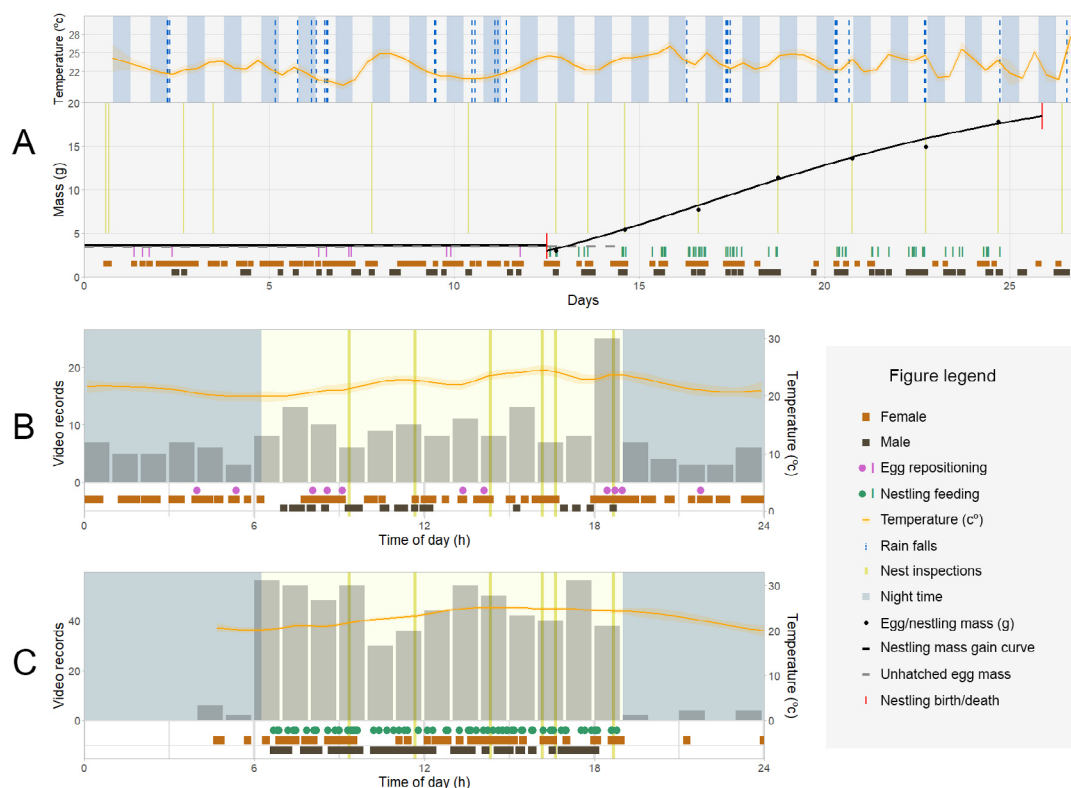


Figure 2. Pattern of parental behavioral activity of *Conopophaga snethlageae* recorded at the nest. Sunrise was defined as 6:15h, and sunset as 19:00h. Events observed throughout the monitoring period (A). Circadian pattern of behavior observed during the incubation period (B). Circadian pattern of behavior observed during the nestling period (C).

During the nestling's development, the majority of the activity was concentrated during the diurnal period, with a slight peak in the early morning (Figure 2c). In this stage, the parents' diurnal activity primarily consisted of quick visits to the nest and feeding the nestling. As a result, the nestling spent most of the day alone in the nest, even during rainfall. Occasionally, the male would cover the nestling during the day. One such instance occurred when a group of coatis, *Nasua nasua* (Linnaeus 1766) - a potential predator, approached the nest in the late afternoon (Figure 3a), the male remained motionless, and the coatis seemingly did not detect the nest. From the nestling's birth onwards, the male started performing a "broken-wing" distraction display (Figure 3b) during nest inspections.

The nestling exhibited its first instance of head-raising and gaping behavior (indicative of food solicitation) approximately two hours after hatching, in response to the female's arrival at the nest edge (Figure 3c). It was then recorded being fed by the female 14 minutes later. Both female and male almost equally participated in feeding the nestling (38/33 records, respectively), with episodes distributed throughout the day. Precise food items provided to the nestling could not be accurately identified; however, we recorded the presence of arthropods such as larvae, small spiders, and a grasshopper.

Both sexes were observed removing fecal sacs from the nest. The male removed the fecal sacs from the nest five times by picking them up with its beak and flying away. Additionally, on two separate occasions, the male ingested the fecal sacs. The female also consumed the fecal sacs twice.

Starting from the 8th day of life, the nestling began to regularly produce soft chirping calls while soliciting food (Macaulay Library: ML627972140), and it also started to perform routine exercises, such as stretching its legs and wings.

On the night of 2 February 2023, the snake *Oxyrhopus petolarius* (Linnaeus, 1758) climbed the tree trunk and attacked the nestling, which emitted distress calls before being swallowed (Figure 3d). The parents did not return that night, and while the male visited the nest nine times in the following days, the female appeared only twice. No further visits were recorded after six additional days of monitoring.

Descriptions provided in this study, including nest shape, egg characteristics, and nestling development, align with patterns expected for the genus, as presented a recent comprehensive review by Vieira et al. (2023). However, unlike other species (e.g. *C. lineata* (Bodrati and Sallo 2020) and *C. roberti* (Pereira et al. 2022)), the sex of the nestling observed in this study was unequivocally determined based on its plumage while still in the nest.



Figure 3. A group of coatis (*Nasua nasua*) foraging on the ground beneath the nest (A). Male of *Conopophaga snethlageae* performing the “broken-wing” distraction display (B). Female feeding the nestling (C). *Oxyrhopus petolarius* snake preying on the nestling (D).

The ‘broken-wing’ distraction display, observed in various *Conopophaga* species, is believed to be characteristic of the genus and serves to divert predator attention from the nest (Schunck and Mix 2021). This behavior, aimed at reducing predation risk, is unknown in related neotropical birds (Schunck and Mix 2021). Previous studies suggest nest and nestling predation as major causes of reproductive failure, but specific predators remain unidentified (Marini *et al.* 2007, Studer *et al.* 2019, Bodrati and Sallo 2020, Pereira *et al.* 2022). Parental immobility, cryptic egg and plumage coloration, and the spiky tree could be additional anti-predatory strategies, though the latter did not deter a climbing snake.

Studies on parental roles in *Conopophaga* species are limited. Alves *et al.* (2002) described *C. melanops*’ reproductive behavior, noting similar patterns to our findings, including that only the female was present in the nest during the night. However, they reported greater male investment in incubation, than in our results. For nestling care, Alves *et al.* (2002) observed equal effort from both sexes, whereas we found the male slightly more active. Differences in methods likely influenced these outcomes, however, brief observations by Lizarazo and Londoño (2022) suggest feeding effort may vary with nestling age but were based on limited data.

This study provides valuable insights into nesting behavior and predation in *Conopophaga*, highlighting parental roles and documenting predation events. Future studies should investigate breeding ecology, dietary requirements of nestlings, foraging strategies during incubation and nestling periods, and the diversity of predators targeting *Conopophaga* species to deepen understanding of factors affecting reproductive success and survival.

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DATA AVAILABILITY: The data that support the findings of this study are available, upon reasonable request, from the corresponding author Luis Aguiar de Moraes. The dataset is not publicly available because the substantial size of the files precludes online availability.



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