

Reproduction of the Red-ruffed Fruitcrow (*Pyroderus scutatus scutatus*) next to the largest urban area in South America

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ABSTRACT—Red-ruffed Fruitcrow (*Pyroderus scutatus scutatus*) occurs in humid forests of Brazil, Paraguay, and Argentina. The bird has disappeared from many regions of Brazil due to deforestation but is still found in well-preserved forests as well as fragments surrounding large urban areas. The reproduction of the *P. s. scutatus* subspecies is not well known, with only 1 nest described. Given this scenario, we provide another nest description and information on this subspecies' reproduction and chicks, and document insect and small vertebrate feeding at a location near the largest urban area in South America. This record was made in 2018, in an Atlantic Forest reserve next to the city of São Paulo. We found 2 large chicks at a nest that differs from a previously described nest in having a simpler structure. Our record is remarkable because this nest was found in the degraded area of a forest fragment close to the large urban area, which is very different from the well-preserved areas of Atlantic Forest where the previously known nest was found. Since this reserve is close to a continuous and well-preserved region of Atlantic Forest, and has areas that are in good condition, we speculate that the location of this nest may have been chosen due to an available food supply. The discovery of this nest highlights the importance of forest fragments for the conservation of this cotingid. *Received 21 September 2020. Accepted 17 September 2022.*

Key words: Atlantic Forest, behavior, Brazil, Cotingidae, natural history.

Reprodução do pavó (*Pyroderus scutatus scutatus*) próximo da maior área urbana da América do Sul

RESUMO (Portuguese)—O pavó (*Pyroderus scutatus scutatus*) ocorre nas matas úmidas do Brasil, Paraguai e Argentina. Desapareceu de muitas regiões do sudeste do Brasil devido ao desmatamento, mas ainda é encontrada tanto em regiões florestais preservadas, como fragmentos do entorno de grandes áreas urbanas. A reprodução do *P. s. scutatus* é pouco conhecida, tendo apenas um ninho descrito. Com base neste cenário, apresentamos a descrição de um novo ninho, informações sobre reprodução, filhotes e alimentação de insetos e pequenos vertebrados dessa subespécie em uma localidade próxima da maior área urbana da América do Sul. O registro foi feito em 2018, em uma reserva de Mata Atlântica ao lado da cidade de São Paulo. Encontramos dois filhotes grandes em um ninho diferente de um anterior conhecido, por ter uma estrutura mais simples. Nosso registro é notável porque este ninho foi encontrado na área degradada de um fragmento florestal próximo da área urbana, bem diferente das áreas bem preservadas de Mata Atlântica onde os ninhos anteriormente conhecidos foram encontrados. Pela reserva estar próxima de uma região contínua e bem preservada da Mata Atlântica e ter áreas em melhor estado de conservação, especulamos de que o local pode ter sido escolhido devido a oferta de alimentos disponíveis. A descoberta deste ninho mostra o potencial dos fragmentos florestais para a conservação desta espécie de cotingídeo.

Palavras-chave: Brasil, comportamento, Cotingidae, história natural, Mata Atlântica.

Species of the family Cotingidae are Neotropical forest birds that occur widely in South America. Among the existing genera, the monospecific *Pyroderus* is represented by the Red-ruffed Fruitcrow (*Pyroderus scutatus*), comprising 5 disjunct subspecies, 4 of which occur from central to northern South America and vary in the amount of red shown on the lower throat, upper breast, and underparts (Snow 1982, 2020). The

nominate form, *P. s. scutatus*, has less red coloration on the breast than the others, an orange ruff with broad bright-red feather fringes, a few chestnut-colored spots on the center of a black belly, and glossed upperparts. It occurs in the humid forests of the southeastern and southern regions of Brazil, in addition to eastern Paraguay and northeastern Argentina (Snow 1982, 2020; Kirwan and Green 2011). It is a medium-sized (46 cm, 350–390 g), solitary, forest interior or forest edge bird that feeds on different types of fruits, in addition to insects and small vertebrates that it captures to feed its young during the reproductive period (Sick 1997, Kirwan and Green 2011, Snow 2020). There is little information available about its reproduction, which occurs in late spring–early summer (Nov–Dec) when males gather in leks where they vocalize in groups and exhibit their orange/red ruffs for which this bird is named (Snow 1982, Sick 1997, Kirwan and Green 2011).

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Only 1 nest has been reported for this subspecies of the Red-ruffed Fruitcrow, which was found in an Atlantic Forest reserve located in Serra do Mar in the state of São Paulo, southeast Brazil. The nest was located about 16 m above the ground within tall primary forest. It was cup-shaped, thinly built with dry, stripped ferns, and had a substantial base composed of twigs. The nest was monitored for 1 day and contained 2 small chicks, which were fed by only 1 adult (Francisco et al. 2008). In addition to the nominate form's, there is only nest and chick information for the subspecies *P. s. granadensis*, which occurs in the Andean region of Colombia and Venezuela (Snow 1982, Serrano 1994, Muir et al. 2008, Kirwan and Green 2011).

The Red-ruffed Fruitcrow had a wide historical occurrence throughout the state of São Paulo, but due to the deforestation and intense forest fragmentation of recent decades it has completely disappeared from the forest areas of the central and western regions of the state, where its natural history had not been studied (Willis 1979, Magalhães 1999, Willis and Oniki 2003). Nonetheless, the subspecies is not considered threatened since it is common in the eastern region of the state where it occurs both in forests that are preserved and protected by large conservation units and in forests surrounding the city of São Paulo, as well as occasionally in the urban green areas of the city itself (Willis and Oniki 2003, City of São Paulo 2018, State of São Paulo 2018, IUCN 2022). The forests surrounding the city of São Paulo are partially protected by different types of conservation units, but deforestation and irregular urban occupation have been increasing in recent years, which is a major threat to all existing biodiversity (Natalini 2020). Based on this scenario, and with the objective of producing data on the natural history of Red-ruffed Fruitcrow, we present the description of a newly found nest and provide information about the reproduction and feeding of thisotingid obtained next to the largest urban area in South America.

Methods

Study area

Parque Natural Municipal Itaim (PNMI; 23°48'51.12"S, 46°43'34.41"W, 780 m above sea level), is a municipal conservation unit created in

2012 as environmental compensation for a highway called Rodoanel, which runs through the city of São Paulo in southeastern Brazil (City of São Paulo 2012; Fig. 1). PNMI consists of a 470 ha forest fragment situated 30 km from the center of the city of São Paulo and only 3 km from its urban area. It is part of the Região Metropolitana de São Paulo, an urban area of ~21.5 million inhabitants (IBGE 2022). The park is surrounded by rural properties and small urban residential centers. It has a mosaic of natural environments, formed by Dense Ombrophilous Forest at mid and advanced stages of development, in addition to secondary and regenerating forest areas, open areas, and flooded environments with riparian forests and exotic vegetation. Field observations were carried out next to the surveillance base of the public use area, a region surrounded by native (queen palm [*Syagrus romanzoffiana*] and Paraná pine [*Araucaria angustifolia*]), and exotic (slash pine [*Pinus elliottii*], eucalyptus [*Eucalyptus* spp.], and Bangalow palm [*Archontophoenix cunninghamiana*]) vegetation with open and flooded artificial areas, including some artificial lakes. The site is ~170 m from an unpaved regional road with frequent vehicle traffic, including the daily commutes of park employees.

Data collection

Systematic field observations were carried out by FS for 5 d during 16–21 December 2018. The visits were made in the morning (0530–1130 h) and in the afternoon (1530–1900 h), for a total of 25.6 field hours (Supplemental Table S1). Non-systematic observations were made by WPS, who works onsite, but were not included in the total sum. The focal observation method was used, with the observer standing at a point located ~20 m from the tree where the nest was located. We also made general observations in the public use area of the park, covering roads and trails with different types of environments. We used Nikon Monarch 10 × 42 and Bausch and Lomb Elite 10 × 42 binoculars and a Kowa TSN-820 (20–60×) telescope to make our observations. The Red-ruffed Fruitcrows' activities were documented with photographs and videos using a Canon 7D camera with a 300 mm lens (Canon, Inc., Tokyo, Japan). Part of the material produced and cited in the text was deposited in the Macaulay Library



Figure 1. The Parque Natural Municipal Itaim (white boundary lines), in the municipality of São Paulo (white line around the city limits of São Paulo). The asterisk indicates the study area within the park. Highlighted in the inset image of the state of São Paulo are Itatiaia National Park (black square) and Serra de Paranapiacaba, where Intervalles and Carlos Botelho state parks (white square) are located, on opposite sides of the city of São Paulo. Source: Google Earth (Landsat/Copernicus image 2020).

(identified with the prefix ML and a unique image number—<https://www.macaulaylibrary.org>).

Secondary data

In order to obtain additional information about the reproduction and animal food items (small vertebrates and insects; fruit feeding is a well-known fact) of the Red-ruffed Fruitcrow, we consulted images available on the online crowd-sourcing ornithological data platforms WikiAves (identified with the prefix WA and a unique image number—<https://www.wikiaves.com.br/>) and eBird (also stored in the Macaulay Library—<https://ebird.org/home>) deposited until 17 July 2020, in addition to information available in primary ornithological literature.

Results

The nest of the Red-ruffed Fruitcrow we studied was found on 28 November 2018 by the guard Aleckessandre Lucino in an exotic conifer stand (bald cypress [*Taxodium distichum*]) at the center

of a group of ~10 trees. This stand is located ~6 m from the main surveillance base of PNMI, next to a flooded environment, a lake, and a small native forest patch (with trees, shrubs, and epiphytic plants), and is connected to a dense area of exotic bamboo (Fig. 1 and Supplemental Fig. S1A). The nest was not closely inspected but was located ~12 m above the ground on a fork formed by rigid branches next to the main trunk of the tree—a location well protected from wind and rain but without camouflage. It was built with dry spaced sticks forming an open basket of a short height. The central part of the nest did not appear to have much covering, besides having sparse long branches around it functioning as a type of protection (Supplemental Fig. S1B).

Our review of online images of Red-ruffed Fruitcrow revealed only 3 nest records. The first was obtained in December 2011 at Parque Estadual Intervalles, which is located in Serra de Paranapiacaba, a stretch of the Serra do Mar in São Paulo (Fig. 1). These images show the presence of a young chick at the nest (WA513406 and

WA526449). The second record was made in December 2017 on the access road to the upper part of Parque Nacional do Itatiaia, which is on the side of the state of Minas Gerais (Fig. 1). These images show the presence of a well-developed chick at the nest (WA2811110 and WA2812099). One of the authors (Soares 2017) reported visiting the place on 8 December and observing a second larger chick that was already outside of the nest accompanying the parents. The third record was made in November 2019, again at Parque Estadual Intervales, and shows an adult individual at the nest (WA3561763). In addition to these confirmed records, there is a citation, made in November 2008 at Parque Estadual Intervales, of a possible nest based only on the behavior of an adult bird, which was observed frequently carrying food to the same place within the forest (Kirwan and Green 2011).

The movements of at least 1 adult individual of Red-ruffed Fruitcrow (Supplemental Fig. S1C) around the surveillance base of PNMI were monitored by WPS beginning on 20 November 2018. Beginning on 10 December, the movement of the bird intensified, and it began to be seen carrying large (unidentified) insects in its bill. This individual always landed near the base, hit the insects on some solid surface to kill them, and proceeded to another perching spot to later access the nest tree. On 13 December, the presumably same adult was observed preying on the chick at the nest of a Rufous-bellied Thrush (*Turdus rufiventris*), capturing it and taking it to the tree where its own nest was located. On 15 December, 2 well-feathered chicks of Red-ruffed Fruitcrow were observed at the nest. These birds could be told apart by their small size difference and the presence of a more evident labial commissure in the smaller individual (Supplemental Fig. S1D). Between 16 and 19 December, it was possible to observe the 2 chicks at the nest taking some movements and wing beats both inside and out of the nest and always fed by a single adult. Chicks were fed insects (mainly cicadas), including caterpillars, and fruits, mainly of *Cecropia* spp., a common plant in the region and which was bearing fruit during the study period (Fig. 2A–C and videos ML351109491 and ML351109501). The adult always left the nest after 0600 h, at daybreak, and returned with food at short intervals

(from 2 to 27 min, with a mean of 9.8 min), which became longer (>30 min) after 0730 h.

On 20 December, the chicks were not found at the nest and only the smallest chick remained close to the adult, ~30 m away from the nest, with the adult emitting a low and short vocalization with restless behavior. This chick was perched ~4 m above the ground in the middle of the leaves of an exotic palm tree, from which it flew ~30 m, landing ~20 m above the ground on the branch of another tree, where it was fed a caterpillar by the adult bird and performed short training flights, jumping from branch to branch (videos ML351111221 and ML351111731). With the smaller chick perching in a more open area, it was possible to see the black juvenile plumage with red pectoral feathers and a pinkish-yellow area without feathers on the throat (Fig. 2D and videos ML351111221 and ML351111731). Chicks were observed both inside and outside of the nest, sequentially inflating the featherless gular region (videos ML351109491 and ML351111221). On 21 and 22 December, the birds were no longer observed at the site, leading to the end of our observations (Supplemental Table S1—full description of these behaviors can be requested from the senior author, FS). WPS searched for nests of Red-ruffed Fruitcrow in the PNMI during the following year, but no further reproductive activity was observed at the site, only occasional visual records of adult birds in the public use area of the park, indicating that they were indeed in the vicinity.

The review of online images of Red-ruffed Fruitcrow revealed only 3 records of young. The first was made in January 2014 in Parque Estadual Carlos Botelho, adjacent to Parque Estadual Intervales and the site of the first known description of the nest of Red-ruffed Fruitcrow. The chick was fed by an adult (WA1737915). The second was in November 2014 at the Parque Estadual Intervales (WA1542003) and a third one was in December 2017 on the access road to the upper part of Parque Nacional do Itatiaia, in the same region as the aforementioned nest (WA2812710). This young individual may be the same one mentioned by Soares (2017). The only image of an individual with sub-adult plumage, that is, with more red feathers on its chest, was taken in March 2018 in the Apiaí region in Serra de Paranapiacaba, São Paulo (WA2929137). Our



Figure 2. Parental care and development of Red-ruffed Fruitcrow chicks. (A) chicks at the nest; (B) adult Red-ruffed Fruitcrow feeding the chicks; (C) adult Red-ruffed Fruitcrow feeding the larger chick outside the nest; and (D) smaller chick outside the nest. Photos: Fabio Schunck.

image search also revealed 16 records of adult Red-ruffed Fruitcrow carrying animal food items: 6 vertebrates (5 frogs and 1 lizard) and 10 insects (1 undetermined, 3 cicadas, 3 caterpillars, 3 moths, and 1 grasshopper). The documentation of these events occurred mainly between September and December ($n = 14$), with only 2 records made outside this period, 1 in May (a moth) and 1 in February (a frog; Supplemental Table S2).

Discussion

The nest of Red-ruffed Fruitcrow found in PNMI is the second to be formally described for

this subspecies. Despite being an open basket built with dry sticks, it exhibited some characteristics that differed from the first description made by Francisco et al. (2008). The main difference is the much simpler structure (amount of material used, internal lining, and height), indicating that it is more fragile, although it was built on a more stable base and close to the main trunk of the tree. This positioning gave the nest greater stability, including during adult landing and chick movements (video ML351109491 and Supplemental Fig. S1D). This nest had characteristics similar to those described for *P. s. granadensis* (Muir et al. 2008) and other medium- and large-sized cotingids, such

as species of the genera *Procnias*, *Xipholena*, *Perissocephalus*, and *Cephalopterus* (Snow 1982, Sánchez 2002, Kirwan and Green 2011). The nesting records obtained from the online data platforms also showed a simple structure similar to that observed in PNMI, indicating that the structure mentioned in the first description made by Francisco et al. (2008) may be atypical, perhaps due to the less stable location at a greater distance from the main trunk of the tree.

As observed by Francisco et al. (2008) and Soares (2017), we also recorded 2 chicks at the nest and only 1 adult individual taking care of them, which may be a possible mode of parental care for this subspecies, as already reported for other cotingas, including *P. s. granadensis* (Snow 1982, Kirwan and Green 2011). However, the number of chicks (2) differs from those reported for *P. s. granadensis* by Muir et al. (2008), who recorded only 1 chick in each of 8 nests studied. Three other characteristics similar to those reported by Francisco et al. (2008) were (1) the absence of fecal material on the ground, close to the nest, suggesting that adults remove feces; (2) the strategy of the adult of using different routes to arrive at the nest and landing in different places before approaching, probably to avoid attracting potential nest predators; and (3) the time interval between visits, at least in the morning.

Unlike Francisco et al. (2008), we observed an inverse relationship between reproduction of Red-ruffed Fruitcrow and the availability of fruit of the juçara palm (*Euterpe edulis*). This palm is common in the public use area of PNMI, but its fruiting season in this region of Serra do Mar of São Paulo occurs in the austral winter, June–September (Reis and Kageyama 2000). Thus, even though it is a type of food very much appreciated by Red-ruffed Fruitcrows, its fruiting makes these birds seek other resources throughout the year, such as pumpwood fruits (embaúba [*Cecropia* spp.]; video ML351109491), which were widely used by the adult to feed the young in PNMI. Bangalow palm, a common exotic, was fruiting in PNMI November–December 2018 (WPS, pers. obs.), but the adult bird was not observed taking this potential resource to its young.

Regarding fruitcrow diet while breeding, our first surprising finding was the observation of the adult individual preying on a Rufous-bellied Thrush chick at its nest and taking it to its own

nestlings, a predatory behavior not previously reported in the literature (e.g., Snow 1982, 2020; Sick 1997; Kirwan and Green 2011). Sick (1997) and Kirwan and Green (2011) mention bones, possibly of a passerine, found in stomach analyses of some Red-ruffed Fruitcrows from southeastern Brazil. Mahecha et al. (2018) observed an Andean Cock-of-the-rock (*Rupicola peruvianus*) preying on a Canada Warbler (*Cardellina canadensis*) and chasing a Swainson's Thrush (*Catharus ustulatus*). Our review of online images found 6 records of Red-ruffed Fruitcrow preying on lizards, a group already known as prey of *P. s. granadensis* and responsible for 25% of its food biomass, as observed by Muir et al. (2008). Our second surprising finding was 5 records of predation on arboreal forest frogs of the family Hylidae, genera *Boana* and *Bokermannohyla*, with 4 positive identifications to the species level (*sensu* Frost 2021; Supplemental Table S2). These nocturnal frogs were captured during the day while resting on vegetation and are unknown food items of the Red-ruffed Fruitcrow, which appears to prey on large frogs with a male snout–vent length ranging 64–88 mm (Haddad et al. 2013).

Other species of Cotingidae use frogs to feed their chicks, such as Andean Cock-of-the-rock, Guianan Cock-of-the-rock (*Rupicola rupicola*), Long-wattled Umbrellabird (*Cephalopterus penduliger*), Snowy Cotinga (*Carpodectes nitidus*), and Bare-necked Umbrellabird (*Cephalopterus glabricollis*), but this type of food item is still poorly known for this Neotropical bird family (Snow 1982, Kirwan and Green 2011, Rojas et al. 2016, Rojas-Carranza 2019). Predation on bird chicks, lizards, frogs, and different types of insects illustrates the variety of food sources used by the Red-ruffed Fruitcrow to feed their chicks.

It is difficult to make a direct comparison between the chick plumage we recorded and the descriptions by Francisco et al. (2008) due to the different ages of the birds involved. However, as noted by those authors, we also observed the featherless gular region with a notable pinkish-yellow skin constantly inflated. This behavior may be due to the emission of some type of vocalization not detected in the field, or as a type of “training” of the typical behavior that adult males perform during lekking displays. Adult males are known to bend down, fill the gular sac with air while shaking their heads sideways, get up

and display the red ball inflated to the maximum (Sick 1997). Based on the data obtained from PNMI and online, we can state that young Red-ruffed Fruitcrow recently out of the nest have a juvenile plumage that is all black with a few red feathers on the chest. This red colored patch certainly increases with the development of the bird, as seen in the image of a sub-adult with more extensive red than the young fledglings (WA2929137). This increase in red coloration should take some years, according to known patterns for other species of Cotingidae (Snow 1982, Kirwan and Green 2011).

All available data on nesting of Red-ruffed Fruitcrow were obtained in the months of November and December, which may, therefore, be the typical reproduction period for this subspecies in southeastern Brazil, including a bird collected in breeding condition as early as mid-September in Rio Grande do Sul state, in extreme southern Brazil (Belton 1985). The precise definition of the reproduction period, as well as new information on the reproduction of this subspecies, will only be satisfactorily determined through a broad review of data from the literature, online databases, and field studies, as done by Muir et al. (2008) for *P. s. granadensis* in Venezuela. The potential for studies on the reproduction of Red-ruffed Fruitcrow is very high due to its wide occurrence and its proximity to large urban centers, such as the city of São Paulo, where there are many ornithologists, universities, and research centers.

When compared with other data for the subspecies, it is remarkable that Red-ruffed Fruitcrow nest at the PNMI, a periurban location in a fragmented and anthropized environment. Other known nests of Red-ruffed Fruitcrow were found in natural habitats far from urban areas, including the primary forests of Serra de Parapiacaba, a common feature among many species of cotingas, which only nest in well-preserved forests (Snow 1982, Kirwan and Green 2011). This may indicate that the nesting site at PNMI, even if anthropized, was chosen by the birds due to its environmental characteristics, including a possible abundance of food, such as fruits (e.g., embaúba), insects (e.g., cicadas), and small vertebrates, such as bird chicks. The presence of some artificial lakes and wetlands around the nest

may also provide a potential place for catching frogs.

The nesting record of Red-ruffed Fruitcrow at PNMI, ~3 km from the urban area of the city of São Paulo, underscores the importance of extant forest areas in this region of the state of São Paulo for the conservation of these birds. It warrants the protection of forest fragments around the city of São Paulo, which are susceptible to deforestation, fires, and sprawling urban development, factors that can harm the Red-ruffed Fruitcrows that still inhabit the periphery of the largest urban area in South America.

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Literature cited

- Belton W. 1985. Birds of Rio Grande do Sul, Brazil. Part 2. Bulletin of American Museum of Natural History. 180:1–241.
- City of São Paulo. 2012. Decreto Municipal 53227, de 20 de junho de 2012. Cria e denomina o Parque Natural Municipal Itaim [Municipal Decree 53227, of June 20, 2012. Creates and names the Itaim Municipal Natural Park]. Diário Oficial da Cidade, p. 1. [cited 18 Jun 2021]. <http://legislacao.prefeitura.sp.gov.br/leis/decreto-53227-de-20-de-junho-de-2012/detalhe>. Portuguese.
- City of São Paulo. 2018. Inventário da Fauna do Município de São Paulo [Fauna Inventory of the Municipality of São Paulo]. Divisão de Fauna Silvestre/SVMA/PMSP. [cited 18 Jun 2020]. www.prefeitura.sp.gov.br/cidade/secretarias/meio_ambiente/parques. Portuguese.
- Francisco MR, Oliveira PRR Jr, Lunardi VO. 2008. Nest and fledglings of the Red-ruffed Fruitcrow (*Pyroderus scutatus*). Wilson Journal of Ornithology. 120:413–416.

- Frost DR. 2021. Amphibian species of the world: An online reference. Version 6.1 (1 Jul 2021). New York (NY): American Museum of Natural History. <https://amphibiansoftheworld.amnh.org/index.php>
- Haddad CFB, Toledo LF, Prado CPA, Loebmann D, Gasparini JL, et al. 2013. Guia dos anfíbios da Mata Atlântica: diversidade e biologia [Guide to Atlantic Forest amphibians: diversity and biology]. São Paulo: Anolis Books. Portuguese.
- [IBGE] Instituto Brasileiro de Geografia e Estatística. 2022. Estimativas populacionais para os municípios brasileiros [Population estimates for Brazilian municipalities] [cited 15 Apr 2022]. <https://cidades.ibge.gov.br>. Portuguese.
- [IUCN] International Union for Conservation of Nature. 2022. The IUCN Red List of threatened species. Version 2022-1 [cited 11 Apr 2022]. <http://www.iucnredlist.org>
- Kirwan GM, Green G. 2011. Cotingas and manakins. Princeton (NJ): Princeton University Press.
- Magalhães JCR. 1999. As aves na Fazenda Barreiro Rico [The birds at Fazenda Barreiro Rico]. São Paulo (Brazil): Plêiade. Portuguese.
- Mahecha L, Villabona N, Sierra L, Ocampo D, Laverde-R O. 2018. The Andean Cock-of-the-rock (*Rupicola peruvianus*) is a frugivorous bird predator. *Wilson Journal of Ornithology*. 130:558–560.
- Muir JA, Licata D, Martin TE. 2008. Reproductive biology of the Red-ruffed Fruitcrow (*Pyroderus scutatus granadensis*). *Wilson Journal of Ornithology*. 120:862–867.
- Natalini G. 2020. Dossiê: A devastação da Mata Atlântica no município de São Paulo [The devastation of the Atlantic Forest in the municipality of São Paulo]. 2nd edition. Technical Report. Portuguese.
- Reis A, Kageyama PY. 2000. Dispersão de semente de *Euterpe edulis* Martius Palmae [Seed dispersion of *Euterpe edulis* palm]. In: Reis MS, Reis A (Orgs.). *Euterpe edulis* Martius (palmeiro) biologia, conservação e manejo [*Euterpe edulis* Martius (palm tree) biology, conservation and management]. Itajaí: Fundação O Boticário; p. 60–92. Portuguese.
- Rojas E, Vargas JC, Barrantes G, Sandoval L. 2016. Observations on the breeding behaviour of Snowy Cotinga *Carpodectes nitidus*. *Cotinga*. 38:14–19.
- Rojas-Carranza AH. 2019. Primer registro de depredación de la Rana de Hoja (*Agalychnis saltator*) por el Pájaro Sombrija Cuellinudo (*Cephalopterus glabricollis*) en la vertiente Caribe de la Cordillera de Tilarán, Costa Rica [First record of predation of the Red-eyed parachuting leaf frog (*Agalychnis saltator*) by the Bare-necked Umbrellabird (*Cephalopterus glabricollis*) in the Caribbean slope of the Tilarán Mountain Range, Costa Rica]. *Zeledonia*. 23:48–52. Spanish.
- Sánchez C. 2002. Nest, egg, and nesting biology of the Snowy Cotinga (*Carpodectes nitidus*). *Wilson Journal of Ornithology*. 114:517–519.
- Serrano VH. 1994. Generalidades sobre la selección de habitat, el ciclo reproductivo y el sistema lek de apareamiento de *Pyroderus scutatus* (toro de monte) [Overview of habitat selection, reproductive cycle and lek mating system of *Pyroderus scutatus* (Red-ruffed Fruitcrow)]. In: Rangel JO, editor. *Ucumari: um caso típico de la diversidade biótica Andina*. Carder Corporación Autónoma and Universidad nacional de Colombia, Cali; p. 343–355. Spanish.
- Sick H. 1997. Ornitologia Brasileira [Brazilian ornithology]. Rio de Janeiro (Brazil): Nova Fronteira. Portuguese.
- Snow DW. 1982. The cotingas. Ithaca (NY): Cornell University Press.
- Snow D. 2020. Red-ruffed Fruitcrow (*Pyroderus scutatus*). Version 1.0. In: del Hoyo J, Elliott A, Sargatal J, Christie DA, Juana E, editors. *Birds of the world*. Ithaca (NY): Cornell Lab of Ornithology. <https://doi.org/10.2173/bow.rerfu1.01>
- Soares HM. 2017. [WA2811110, *Pyroderus scutatus* (Shaw, 1792)]. *Wiki Aves—A Enciclopédia das Aves do Brasil* [cited 18 Jun 2020]. <http://www.wikiaves.com/2811110>. Portuguese.
- State of São Paulo. 2018. Decreto Estadual N° 63.853 de 27 de novembro de 2018. Declara as espécies da fauna silvestre do Estado de São Paulo regionalmente extintas, as ameaçadas de extinção, as quase ameaçadas e as com dados insuficientes para avaliação de seu grau de conservação, bem como as diretrizes a que estão sujeitas [It declares the species of wild fauna of the State of São Paulo regionally extinct, those threatened with extinction, those almost threatened and those with insufficient data to assess their degree of conservation, as well as the guidelines to which they are subject]. *Diário Oficial do Estado de São Paulo, seção 1, Vol. 128, Num. 221*. São Paulo (SP): Governo do Estado de São Paulo. Portuguese.
- Uetz P, Freed P, Aguilar R, Hošek J, editors. 2021. The reptile database [cited 7 Jan 2021]. <http://www.reptile-database.org>
- Willis EO. 1979. The composition of avian communities in remanent woodlots in southern Brazil. *Papéis Avulsos de Zoologia*. 33:1–25.
- Willis EO, Oniki Y. 2003. *Aves do Estado de São Paulo* [Birds of the State of São Paulo]. Rio Claro (Brazil): Editora Divisa. Portuguese.