New information on the breeding biology of fifteen Brazilian bird species

Novas informações sobre a biologia reprodutiva de quinze espécies de aves brasileiras

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Abstract: Although birds are a well-studied group, the breeding biology of many species is still poorly known, especially in the Neotropical region. This lack of knowledge implies the absence of subsidies for conservation, lack of more reliable data for phylogenetic reconstruction, and for studying the effects of environmental change on these species. In view of this scenario we collected information on the reproduction of 15 bird species in 16 Brazilian locations from February 2003 to December 2021. This article presents new data on the nests, eggs, juveniles/nestlings and/or breeding behavior of *Veniliornis spilogaster* (Picidae), *Philydor atricapillus* (Furnariidae), *Myiobius barbatus* (Onychorhynchidae), *Tityra semifasciata* (Tityridae), *Phylloscartes paulista* (Rhynchocyclidae), *Phylloscartes oustaleti* (Rhynchocyclidae), *Elaenia obscura sordida* (Tyrannidae), *Tyrannus albogularis* (Tyrannidae), *Cnemotriccus fuscatus* (Tyrannidae), *Icterus pyrrhopterus* (Icteridae), *Nemosia pileata caerulea* (Thraupidae), *Trichothraupis melanops* (Thraupidae), *Thlypopsis sordida* (Thraupidae), *Cyanophonia cyanocephala* (Fringillidae) and *Chlorophonia cyanea roraimae* (Fringillidae). We include new data on parental care for six species, descriptions of nests for eight species, and new information on nest building behavior for five species. This data is of special interest for the management of these species and their habitats and for the reconstruction of their phylogenetic relationships.

Keywords: Nest. Egg. Constancy of incubation. Juvenile. Parental care.

Resumo: Apesar de as aves estarem entre os animais mais estudados, muitas espécies ainda possuem a biologia reprodutiva pouco conhecida, principalmente na região Neotropical. Essas lacunas de conhecimento implicam a falta de subsídios para conservação, reconstrução de filogenias e entendimento dos efeitos de alterações ambientais nas espécies. Tendo em vista esse cenário, de fevereiro de 2003 a dezembro de 2021, foram coletadas informações sobre a biologia reprodutiva de 15 espécies de aves, em 16 localidades brasileiras. Apresentamos dados inéditos sobre ninhos, ovos, juvenis e/ou comportamento reprodutivo para *Veniliornis spilogaster* (Picidae), *Philydor atricapillus* (Furnariidae), *Myiobius barbatus* (Onychorhynchidae), *Tityra semifasciata* (Tityridae), *Phylloscartes paulista* (Rhynchocyclidae), *Phylloscartes oustaleti* (Rhynchocyclidae), *Elaenia obscura sordida* (Tyrannidae), *Tyrannus albogularis* (Tyrannidae), *Cnemotriccus fuscatus* (Tyrannidae), *Icterus pyrrhopterus* (Icteridae), *Nemosia pileata caerulea* (Thraupidae), *Trichothraupis melanops* (Thraupidae), *Thlypopsis sordida* (Thraupidae), *Cyanophonia cyanocephala* (Fringillidae) e *Chlorophonia cyanea roraimae* (Fringillidae). Divulgamos novas informações sobre o cuidado parental de seis espécies e a construção do ninho de cinco espécies, bem como fornecemos descrições de ninhos de oito espécies. Estes dados são de especial interesse para o manejo das espécies e seus hábitats, além de auxiliarem na reconstrução de suas relações filogenéticas.

Palavras-chave: Ninho. Ovo. Constância de incubação. Juvenil. Cuidado parental.

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INTRODUCTION

Birds are one of the best studied groups of vertebrates (Fazey et al., 2005; Titley et al., 2017). Yet, much of their natural history remains unknown, particularly in the Neotropics, which holds an enormous diversity of bird species (Jetz et al., 2012; Stutchburry & Morton, 2001). Even basic information on the reproductive biology of many Neotropical bird species remains obscure, often restricted to brief descriptions in the gray literature. Xiao et al. (2016), analyzing the species whose clutch size, incubation period and/or nestling periods have been described, found that only a third of the world's bird species are well known. This knowledge gap directly affects conservation, since information on breeding parameters such as clutch size, reproductive phenology and nest survival could contribute to a better understanding of population demography, viability of threatened species, and to provide data for species recovery plans (Gjerdrum et al., 2005; Zhu et al., 2012; Cheng et al., 2020). Lack of this information also precludes studies in other areas such as reconstruction of phylogenies that require reproductive traits and studies on the adaptation of birds to environmental and climate changes (Zyskowski & Prum, 1999; Both et al., 2004; Crick, 2004; Wegge & Rolstad, 2017). Little is also known about intraspecific variations in nest architecture, nest material, and the influence of species range and environmental characteristics on these parameters for a given species. In addition, data on the reproductive biology of a species not only fills in knowledge gaps, but also allows inferences about the reproduction of little-known congeners (Xiao et al., 2016). Here, we provide new information on the breeding biology of 15 understudied Brazilian bird species, including nest and egg descriptions, nestling and fledging characteristics, clutch sizes, nesting phenology, and parental attendance.

MATERIAL AND METHODS

From February 2003 to December 2021, we collected information regarding the reproductive biology of 15 bird species at 16 Brazilian locations (Figure 1, Table 1). Nests were classified following Simon and Pacheco (2005), with a few adaptations. Whenever possible, we collected information about the height above the ground, substrate where the nests were built and the materials used. The cavity used by the *Philydor atricapillus* (Wied, 1821) was measured using a metal caliper of 0.1 mm precision (horizontal and vertical lengths of the chamber entrance) and a measuring tape (for other dimensions). For measurements we considered: height of the cavity (from the lower lip of the entrance to the ground), diameter of the tree at breast height, vertical and horizontal diameters of the entrance (taken in the larger diameter of each one), depth of the cavity (from the lower edge of the entrance to the cavity bottom), and the diameter of the cavity, measured from the lower internal edge of the entrance to the back wall of the cavity (Lange, 1967). Eggs were measured with a caliper to the nearest 0.05 mm, handled in the absence of adults, with cleaned hands, and taking caution with the integrity of the eggshell. Observations of reproductive behavior, when feasible, were performed using focal observations and recordings with a Samsung HMX-F80 camcorder 52x optical zoom [the last method only for *Elaenia obscura sordida* Zimmer, 1941 and *Cnemotriccus fuscatus* (Wied, 1831)]. We also recorded the role of each individual while building the

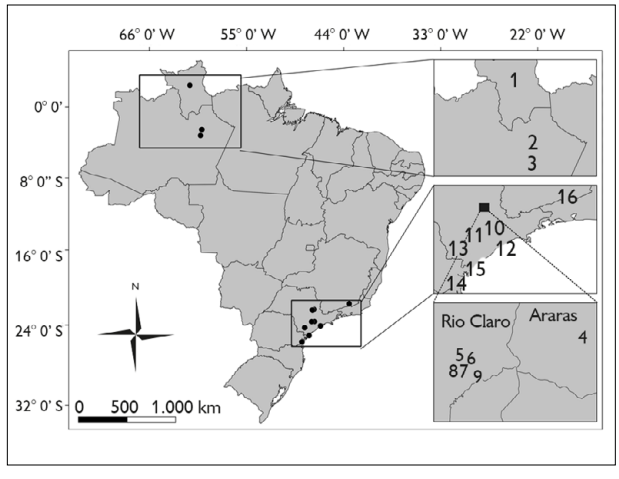

Figure 1. Localities surveyed in the present study. See Table 1 for the names and geographic coordinates of each locality. Map: Arthur M. Gomes (2020).

nest, egg incubation and care of the young. For *E. obscura sordida*, we present the constancy of incubation as the proportion of daytime that adults had their bodies directly in contact with eggs (adapted from Kendeigh, 1952, and Skutch, 1962). Food items recorded during focal observations [*Icterus pyrrhopterus* (Vieillot, 1819), *Nemosia pileata caerulea* (Wied, 1831) and *Thlypopsis sordida* (d'Orbigny & Lafresnaye, 1837)] were visually identified and classified according to Triplehorn and Johnson (2005). The acronyms and details for each location are shown in Table 1.

RESULTS AND DISCUSSION

WHITE-SPOTTED WOODPECKER *Veniliornis spilogaster* (WAGLER, 1827)

One nest was observed on 10 October 2012 in the visitor's area of the Fundação Parque Zoológico de São Paulo, which is inside the PEFI. The nest was a cavity/with-tunnel, constructed about 4 m above the ground in the branch of an unidentified tree. The tree was almost 10 m high and hosted many vines. Despite the tree being alive (with green leaves), the nest was in a dead branch and positioned around 45° in relation to the main trunk, which kept the cavity entrance almost facing the ground (Figure 2).

Figure 2. Nestling *Veniliornis spilogaster* at the tree cavity entrance, observed on 10 October 2012 in São Paulo, SP. Photo: Daniel F. Perrella (2012).

Table 1. Localities surveyed in the present study.

Locality number	Locality name	Latitude	Longitude
1	Serra do Apiaú, Mucajaí, RR	2° 27' N	61° 26' W
2	Access road to ZF-2 tower, Manaus, AM	2° 32' 51" S	60° 04' 34" W
3	Ramal do Caldeirão, Iranduba, AM	3° 14' S	60° 13' W
4	Parque Ecológico de Araras (PEA), Araras, SP	22° 21' 50.9" S	47° 21' 21.3" W
5	Parque Municipal do Lago Azul (PMLA), Rio Claro, SP	22° 23' 36" S	47° 33' 49" W
6	Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), Rio Claro, SP	22° 23' 45,7" S	47° 32' 38,3" W
7	Shopping Center Rio Claro (SCRC), Rio Claro, SP	22° 24' 46.0" S	47° 33' 17.0" W
8	Faculdades Integradas Claretianas (FIC), Rio Claro, SP	22° 24' 50" S	47° 34' 22" W
9	Floresta Estadual Edmundo Navarro de Andrade (FEENA), Rio Claro, SP	22° 25' 35,2" S	47° 31' 44,9" W
10	Associação Veleiros de Ibiúna (AVI), Ibiúna, SP	23° 38' 13" S	47° 18' 25" W
11	Parque Estadual Fontes do Ipiranga (PEFI), São Paulo, SP	23° 38' 52.8" S	47° 37' 13" W
12	Parque Poço das Antas (PPA), Monguagá, SP	24° 05' 13" S	46° 37' 23" W
13	Parque Estadual Intervales (PEI), Ribeirão Grande, SP	24° 16' 06" S	48° 24' 46" W
14	Reserva Bicudinho-do-brejo (RBB), Guaratuba, PR	25° 44' S	48° 44' W
15	Parque Estadual da Ilha do Cardoso (PEIC), Cananéia, SP	25° 04' 36" S	47° 54' 47" W
16	Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora, MG	21° 46' 37'' S	43° 22' 13'' W

A well-developed nestling was begging with its head out of the nest entrance, while an adult female replied to it from a nearby tree, carrying a worm in her beak.

The only known measurements of a White-spotted Woodpecker nest were reported by Cockle et al. (2011), based on two cavities found at Misiones, in Argentina. Rumboll (cited in de la Peña, 2016) found a nest cavity 12 m above the ground in the Parque Nacional Iguazú, considerably higher than the nest we observed. The breeding season of this species seems to be similar to that of other *Veniliornis* woodpeckers from southeast Brazil (Guaraldo & Gussoni, 2009; Cockle et al., 2011; de la Peña, 2013), corroborating the observation of Marcon and Vieira (2017) that recorded breeding activity during spring and summer for the White-spotted Woodpecker. Previous data on nestling diet are similar to our observation of worms in the diet. Buzzetti and Silva (2005) observed an adult female feeding nestlings with arthropods, but Marcon and Vieira (2017) suggest that both male and female feed the nestlings.

BLACK-CAPPED FOLIAGE-GLEANER *Philydor atricapillus* (WIED, 1821)

On 20 October 2013, an adult was observed carrying some moss in its bill in RBB. Later, on 30 October 2017, an active nest was observed in the visitor's area of PPA, in Mongaguá, SP. The nest is a cavity/with-tunnel in vertical position/low cup and was inside a cavity produced by wood decay in an unidentified living tree, 1.7 m close to a channeled stream (Figure 3). The diameter at breast height (d.b.h.) of the tree was 80 cm, and the cavity entrance was 1.59 m above the ground, although the tree was much higher. Cavity depth measured 39.5 cm, the inside diameter was 16.5 cm, and the entrance was an ovoid measuring 56.6 mm (horizontal length) by 69.2 mm (vertical length). Inside the cavity there was an open shallow cup filling its entire bottom. The cup was bulky, composed of fine rootlets and black fungal hyphae, maybe *Marasmius* sp., and contained three white eggs (Figure 3). When found, an adult was inside the nest incubating the eggs.

Another nest found in Ubatuba, SP, in January 2015, was built inside a bamboo branch and had two well developed nestlings (Tanaka et al., 2016). Although the material of the nest is poorly described, the illustration in Tanaka et al. (2016) shows fine rootlets as nesting material, corroborating our observation. Ruschi (1981) reports that Black-capped Foliage-gleaner builds nests in cavities of ravines. However, Cockle and Bodrati (2017) suggested that the nests described by Ruschi (1981) were misidentified. Thus, based on the contradictions contained in these publications (see Cockle & Bodrati, 2017), it would be necessary to carry out new and more detailed investigations about the nesting of the Black-capped Foliage-gleaner to better understand its breeding biology.

SULPHUR-RUMPED FLYCATCHER *Myiobius barbatus* (GMELIN, 1789)

We found three active nests of *M. barbatus mastacalis* (Wied, 1821) in 2005 and 2006 at PEIC, in an area of lowland Atlantic Forest. The nests were found, respectively, on 9 October 2005 (N1), 15 September 2006 (N2) and 10 October 2006 (N3). All nests used the end of tree branches as a fixation point, and the support plant for the first two nests was *Eugenia cuprea* (Berg) (Myrtaceae), an abundant species in the area (ACG, personal observation). The tree hosting N3 remained

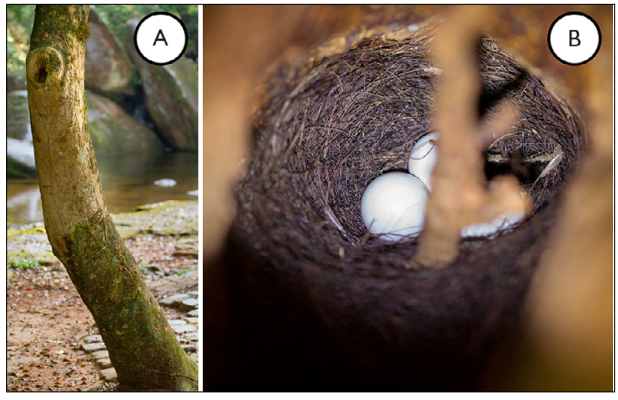

Figure 3. Nest of *Philydor atricapillus* recorded on 30 October 2017 in Mongaguá, SP. A) Tree with the cavity entrance; B) The bulky nest with eggs inside the cavity. Photos: Daniel F. Perrella (2017).

unidentified. Regarding the micro-habitat, all nests were built on branches projected over low order streams at a height of 2 m (N1), 3 m (N2) and 5 m (N3) above the water surface. Nest morphology was of the closed/retort/pensile/with vertical tunnel downwards type (Figure 4) and their morphometry is shown in Table 2. These birds predominantly used dry thin sticks and plant fibers similar to hyphae of fungi of the genus *Marasmius*. Additionally, they used tree bark, thin dry roots, paina-like vegetable fibers (only in N1), some green leaves (in N2 and N3), lichens (N2) and fragments of fern leaves (*Cyathea* sp.) (N2). With the exception of N3, which contained dry leaves covering the oological chamber, none of the other nests had any material covering this structure. On the day of its discovery, N1 had two eggs (Figure 4) and N2 had two chicks. Access to N3 was only possible shortly after the nesting event ended, thus preventing inferences about its content at the time of its discovery. The eggs found in N1 had 18.6 x 13.2 mm and 17.6 x 12.5 mm. Both eggs had a light brown color and a crown of dark brown spots near the larger pole, although this characteristic was more obvious in only one of the eggs (Figure 4).

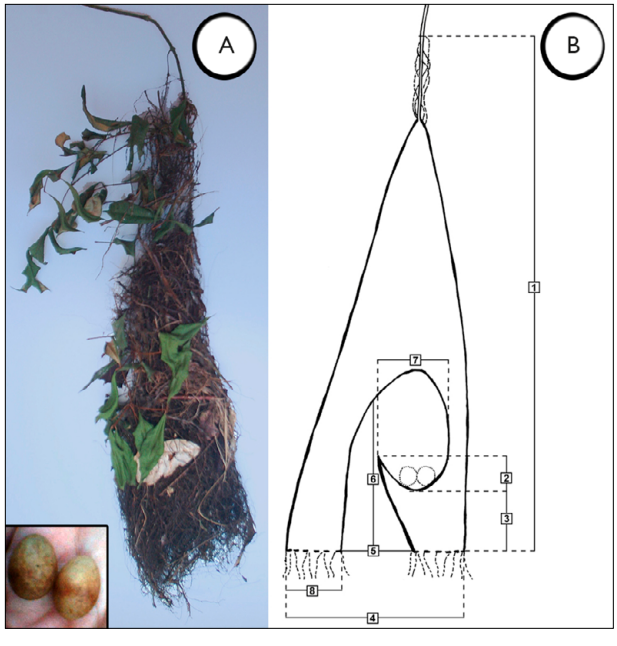

Figure 4. Nest and eggs of *Myiobius barbatus* found in PEIC, Cananéia, SP (the numbers refer to the measurements shown in Table 2). Photos: André de C. Guaraldo (2006).

On 30 December 2021, in a border of an Amazonian *terra firme* forest on the access road to the ZF-2 observation tower, a nest of *M. barbatus barbatus* (Gmelin, 1789) was found. The nest was ca. 40 cm long and was fixed on the end of an overhanging branch. The materials used for the construction were small sticks, vegetal fibers, small leaves and possibly lichen. The entrance was situated at the base that gives access to a covered oological chamber. On this occasion there was only one egg in the oological chamber and another broken on the ground below the nest. The egg had 18 x 13 mm, with a matte cream-brown background color and brown markings covering ca. 60% of the surface, with a greater density of these markings on the larger pole. Despite being another subspecies, all characteristics regarding the nest and eggs were quite identical to what we report above for *M. b. mastacalis*. Only the microhabitat was significantly different since there was no stream nearby.

The nests described here are similar to those found by other authors (e. g. Farnsworth & Lebbin, 2020). However, the descriptions of *M. barbatus* nests are difficult to compare, and several authors do not make it clear how

Table 2. Morphometric data of the three nests of *Myiobius barbatus* found in PEIC, Cananéia, SP. Numbers refer to the structures indicated in Figure 4B (measurements in mm).

Number of the structure	Description	N1	N2	N3
1	Nest height	428.0	470.0	460.0
2	Depth of the oological chamber	NA	28.3	23.0
3	Appendix length	40.0	65.0	34.7
4	Nest base diameter	155.5	170.0	160.0
5	Diameter of access tunnel	108.5	85.0	105.0
6	Tunnel length	125.0	160.0	130.0
7	Diameter of the oological chamber	62.0	55.6	57.3
8	Nest wall thickness	23.5	42.5	27.5

the measurements were performed. Thus, we believe that the descriptions presented here, together with a detailed illustration of the measured structures, should make these nests more easily comparable. The eggs were slightly larger than those measured by Greeney et al. (2018) in Ecuador: 16.7 x 12.3 and 16.2 x 12.4 mm.

MASKED TITYRA *Tityra semifasciata* (SPIX, 1825)

On 29 December 2018, on the Ramal do Caldeirão, a cavity was found being used as a nest about 4 m above the ground, located in a utility pole made of Black Manwood *Minquartia guianensis* Aubl. (Oleraceae). One male was observed bringing fruit to a female at the nest entrance, doing so twice within a ten-minute interval, with the female appearing at the entrance to receive the fruit. On 27 January 2019, the pair was near to the nest, although they were not observed using it. Despite being a well-known species, little is known about the breeding biology of this bird in Brazil. In Central America, breeding occurs between March and July, while in Colombia it occurs from January to August (Mobley & Juana, 2020). Records from WikiAves (2020) suggest that Masked Tityras occupy cavities mainly from the end of October to March, lay eggs around November, and feed juveniles between November and February. These data thus show that the reproductive period of the species occurs between October and March in the Central Amazon and between March and June in more northerly locations (e.g. Central America). This shift in reproductive phenology – apparently linked to latitude – may be due to differences in photoperiod (Dawson, 2013), seasonality of dry and wet season (Stouffer et al., 2013), food availability (Golabek et al., 2012) and on other non-mutually excluding factors. We provide here the first record of use of an artificial nesting structure for this species. The fact that the species usually nests above 10 m and rarely uses low cavities (e.g. between 3-4 m) may be an indication that there is an absence of suitable breeding sites at this location (Skutch, 1969).

SÃO PAULO TYRANNULET *Phylloscartes paulista* IHERING & IHERING, 1907

On 8 February 2011, a pair was observed with one recently fledged young at PEI. One of the adults was seen feeding the young at least four times, but it was not possible to verify if both adults did so.

Fitzpatrick (2020) mentions that individuals with enlarged testicles were found in October, suggesting a breeding period between September and December. In addition, in the citizen science database WikiAves (2020), there are photos of occupied nests in October (WA3530431 and WA3530441) and November (WA3601102 and WA3597048). The present report extends this species' breeding period by two months, i.e., up to February.

OUSTALET'S TYRANNULET *Phylloscartes oustaleti* (SCLATER, 1887)

On 24 October 2011, one adult bird was observed at PEIC collecting nest material about 4.5 m above the ground and depositing bundles of material in a bush at the same height above the ground. The next day, an individual was recorded again, in the same place, collecting vegetable fibers about 2.5 m above the ground.

The information presented here on a nest being built in October, as well as its height, agrees with what is known for the species, whose breeding period extends from August to December (Gonzaga et al., 2016). Nevertheless, these are the first data on the reproduction of this species in the state of São Paulo, along with a photograph of one adult with nest material in September (Ribeirão Grande, SP) published in WikiAves (WA2728037).

SMALL-HEADED ELAENIA *Elaenia obscura sordida* ZIMMER, 1941

Two nests were found in the RBB (Figure 5). The first was found on 21 October 2013, 1.75 m above the ground in a *Tibouchina* sp. and held two chicks. The nest was a low cup/fork, constructed with dry thin

Figure 5. Nests of *Elaenia obscura sordida* found at Reserva Bicudinho-do-brejo, 18 November 2013 (A) and 22 October 2013 (B). Photos: Carlos O. A. Gussoni (2013).

branches and presented the following measurements: height 47.0 mm, external diameter 81.0 mm, depth of the oological chamber 40.0 mm, thickness of the nest wall 7.0 mm. The second, found on 18 November 2013, 1.3 m above the ground, contained two eggs and was a low cup/fork, presenting the following measurements: height 35.9 mm, external diameter 68.3 mm, oological chamber depth 23.4 mm, nest wall thickness 8 mm. It was built with dry thin branches, lichens and cf. hyphae of *Marasmius*. Both eggs were white with a crown of reddish-brown spots near the obtuse pole and measured 23.4 x 16.4 mm and 23.8 x 16.2 mm. We obtained 117.43 min of recordings of the second nest. During this period, the bird turned the eggs 18 times (0.16 times/min). The duration of the periods in the nest ranged from 6.53 to 20.66 min (mean = 12.64 ± 5.70; median = 11.73; n = 6). Periods outside the nest ranged from 2.10 to 5.71 min (mean = 3.25 ± 1.44; median = 2.98; n = 5). The bird stayed at the nest 41% of the time (constancy of incubation = 0.41).

The data recorded for these two nests are similar to what has been described for the species (Ihering, 1900; Hartert & Venturi, 1909; Lopes et al., 2013), both in the shape and support, as well as in the measurements of the nest. The width of the eggs is within the expected values for the species (15-16 mm), but the length was slightly longer than usual (21-22 mm) (del Hoyo et al., 2020). The data presented here are the first breeding behavioral information for this species.

WHITE-THROATED KINGBIRD *Tyrannus albogularis* BURMEISTER, 1856

In the municipality of Rio Claro, SP, we made three observations of adults feeding recently fledged young. In the first, on 7 November 2015 (on the *campus* of FIC), two adults were observed accompanied by two young (Figure 6) at 8:40 a.m. The adults fed the chicks, but it was not possible to confirm whether both performed this task. In the same year, 4 December, an adult was observed feeding two chicks outside the nest at the SCRC at 10:30 a.m. On 11 February 2019, an adult was seen feeding one recently fledged young with an insect in the PMLA.

Little is known about the reproductive biology of this species, and the information is mainly restricted to

Figure 6. Fledgling of *Tyrannus albogularis*, 7 November 2015, Rio Claro, SP. Photo: Carlos O. A. Gussoni (2015).

that described by Davis (1993) and Lopes et al. (2018). Nevertheless, we provide the first data on parental care of the fledglings for this species. According to Vasconcelos and Ziade (2020), the breeding season of this species occurs between September and February and Lopes et al. (2018) reported juveniles from 9 November to 29 March (WikiAves data and museum specimens). Our observations corroborate the period reported by both authors.

FUSCOUS FLYCATCHER *Cnemotriccus fuscatus* (WIED, 1831)

On 15 November 2013, a nest under construction was found 2.5 m above the ground, inside a cluster of bromeliads in the RBB. A camcorder was installed near the nest and, during 60 min of filming (beginning at 16:33), two individuals were recorded building the nest with dry leaves, dry twigs and dry thin roots, the latter two being brought in bundles.

There is little information concerning the reproductive biology of this species, especially in Brazil. According to Vasconcelos and Ziade (2020), its breeding season occurs from October to December. Belton (1985) found a nest under construction and another with a chick, both in November. The first, as in the present study, was constructed in a cluster of bromeliads, but higher (10 m above the ground), but the latter was built in a tree hollow 0.4 m above the ground. The nest material in the bromeliad cluster was similar to that recorded by us. Lopes et al. (2013) found two nests in the state of Minas Gerais, also at low height (1.8 m and 0.3 m), one of them in a rocky wall and the other in a cavity in a tree knot. One of these nests differed slightly in the material used from those we found, being constructed with vegetal fibers and ornamented with mosses. Until now, there was no information in the literature about the role of the parents in the construction of the nest.

VARIABLE ORIOLE *Icterus pyrrhopterus* (VIEILLOT, 1819)

From 2 to 9 May 2007, we recorded parental care in a nest of this species with two chicks, found on the UNESP *campus*. We made 16 h of observations, 13 h for nestlings and 3 h of fledglings. The nest was located in a palm tree (*Roystonea* sp., Arecaceae), about 6 m above the ground and was hanging on the bottom of one of the leaves. On another leaf near the nest, there was an abandoned wasp nest (cf. *Polybia paulista* Ihering, 1896, Vespidae). Both parents fed the chicks, and while one looked for food and/or fed the nestlings, the other generally stayed as a sentinel in a *Ceiba* sp. tree located five meters from the nest. The bird that fed the chicks imitated the calls of a Roadside Hawk [*Rupornis magnirostris* (Gmelin, 1788)] when it arrived at the nest (n = 15, 11.28% of the feeding events) and when leaving the nest (n = 15, 11.28%). It also imitated Chalk-browed Mockingbird calls (*Mimus saturninus* (Lichtenstein, 1823); n = 23 when arriving at the nest and n = 30 when leaving the nest; 17.3% and 22.6 % of the events, respectively), and the Smooth-billed Ani vocalizations (*Crotophaga ani* Linnaeus, 1758; n = 10 when arriving at the nest and n = 4 when leaving the nest; 7.5 % and 3.0 % of the events, respectively).

We recorded a total of 133 feeding events of the chicks and identified the following prey: Orthoptera (Acrididae and Tettigoniidae; N = 10), Hemiptera (N = 6, including individuals from the Pentatomidae family), Coleoptera (N = 1) and caterpillars (Lepidoptera; N = 4). The rate of prey delivery was 10.2 prey/h. While foraging for the chicks, the adults also ingested several insects, searching for prey in the

vicinity of the nest, rarely further than 30 m from it. Most of the time (90%) the bird arrived directly to the nest with food, while in a few opportunities (10%) the bird initially perched on another palm before heading to the nest. Foraging took place throughout the day, from a few minutes after dawn until dusk. It was observed that, in the last two days of the nestling period, the chicks stayed for long periods perched on the edge of the nest. We observed five events of fecal sac removal by adults, and the birds perched on a *Ceiba* sp. tree near the nest (ca. 5 m) to discard the material. On one occasion, when one of the chicks finished feeding, it defecated outside the nest and the adult took the fecal sac in flight, then headed and perched on the *Ceiba* sp. tree to dispose it off. We recorded three events of collection of nest material, all on the first day of observations and performed by both adults. We observed agonistic encounters once with each of three species: Great Kiskadee [*Pitangus sulphuratus* (Linnaeus, 1766)], Chalk-browed Mockingbird (*Mimus saturninus*) and Variable Oriole (*Icterus pyrrhopterus*), all on the *Ceiba* sp. tree near the nest, and all ending with the expulsion of the invaders.

The chicks fledged early in the morning of 10 May. On this and the following day, adults were observed caring for the fledglings near the nest. On 19 May, we observed two adults feeding fledglings in trees on a city block on the outskirts of the university, probably the same individuals. With this, we conclude that the fledglings were fed by the parents outside the nest for a period of at least 10 days. During this period, we observed the adults feeding their young exclusively with insects (including Tettigoniidae and Heteroptera). Both adults fed the fledglings, and imitated the vocalization of the Roadside Hawk before approaching the young.

According to Vasconcelos and Ziade (2020) the breeding season of this species ranges from September to April, so the nest found in Rio Claro extends this period another month, i.e., up to May. The nest shape, as well as the height above the ground (1.4 to 7 m) and substrate where it was built agrees with descriptions made by de la Peña (1987), Höfling and Camargo (1996), Sick (1997), Antas (2004), Di Giacomo (2005) and Sigrist (2006): distally on palm and banana leaves. According to Di Giacomo (2005), both adults feed the nestlings, as observed in the present study.

HOODED TANAGER *Nemosia pileata caerulea* (WIED, 1831)

On 13 October 2009, one adult female was observed feeding a fledgling (Figure 7) with a Heteropteran at the UNESP *campus*. At the same place, on 12 January 2010, an adult male was recorded feeding a fledgling. The information presented here is the first on the parental care of fledglings of this species in Brazil. Renaudier et al. (2008) also recorded both individuals of the pair feeding juveniles in Guyana. Recently fledged young were recorded in February (Suriname), March (French Guiana) and October (Venezuela) (Haverschmidt, 1968; Cruz & Andrews, 1989; Renaudier et al., 2008). Among the food items delivered to the nestlings (Studer et al., 2021) there were only caterpillars, indeterminated insects and two fruit species, with no mention of heteropterans.

BLACK-GOGGLED TANAGER *Trichothraupis melanops* (VIEILLOT, 1818)

The nest (Figure 8) was found on the UFJF *campus* on 25 November 2019, in front of a parking lot that has a small strip of vegetation behind it. The existence of the nest was detected due to the behavior of the male in

Figure 7. Fledgling of *Nemosia pileata caerulea*, UNESP *campus*, Rio Claro, SP. Photo: Carlos O. A. Gussoni (2009).

attacking the windshields of parked cars. The nest was a high cup/base, supported on the leaves of an exotic *Dracaena* sp. (Asparagaceae), 2.7 m high above the ground and consisting of leaves and dry grasses. The inner and outer diameters of the nest were 66.9 and 117.3 mm, respectively, with a 36.4 mm depth of the egg chamber and nest height of 67.7 mm. Two off-white eggs were found, with burgundy and brown spots scattered throughout the egg shell and more concentrated on the blunt pole. The average length of the eggs was 22.5 mm (22.2-22.9 mm) and the average width was 16.2 mm (15.8-16.7 mm). Only the female was observed incubating and, when she noticed one observer approaching, silently fled into the forest behind the nest.

Studies on the breeding biology of the species are scarce, and the most significant description of nests so far is that of Euler (1900, p. 22), who found a nest in November containing three nestlings and described it as "an ordinary bowl, without art, made of roots on a loose base of sprigs. It was placed one meter high in a small bush inside a bamboo grove". The characteristics found in the present study are in agreement with those of Euler (1900), as well as the described reproductive period (November). Although some authors (e.g. Silva, 1995; Abilhoa & Amorin, 2017) consider the species as not tolerant to urbanization (i.e. highly dependent on forest habitats), we found the nest in a highly urbanized area at the UFJF *campus*.

ORANGE-HEADED TANAGER *Thlypopsis sordida* (D'ORBIGNY & LAFRESNAYE, 1837)

On the afternoon of 26 February 2003, one adult bird was observed carrying nest material to a bamboo grove in FEENA. On 22 October 2015, a nest was found under construction with thin and dry plant material, about 3 m above the ground in Araras (PEA), SP. On 17 October 2008, a nest with four eggs was photographed on the UNESP *campus*. Apparently, it contained one or more eggs of a brood parasite species (Figure 9), potentially the Shiny Cowbird [*Molothrus bonariensis* (Gmelin, 1789)], the most common at the site. The nest can be classified as a high cup/base. We observed one adult male incubating the eggs (Figure 9).

On 5 February 2020, on the UNESP *campus*, between 8:15 am and 9:24 am, we observed a pair of Orange-headed Tanagers followed by a juvenile Shiny Cowbird. An adult Orange-headed Tanager was spotted with a green caterpillar (Lepidoptera) in the beak next to the juvenile Shiny Cowbird, but apparently noticed our presence and avoided feeding the young. Between 8:59 a.m. and 9:00 a.m., we recorded two feeding events of the juvenile Shiny Cowbird by the Orange-headed Tanagers. At 9:07 a.m., the adult male (marked by other researchers with a metal band on the left tarsus) fed the young. Between 9:11 a.m. and 9:24 a.m., we saw four feeding events, all of them by the banded adult male. The next day, 6 February 2020, in

Figure 8. Nest of *Trichothraupis melanops*, UFJF *campus*, Juiz de Fora, MG. Photo: André de C. Guaraldo (2019).

Figure 9. Nest of *Thlypopsis sordida* found on the UNESP *campus*, Rio Claro, SP. Photos: André de C. Guaraldo (2008).

the same place, we observed the pair and the fledgling again, between 9:10 a.m. and 9:48 a.m. During some of the feeding events, it was possible to determine which individual fed the young: the male four times and the female once. In one of the events the male fed the Shiny Cowbird with a green caterpillar (Lepidoptera) about 2 cm long. The juvenile bird was fed with a frequency of 0.95 prey/min and the mean interval between feeding events was 56.0 ± 53.0 s (min. = 3.0 s; max. = 150.0 s; N = 9).

Dinelli (1918) described a nest of this species found in Argentina in December with two eggs. The nest was about 2 m above the ground, similar to that recorded in the present study, and was constructed with petioles of leaves, plant fibers and horse mane. According to Höfling and Camargo (1996), the female is responsible for incubating the eggs, but in Rio Claro we observed the male incubating. According to Hilty (2020), the nests are regularly parasitized by the Shiny Cowbird, but the author presents no data on parental care. Mitchell (1957) observed an adult feeding three fledglings in February. The nest found in Rio Claro is similar to the one in the photograph available in Studer (2015). According to our data, the breeding season of this species is at least three months longer than reported by Vasconcelos and Ziade (2020) (July to November).

GOLDEN-RUMPED EUPHONIA *Cyanophonia cyanocephala* (VIEILLOT, 1818)

On 13 February 2014, a fledgling was recorded at AVI. It presented a well-developed plumage, but with remnants of white swallow flanges, and two individuals were heard nearby. The plumage of the fledgling was olive in the crown, breast and upperparts. The sides of the head and the shoulders were yellowish-olive, and the belly and throat were bright yellow. Three distinct developing turquoise-blue feathers were visible on its head, as well as an orangish growing feather on its forehead (Figure 10).

Breeding biology data on the Golden-rumped Euphonia are scarce, with some data provided by Greeney and Nunnery (2006), Wright et al. (2017), and Hilty (2021) for populations from Venezuela, Colombia and Ecuador. In Venezuela, active nests were observed in January and February, and in Colombia breeding activity was reported from December to May (Hilty, 2021). In Ecuador, Greeney and Nunnery (2006) have reported nest building in November, December, May and June, while Wright et al. (2017) have described and detailed the parental attendance for a single nest from February 2014, with no details about nestling and fledgling characteristics.

BLUE-NAPED CHLOROPHONIA *Chlorophonia cyanea roraimae* SALVIN & GODMAN, 1884

On 19 February 2019 at 9:30 a.m., in Serra do Apiaú (1.200 m a.s.l.), a pair was observed collecting nesting materials. The individuals searched for moss filaments trapped in the vegetation, which they accumulated in the bill and took to the nesting site (ML211448261, Gomes, 2019). On the next day, two individuals were seen in the same place still collecting materials, probably the same pair. Of the 16 observations of this species at the locality, in 15 the individuals were paired and only once we detected a solitary individual. The recurrent observations of pairs possibly indicate mating behavior, suggesting that other pairs could be breeding at the same time.

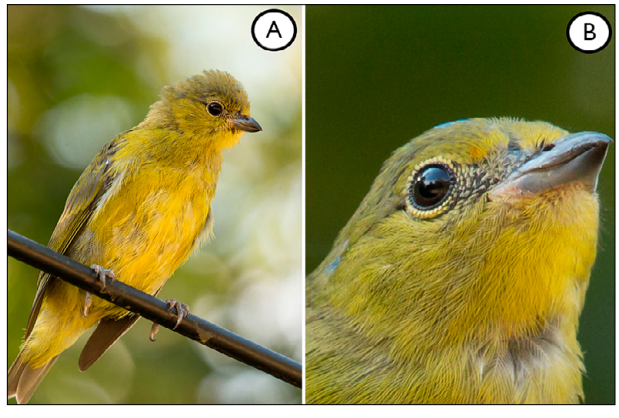

Figure 10. Fledgling *Cyanophonia cyanocephala* recorded on 13 February 2014 in Ibiúna, SP. A) General plumage of the fledgling; B) Details of the turquoise-blue and orangish feathers on its head. Photos: Daniel F. Perrella (2014).

Since this subspecies occurs in tepuis, which are Amazonian mountains difficult to access, there are no previous records of its reproduction (Pacheco & Parrini, 2013; Hilty & Bonan, 2020). However, the geographically closest Andean subspecies, *C. c. intensa* Zimmer, 1943 builds its nest between January and June (Hilty & Bonan, 2020), and *C. c. psittacina* Bangs, 1902 between February and March, with active nests up until June (Freeman et al., 2012). Juveniles of *C. c. longipennis* (Du Bus, 1855) were observed in April by Janni et al. (2008). In contrast, the subspecies *C. c. cyanea* (Thunberg, 1822), in the Atlantic Forest, reproduces in September in Brazil and November in Argentina, thus later when compared to the northern subspecies (Pacheco & Parrini, 2013; Hilty & Bonan, 2020). With that, it is likely that the reproductive period of *C. c. roraimae* is similar to that of the Andean subspecies due to similar latitude (see Dawson, 2013).

CONCLUSION

Here we fill important knowledge gaps on the reproductive biology of some Neotropical birds, presenting new data on parental care for six species, descriptions of nests for eight species, and new information on the nest building behavior for five species. However, many gaps still persist, especially on parental care, and incubation and nestling periods. This information is of special interest for the management of these species and their habitats and for the reconstruction of their phylogenetic relationships. Therefore, we expect that our study and findings will encourage others to perform further studies on the species reported here. That could include the publication of unpublished data on nests already found for these species, which would allow, in the near future, to clarify various aspects of the breeding behavior and overall life histories of these species.

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AUTHORS' CONTRIBUTION

C. O. A. Gussoni contributed to project administration, formal analysis, conception, data curation, written (original draft, proofreading and editing), research, methodology, supervision, validation, and display; A. M. Gomes to formal analysis, data curation, written (original draft, proofreading and editing), research, methodology, supervision, validation, and display; D. F. Perrella to formal analysis, data curation, written (original draft, proofreading and editing), research, methodology, validation, and display; A. C. Guaraldo to formal analysis, data curation, written (original draft, proofreading and editing), research, methodology, validation, and display; R. C. Machado to data curation, written (original draf), research, validation, and display; M. C. Tinti to data curation, written (original draft, proofreading and editing), research, validation, and display; P. H. Paixão to data curation, written (original draft), research, validation, and display; H. E. Noventa to data curation, written (original draft), research, validation, and display; V. A. Rodrigues to data curation, written (original draft, proofreading and editing), research, validation, and display; and S. Rampin to written - original draft, research, validation, and display.