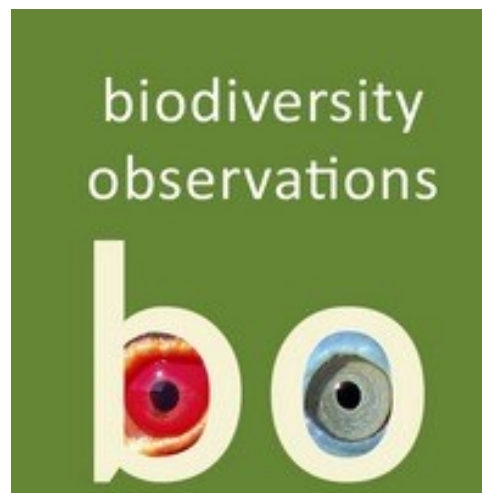


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Reproduction and natural history of the Yellow-faced Siskin *Spinus yarrellii* in northeastern Brazil

Anita Studer^{1†}, Marcelo C. Sousa^{1‡}, Gwyneth Stoudmann^{1*},
Natanael Vieira Santos^{1§}

¹Nordesta Reforestation and Education. 19, rue de Chantepoulet, 1201,
Geneva, Switzerland

[†]studer.anita@gmail.com

[‡]mcsbird@gmail.com

^{*}gw.stoudmann@gmail.com

[§]biologonatan@gmail.com

Abstract

The Yellow-faced Siskin *Spinus yarrellii* is a Vulnerable species with declining populations and little data on its reproduction. Some of its reproductive parameters are presented here, having been obtained in the northeastern region of Brazil, in the state of Alagoas, when four nests were monitored between 1991 and 2009 near the Pedra Talhada Biological Reserve. The nests were located in trees in anthropogenic areas and capoeiras at heights ranging from 2 to 5 m. We measured three of them, resulting in averages of 9.7 cm in

external diameter, 4.7 cm in internal diameter, 6 cm in external height and 2.8 cm in internal height. Clutch sizes ranged from three to four eggs. Incubation lasted 11 to 12 days, with both parents participating, and chicks fledged between 10 and 11 days. Our records seem to be one of few that reveal information on the reproduction of this species. Our observations demonstrate undemanding nest site selection, with siskins utilising exotic plant species and disturbed environments for reproduction. Despite this adaptability, Yellow-faced Siskin populations face significant threats from illegal wildlife trade and habitat destruction with the indiscriminate use of pesticides on crops and pastures, which continue to intensify in the species' habitat. With this study, we hope to provide valuable insights into the reproductive ecology of the Yellow-faced Siskin and contribute to broader conservation strategies for this rare and declining species.

Keywords: Reproductive biology, eggs, incubation, conservation, Yellow-faced Siskin, northeastern Brazil

Introduction

The Yellow-faced Siskin *Spinus yarrellii* is geographically restricted to northeastern Brazil, with occurrences in almost all the states in the region. However, it has been recorded in the centre-west of the country, in the state of Tocantins (Clement & Sharpe 2020). There are also disjointed distribution records in Venezuela and Colombia, supposedly of individuals in captivity (Castro-Lima & Ocampo-Peñuela 2010).

The Yellow-faced Siskin usually occurs on the edges of floodplain forests, secondary forests, caatinga, crop edges, coffee plantations and around urban areas (Clement & Sharpe, 2020) and has also been observed in pasture areas (Lyra-Neves et al. 2018). It can be distinguished from *Spinus magelanicus*, the other allopatric species of the genus found in Brazil, only by the somewhat reduced black head cover of the males (Clement & Sharpe 2020).

The Yellow-faced Siskin is a scarce species, with fragmented and declining populations, mainly due to the pressure of capture for illegal trade and wildlife trafficking (Lyra-Neves et al. 2018). According to Lyra Neves et al. (2018), continuous persecution, especially of males,

leads to a decrease in mature individuals and, consequently, puts the species at risk of extinction. Its IUCN classification is Vulnerable (Clement & Sharpe 2020).

The reproductive biology of the Yellow-faced Siskin is poorly known, and many aspects of its natural history are ignored (Clement & Sharpe 2020). Therefore, data which provide information on reproductive parameters, nests, eggs, chicks, incubation period, clutch size and reproductive season are essential not only for understanding its natural history but also to help establish conservation actions for this species and various other tropical species whose reproductive data is scarce or non-existent as confirmed by Xiao et al. (2017) and Lees et al. (2020).

Hence, we report on the reproductive parameters of the Yellow-faced Siskin, specifically on the nest and egg characteristics, clutch size, nestling description, incubation period, feeding and nestling period. This paper is the third of a series which aims to fill gaps in our knowledge of the reproductive biology of birds in this region; the other two deal with the Scarlet-headed Blackbird *Amblyramphus holosericeus* (Studer et al. 2023) and the Ultramarine Grosbeak *Cyanoloxia brissonii* (Studer et al. 2025).

Study area and methods

The study was conducted in the municipality of Quebrangulo, in the state of Alagoas, c. 2 km south of the Pedra Talhada Biological Reserve, Brazil (Figure 1). The surrounding landscape is dominated by pastures interspersed with scattered shrubs and trees, reflecting a history of deforestation and ongoing vegetation regeneration (Studer et al. 2023).

Although outside the boundaries of the reserve, the study area benefits from the same relatively humid climate characteristic of the region. Average annual rainfall is 1,600 mm, with temperatures ranging from 14°C to 36°C. These conditions are influenced by the relief of the Borborema Plateau, which intercepts oceanic winds, causing condensation and higher precipitation levels than in neighbouring areas (Studer et al. 2015, 2023).

The Pedra Talhada Biological Reserve itself spans 4,469 ha and is



Figure 1: Location of the study area. Alagoas, northeastern Brazil.

considered one of the largest and most ecologically significant forest remnants in the region. It consists of a submontane ombrophilous forest—an altitude swamp formation—that has persisted due to the area's unique microclimate. The Borborema Plateau plays a key role in maintaining this favourable climatic regime, which has allowed the forest to act as a floristic refuge during periods of drought (Studer et al. 2015, 2023). Due to centuries of deforestation, the reserve has become an isolated fragment. Its surroundings are dominated by pastures, where the regeneration of native vegetation continues, often in the form of scattered patches of shrubs and trees.

Nest searches were conducted opportunistically between 1991 and 2009 within the study area. Once adult individuals or pairs were located, their behaviour was observed to identify breeding activity, particularly nest-building, provisioning and site fidelity. Observations were conducted from a concealed position using a camouflaged hide set c. 10 m from the nests, aided by binoculars (10×42). This approach allowed for detailed behavioural monitoring while minimising disturbance.

Nests were monitored every two days throughout the breeding cycle, with increased observation frequency during the nestling phase to

ensure accurate tracking of key developmental events. The following reproductive parameters were recorded: nest and egg description, clutch size, description of chicks, diet, incubation period (from clutch completion to hatching of the first chick), and nestling period (from hatching of the last chick to fledging of the first chick).

Physical access to the nests for direct measurements was undertaken after the chicks had fledged to ensure minimal disturbance. These post-fledging visits allowed us to collect structural nest data without affecting reproductive success. The recorded nest characteristics included nest height above ground, plant species used as a support, and nest dimensions (diameter, depth) measured with a flexible tape measure and a 150 mm graduated calliper. Nest weight was obtained using precision Pesola scales.

Photographic records were taken using a digital camera with a 70–300 mm telephoto lens, allowing close documentation without physically approaching the nests during sensitive phases.

Results and discussion

We located four active nests between 1991 and 2009 in the months of April and May, the rainy season in the region.

Following the pattern of Simon & Pacheco (2005), all the nests had a shallow cup shape and were built with stems, stolons, grass rootlets and herbaceous inflorescences. Spider webs and oothecae were also found, and the interior was densely lined with plant flakes and fine rootlets.

We observed that both the male and female took part in building the nests. Nests were located at heights ranging from 2 m to 5 m, in the forks of the denser and outermost branches of mango trees *Manguifera indica* (two nests) and mulungu *Erythrina mulungu* (one nest), as well as one in the forks of the thicker and relatively exposed trunks of an unidentified tree.

Of the nests found, three had their average dimensions measured at 9.7 cm in external diameter, 4.7 cm in internal diameter, 6 cm in external height and 2.8 cm in internal height. The average weight of two nests were 10 g (Table 1).

Table 1: Dimensions of three Yellow-faced Siskin *Spinus yarrellii* nests at Quebrangulo, Alagoas, Brazil.

Nest	External diameter (cm)	Internal diameter (cm)	External height (cm)	Internal height (cm)	Weight (g)
1	7.0	4.5	6.0	2.5	8
2	9.0	5.0	6.0	3.0	–
3	13.0	4.5	6.0	3.0	12
Mean	9.7	4.7	6.0	2.8	10

We observed complete clutches of four eggs in three nests and three in one nest. The white eggs, with a few small brown dots all over the surface, sometimes more concentrated at the rhombic pole, were pointed oval to long pointed oval in shape, with average dimensions of 16.54×12.14 mm (*n* =11) (Figure 2).

Upon hatching, the chicks had pinkish-yellow skin with slight fine grey down. The inside of the throat was reddish, the beak was golden yellow, turning yellowish grey after the first few days, and the commissures were yellowish (Figures 3).

Field Notes

The nest-building activities and care for the nestlings were observed for pairs at four monitored nests:

Nest 1

On 24 April 1991, the pair started building the nest, working together and carrying the first straw. After nine days, on 3 May, the female laid her first egg. After three days, on the morning of 6 May, the clutch was complete, with three eggs and incubation commenced (Figure 4). The chicks hatched on 17 May, 11 days after the first egg was laid.



Figure 2: A Yellow-faced Siskin *Spinus yarrellii* nest with four eggs at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 4: Female Yellow-faced Siskin *Spinus yarrellii* incubating eggs with male next to her in the nest at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 3: Female Yellow-faced Siskin *Spinus yarrellii* brooding the nestlings at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 5: Pair of Yellow-faced Siskin *Spinus yarrellii* feeding nestlings a few days after hatching at Quebrangulo, Alagoas, Brazil (Nordesta Collection).

On 25 May 1991, the nest was observed for 100 minutes, from 07:00 to 08:40. The female arrived at the nest at 07:20 carrying the food, which appeared to be a pasty cluster of small seeds. As soon as she landed on the nest, she regurgitated and distributed it equally to the three chicks. She collected and swallowed the faeces of the nestlings and brooded them for 15 minutes. She then flew off and returned with the male. The male and female fed the chicks, left the nest and returned three more times. Both adults fed the chicks. At 08:00, the female brooded the chicks, and the male brought the food to the female, who distributed it to the chicks (Figures 6–10).

Nest 2

On 30 May 1996, a nest with four chicks three days old was observed for 100 minutes, from 11:00 to 12:40. The female was in the nest and remained there for the entire time. During this period, on two occasions, the male brought her small seeds agglomerated in a paste, which she distributed to the chicks.

Nest 3

On 19 May 2008, we observed a nest containing four chicks, five days old, for 130 minutes, from 07:20 to 09:40. The female arrived at the nest at 07:45 and settled on top of the chicks, brooding them. After a few minutes, at 07:53, she got up, fed each chick, and then collected and swallowed the chicks' faeces. She brooded them again and got up at 08:20 to clean the nest for a few minutes. She collected the faecal sacs for a second time, swallowed them and settled back on the chicks. At 08:30, sensing the arrival of the male, she began to shake her body and open her beak. The male landed on the nest and passed some food to the female and the rest to the four chicks. As soon as the male left, the female started feeding the four chicks.

The female left the nest at 08:45, returned 10 minutes later, at 08:55, apparently without food, and once again brooded the chicks. Soon afterwards, she cleaned the nest, swallowed the droppings, lay down and, sitting on the chicks, started cleaning the nest again. At 09:35, she flew from the nest just as the male arrived to feed the chicks.



Figure 6: Female Yellow-faced Siskin *Spinus yarrellii* feeding the chicks at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 7: Female Yellow-faced Siskin *Spinus yarrellii* collecting faecal sacs at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 8: Male Yellow-faced Siskin *Spinus yarrellii* feeding the female in the nest at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 9: Male and female Yellow-faced Siskins *Spinus yarrellii* feeding the nestlings at Quebrangulo, Alagoas, Brazil (Nordesta Collection).

Nest 4

On 8 April 2009, observations were made at a nest with four eight-day-old chicks. During 120 minutes of observations, from 09:50 to 11:45, the male and the female fed the chicks. The male came to the nest twice, and the female four times. Each feeding session lasted between one and two minutes, and the food was distributed several times among the brood. The female brooded the chicks between feedings and eventually got up to clean the nest and swallow the faeces (Figure 9).

Two days later, on 10 April 2009, in the same nest, during 120 minutes of observations, from 06:45 to 09:45 in the morning, the male fed the chicks four times and the female five times. The food was distributed to all the young. The adults seemed to chew, feed, re-chew and feed again. The female took her time with the young at each visit and swallowed the faeces. At the end of the observations, the female remained on the chicks. The male arrived again after a few minutes, fed each of the chicks, and then they both flew away carrying faecal sacs (Figure 11).

As the chicks grew, the adults collected and sometimes swallowed the faecal sacs but stopped taking them away from the nest. However, the interior remained clean because the older chicks' faeces and that of the adults were ejected away from the edges of the nest; some remained stuck on the sides, however (Figure 12).

Our records revealed important information about the reproduction of this species. They show that the Yellow-faced Siskin is undemanding when it comes to nesting sites, often choosing anthropogenic areas as breeding grounds and exotic plant species to build its nests and even to feed on. This statement is based on records obtained during field research carried out in 2010, when we found a pair of Yellow-faced Siskins feeding on the fruits of the Casuarina Tree *Casuarina equisetifolia* in a noisy place with a lot of pedestrian traffic next to the boilers of a cement factory, about 1 km from the Ibura National Forest, in the state of Sergipe. Although we did not find the nest, factory workers assured us that the species was breeding there (Figure 13).

These observations suggest that the species can reproduce and forage in disturbed areas. However, the Yellow-faced Siskin seems to



Figure 10: Male Yellow-faced Siskin *Spinus yarrellii* in the nest feeding the chicks at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 12: Male Yellow-faced Siskin *Spinus yarrellii* collecting and swallowing the faecal sacs and faeces ejected and stuck to the side of the nest at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 11: Female Yellow-faced Siskin *Spinus yarrellii* cleaning the nest, collecting and swallowing the faecal sacs at Quebrangulo, Alagoas, Brazil (Nordesta Collection).



Figure 13: Female Yellow-faced Siskin *Spinus yarrellii* among fruit of Casuarina Tree *Casuarina equisetifolia*, next to a cement factory boiler at Sergipe, Brazil (Nordesta Collection).

depend on forested areas because it was observed several times moving from the forest's edge to anthropogenic areas, possibly moving between its breeding and feeding sites. It is possible that the presence of the species in disturbed areas and pastures, as mentioned by Lyra-Neves et al. (2018) and observed in the present study, is due to the species' preference for reproducing in clearings or to a common daily movement pattern of populations. It could also be due to the dispersal of individuals through the capões, capoeiras and wooded fields used as ecological stepping stones when moving between forest fragments. Although the species was suggested by Lyra-Neves et al. (2018) not to be migratory, it is possible that part of its populations are migrants (Castro-Lima & Ocampo-Peñuela 2010).

In all situations, the pressure of capture for clandestine trade remains intense in the region, and the indiscriminate use of pesticides is a threat to the survival of the species, as also mentioned by other authors (Lyra-Neves et al. 2018, Clement & Sharpe 2020, Woods 2020, Santos et al. 2024).

We believe that the conservation of populations of this Vulnerable species can be achieved by protecting the forests and surrounding environments where the species is found and through environmental education programs. Strict enforcement of legislation aimed at curbing the illegal capture and trade of birds is also required. In addition, reforestation actions are needed to expand forested areas and create ecological corridors to connect isolated fragments and enable the gene flow of populations of this and other animal and plant species.

However, further studies on the reproduction and natural history of Yellow-faced Siskin are required to fill the information gaps in our knowledge of this species. This is also the case with many other Neotropical bird species (Lees et al. 2020), and especially the reality in northeast Brazil. Filling these gaps would help us understand the reproductive behaviour of the species and aid in developing conservation strategies against threats like habitat loss, pesticide use, and illegal trafficking.

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