

# Observations on the breeding biology of the Pygmy Nightjar *Nyctipolus hirundinaceus* in the *Caatinga* of Bahia and Ceará, Brazil

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**ABSTRACT:** We present the first details of nesting sites, eggs, and chicks of the Pygmy Nightjar (*Nyctipolus hirundinaceus*), a small nocturnal bird endemic to northeastern Brazil. We conducted behavioral observations near Curaçá in northern Bahia, and at Potengi, southern Ceará, both located in the heart of the Brazilian *Caatinga*. We found four 'nests' in Bahia and another five in Ceará. In all cases, a single egg was laid, and only the females took care of the chick during the day. Pygmy Nightjars in both places bred mostly during the rainy season, as do most of the bird species in the region. By gathering breeding data from throughout the species distribution, we observed that although most populations (c. 75 %) breed during the rainy season, some populations of the race *cearae* also seem to breed during the dry season.

**KEY WORDS:** Brazil, Caprimulgidae, eggs, nesting biology, reproduction.

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## INTRODUCTION

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The family Caprimulgidae, which contains nighthawks and nightjars, includes cryptically colored, mainly nocturnal species that are often difficult to find and observe. More commonly heard than seen, several basic aspects of their biology remain poorly known, especially for the Neotropical members of the family (Cleere 1998, 1999; Holyoak 2001). Their breeding biology is particularly under-studied; the most recent monographs on the family have pointed out that ~70% of all species had either 'no breeding information' or their breeding biology was 'poorly known' (Cleere 1998, 1999; Holyoak 2001).

Among the least known species in the family is the Pygmy Nightjar (*Nyctipolus hirundinaceus*), endemic to the Brazilian northeast, where three described allopatric subspecies (*hirundinaceus*, *cearae*, and *veilliardi*) occupy open areas in light woodland, scrubland, and areas with xeric vegetation locally known as *Caatinga* (*hirundinaceus* and *cearae*), as well as areas with xeric vegetation on

inselbergs in the Atlantic Forest (*veilliardi*; Cleere 1999). As the name suggests, the Pygmy Nightjar is among the smallest Neotropical members of the family (16 – 20 cm), and seems to prefer to some extent the vicinity of flat rocky outcrops (*lajeiros*) both in the *Caatinga* and the Atlantic Forest (Sick 1997; Vasconcelos & Lins 1999; Ingels *et al.* 2014).

The evolutionary relationships of this nightjar are only now starting to be unveiled. Formerly located in the genus *Caprimulgus*, the Pygmy Nightjar was recently placed in an expanded genus *Hydropsalis* by the Comitê Brasileiro de Registros Ornitológicos (2014), following the taxonomic recommendations of Han *et al.* (2010). More recently, the South American Checklist Committee (Remsen *et al.* 2014) decided to resurrect the genus *Nyctipolus*, including both *N. hirundinaceus* and the Blackish Nightjar (*Nyctipolus nigrescens*), following the recent findings of the first available molecular sequences of Pygmy Nightjar (Sigurdsson & Cracraft 2014).

During January and February 1997, JMB, LNN, and ALR spent several weeks in the *Caatinga* of Curaçá,

located in the interior of the Brazilian state of Bahia (see Mazar Barnett *et al.* 2014 for a more detailed description of this site). During that time, while working for the Spix's Macaw Project (*Projeto Ararinha-azul*), they observed and documented the breeding behavior of 29 different species of birds (Mazar Barnett *et al.* 2014), including several with undescribed nests at the time, such as the Cactus Parakeet (*Aratinga cactorum*; Naka 1997), the Lesser Nighthawk (*Chordeiles pusillus*; Leite *et al.* 1997), the Scarlet-throated Tanager (*Compsothraupis loricata*; Mazar Barnett *et al.* 2014), and the Pygmy Nightjar, of which four 'nests' were found around the Spix's Macaw Project headquarters, at Fazenda Concórdia. Although some basic information from these observations has been reported elsewhere (Cleere 1998, 1999; Holyoak 2001), detailed information on the breeding biology of the Pygmy Nightjar remains lacking. More recently, JLGL found, and reports here on, five eggs in southern Ceará, some 250 km north of Curaçá.

Here, we present the first detailed description of the 'nest,' eggs, and chicks of the Pygmy Nightjar, including observations on the general breeding behavior of this Brazilian endemic nightjar. We discuss the timing of breeding in relation to rainfall, and compare our data with newly available breeding information obtained from throughout the species' distributional range.

## METHODS

We studied the breeding behavior of Pygmy Nightjars at Fazenda Concórdia (09°09'S, 39°45'W), situated *c.*25 km south of Curaçá in northern Bahia (Mazar Barnett *et al.* 2014) and at Sítio Pau Preto (07°04'S, 40°05'W), located *c.*5 km west of Potengi in southern Ceará. Both regions are covered by scrubland and dry woodland. Fazenda Concórdia is covered by open xeric vegetation, dominated by bushes and small trees such as, *Cnidocolus phyllacanthus* (Euphorbiaceae), *Jatropha mollissima* (Euphorbiaceae), *Caesalpinia pyramidalis* (Caesalpinoideae), and several species of cacti. Along the seasonal streams filled during the rainy season grows riparian forest dominated by tall *Tabebuia caraiba* (Bignoniaceae) trees. Sítio Pau Preto is known for having an artificial pond that provides water to the town of Potengi. Both areas present clayish soil with abundant gravel, pebbles, and rocks, although Sítio Pau Preto seems to have more rocky outcrops. The natural vegetation cover of both areas has been severely modified. Fazenda Concórdia has been subjected to heavy grazing by goats and cattle, resulting in a heavily eroded land, whereas corn and bean plantations were the main economic activities at Sítio Pau Preto. Although both sites are located in the heart of the semi-arid interior of the *Caatinga*, Curaçá is better known for the presence, until recently, of the last

surviving wild Spix's Macaw (*Cyanopsitta spixii*) (da Ré 1995, Mazar Barnett *et al.* 2014).

Observations around Fazenda Concórdia near Curaçá were made between 2 January and 3 February 1997 by JMB, LNN, and ALR, whereas observations at Sítio Pau Preto near Potengi were made by JLGL between November 2013 and May 2014. To evaluate whether there is a seasonal pattern in the breeding behavior of the Pygmy Nightjar, we gathered additional data from an online source, namely WikiAves ([www.wikiaves.org](http://www.wikiaves.org)), where dated and georeferenced photographs of both eggs and chicks were available (Table 1). To determine the breeding time of the species from available photographs, we used the date when the egg was photographed. For the chicks, we estimated their age in days, and then calculated the date the eggs were likely laid using a 16-day incubation period, as has been previously reported for similar-sized nightjars (Cleere 1999). Although the accuracy of this method is not ideal, we believe it is accurate enough to shed light on the general breeding patterns of the species. Because there is considerable geographic variation in the patterns of rainfall throughout the distribution range of the Pygmy Nightjar, we obtained rainfall data for each locality, when available. When these data were not available for the exact location where the eggs and chicks were photographed, we used rainfall data from the closest locality available (Table 1). Rainfall data (1911-2009) for Bahia, Paraíba, Rio Grande do Norte, and Ceará were obtained from the Departamento de Ciências Atmosféricas (DCA), Universidade Federal de Campina Grande (<http://www.dca.ufcg.edu.br/clima>); data for Minas Gerais were obtained from the Instituto Nacional de Pesquisas Espaciais (INPE), Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) (<http://www.cptec.inpe.br/cidades/>). We considered records prior to the two rainiest months as early rainy season, during the two rainiest months as rainy season, and after the two rainiest months as late rainy season. We considered the first month of drought as early dry season, the last month of drought as late dry season, and all months in between as the dry season.

## RESULTS

### General observations

Although no quantitative estimates of density or abundance of the Pygmy Nightjar were made either at Fazenda Concórdia or Sítio Pau Preto, we noted that several individuals or pairs lived in close proximity, and we believe the species was fairly common in both areas, as individuals were seen on a daily basis. At Fazenda Concórdia, feeding bouts at night were observed as described by Vasconcelos and Figueiredo (1996; Figure

1), with birds sallying *c.* 0.5 to 1.0-m upwards from the ground and landing back on the same spot. We also noted individuals that appeared to be feeding while flying very low over large areas of open ground, mostly in circles or loose figures. Once, a female was observed sitting in the middle of the road, making sharp sideward movements with her head, apparently capturing tiny coleopterans that swarmed in myriads around her. At Sítio Pau Preto, where rocky outcrops are more abundant, Pygmy Nightjars were seen exclusively in these locations.

No body mass data are available for this species (Holyoak 2001). An adult male captured at Fazenda Concórdia weighed 32 g. The length of his wings and tail, 133 and 92 mm respectively, seems to place it near the nominate race, for which Cleere (1998) gives ranges of 119-130 mm and 77-94 mm.

### Description of the nest, egg, and chick

As is the case for the rest of the family, no actual nest is built by Pygmy Nightjars. Four eggs of at least three breeding pairs were found in January 1997 at Fazenda Concórdia. Three nests (nests A, B, and C) were found on the side of an unpaved road used occasionally by vehicles and pedestrians, and one nest (nest D) was found *c.* 15 m-away from the same road and within meters of a rocky outcrop. Nest A was situated near a house surrounded by lush woody vegetation. Nests B and C were found

in an area of open *Caatinga* with sparse low vegetation and large areas of bare soil and stony ground. The two roadside nests B and C, and nest D were within 15 to 20 m of each other, whereas nest A was *c.* 350 m from the other ones. Most observations were made at nest A. We presume that the four eggs belonged to three different pairs: nest A belonged to one pair, nests B and C probably to a second pair, and nest D to a third one. The egg of nest C is presumed to be a replacement clutch for the egg of nest B, which was abandoned and likely eaten by a predator.

All nests contained a single egg, laid directly on the sandy to stony ground. The area immediately around the eggs was cleared of small gravel, probably as a result of comfort movements when an adult installs itself on the egg. All eggs had a pale buffy-cream ground color, with irregular rufous reddish spots and dark blotches, similar to other eggs of this species found elsewhere in the *Caatinga* (Figure 1). Three eggs measured 24.1 x 18.3 mm, 24.3 x 18.0 mm, and 24.7 x 17.4 mm.

The egg of nest A was found on 6 January 1997 and was probably laid a few days earlier. A second egg (nest B) was found in early January, but it already seemed abandoned and remained unattended for about two weeks, when it finally disappeared. The egg of nest C was found on 24 January, whereas the egg of nest D was found broken, with an almost fully-grown chick inside, on 3 February.



**FIGURE 1.** Egg of Pygmy Nightjar (*Nyctipolus hirundinaceus*) found in a depression filled with vegetal litter, gravel, and rock debris on rocky outcrop (*lajeiro*) Morada Nova (Ceará, 05°07'S, 38°23'W). Photograph by Arthur Grosset.

Two of the eggs found eventually hatched. A chick, estimated to be 2-4 days old, weighing 4 g was found at nest A on 24 January. It was covered with grayish white down with a pattern of rufous-brown lines. On 28 January, when we estimated the chick was 6-8 days old, it weighed 7.5 g, and the first feather shafts appeared, rufous on the scapulars, and dark in the wings and tail (see Figure 2 for

a similar looking chick). A day later it weighed 9 g. The egg of nest C apparently hatched on 3 February, but we could only find the two halves of the eggshell, with no sign of a hatchling or any of the adults. Given that an egg of a few days old was found on 6 January at nest A and a 2-4 days old chick was found there 18 days later, we believe that the incubation period lasts at least 16 days.



**FIGURE 2.** Temporal series of an egg, chick, and young of Pygmy Nightjar (*Nyctipolus hirundinaceus*) at Sítio Pau Preto near Potengi. A) First egg found at site (18 November 2013); B) chick of 1-2 days old (1 February 2014); C) chick of 15-16 days old (16 February 2014); D) same chick with adult female (16 February 2014); E) young bird of 31-32 days old (4 March 2014).

Five eggs were found at Sítio Pau Preto between November and May, 2014. All eggs were found on three rocky outcrops; 3 on rock 1, and 1 on rock 2 and 3, respectively, located some 300 m apart. All rocky outcrops were relatively small: rock 1 measured 40 x 40 m (~1600 m<sup>2</sup>), rock 2 measured 26 x 15 m (~340 m<sup>2</sup>), and rock 3 measured 40 x 20 m (~800 m<sup>2</sup>). A first egg (Figure 2a) was found in a crack on rock 1 on 18 November 2013, a couple of weeks before the beginning of the rainy season, which arrived on 16 December in that particular year. The fate of that egg was not followed, but on 1 February 2014 a recently hatched chick (Figure 2b) was found on the same rock, 5 m from the site where the above mentioned egg was found, but obviously from a different egg, although likely from the same breeding pair. That same chick, with an estimated age of 16 days old (Figure 2c), was observed on 16 February being protected by an adult female (Figure 2d). Presumably the same young bird was observed again on 4 March at an estimated age of 32-33 days (Figure 2e). All observations were done on the some rocky outcrop and an adult bird was always found in the area. On 4 March, four adult birds were observed at the

outcrop. A new visit to rock 1 on 23 March resulted in the finding of a third egg, laid at exactly the same place where the chick was found on 16 February. Although it is likely that this third egg was laid by the same pair, several adult birds were seen on rock 1, and the use of the same place for breeding by different pairs cannot be discarded. This egg could not be relocated on subsequent visits to the rock. On 26 March 2014 another egg was found at rock 2, and on 31 May 2014 a fifth egg was found on rock 3 (Figure 3). In all cases, the eggs were laid directly on the bare rock (Figs. 2 and 3).

### Behavior of the chick

Our observations suggest that a chick remains around its nesting site for at least four weeks after hatching. At Curaçá, during the first days after hatching, the chick of nest A remained in the immediate vicinity of the nest site, never moving more than 0.5 m away from that spot. These movements were apparently not related to the availability of shade. Six to eight days after hatching, the chick had moved 2.5 m away from the original nesting



**FIGURE 3.** Rocky outcrop (*lajeiro*) at Sítio Pau Preto (rock 3) near Potengí and egg of Pygmy Nightjar (*Nyctipolus hirundinaceus*) found on 31 May 2014.

site. At Potengi, the chick found in February remained on the rocky outcrop until at least 32 days old, only moving 1 m away from the egg shells after two weeks, and *c.* 10 m after 4 weeks.

Detailed observations at Curaçá revealed that at dusk when the adults became active, the chick stretched and walked around. On occasions, it also made short jumps like the adults do when alarmed. It always remained in the open, but quickly ran to the edge of dense grass to seek cover, when the breeding adult was flushed by approaching humans. When the adult returned and while still approaching, the chick sometimes ran up to it, seeking cover under its raised breast feathers. Food begging was by means of tapping the bill of the adult. When handled, the chick uttered soft alarm calls.

### Behavior of the adults at the nest

During daytime, only the female was seen incubating the egg or brooding the chick, both at nest A (at Curaçá) and rock 1 (at Potengi). We never saw the male attending the nest before dusk. At Curaçá, throughout the incubation period, the egg remained almost at the same spot, moving only a few cm sometimes, probably as a result of an adult turning it. When the female was flushed during the day, it took her only *c.* 1 to 2 min to return to the nest site, and even less, once the chick had hatched. To return, the adult usually landed 1 to 2 m away from the egg or chick, slowly approaching it by walking in a semi-circle.

The male that we assumed to be associated with nest A roosted within *c.* 5 to 15 m from the nest, in the cover of light leguminous shrubs or trees, as noted by Vasconcelos and Figueiredo (1996). Normally, the male was observed taking over the nest at dusk, and was more shy and nervous than the female, as he was probably less used to our presence. The male also gave alarm calls more often. On occasions, he performed a distraction display by walking short distances with fanned tail and spread wings raised slightly in V-shape. The female performed a different distraction display by flattening her body against the ground and flapping her wings while crawling away from the nest site, a display resembling a 'broken wing display.' The male was seen to do a similar display only once. Both adults responded vigorously to the playback of the chick's calls, with the female once flying very close, producing dry sounds by clapping her wings.

### Annual rainfall and breeding season

Five of the nine eggs found during our studies were laid during the early rainy season before the heavier rains arrived, three during the rainy season, and only one egg was laid before the arrival of the rainy season (Table 1). We obtained data for 7 additional eggs and 11 chicks found throughout the distribution range of the Pygmy

Nightjar. Surprisingly, we found reports of nesting birds from throughout the year. The only months lacking nesting records are August and December. Thus, breeding records include all seasons, from the early dry to the late rainy season (Table 1).

## DISCUSSION

The clutch of the Pygmy Nightjar consists of a single egg. Our own observations and 18 additional records report a single egg or chick (Table 1). Although it has been claimed that the clutch size of the Pygmy Nightjar is one or two eggs (Cleere 2010; WikiAves 2013), we have not found any evidence of more than one egg. On the other hand, although we did not mark adult breeding birds, our observations from Potengi suggest that a single pair laid three eggs during five months (November, January, and March) at two individual spots located 5 m apart.

Comparing available pictures (Table 1), egg coloration seems very similar throughout the range of the species, which is in contrast to the large color variation found in the adults. Although the Pygmy Nightjar is considered a rocky outcrop specialist (Ingels *et al.* 2014) our data from Curaçá demonstrate that this species can breed away from these substrates, using bare ground. On the other hand, it seems that when rocky outcrops are available as in Potengi, Pygmy Nightjars will lay their eggs exclusively on these outcrops. A detailed study of rocky outcrop availability and nesting site selection by this species may shed a light on this issue.

A striking feature of our observations at Fazenda Concórdia was the close proximity of three of the Pygmy Nightjar nests. Sick (1997) mentions that Little Nightjars (*Setopagis parvulus*) and Sand-colored Nighthawks (*Chordeiles rupestris*) occasionally breed in groups, while Cleere (1999) noted that some caprimulgids breed in a semi-colonial or even colonial way. The Blackish Nightjar, the closest relatives of the Pygmy Nightjar, is known to breed in an almost colonial way on inselbergs in primary rainforest in the Guianas (Ingels *et al.* 1984, 2009; Cleere & Ingels 2002). Unfortunately, the small number of nests with detailed observations does not allow a conclusion about communal nesting by Pygmy Nightjars.

The breeding of nightjars is often linked to moon phases and annual rainfall (Cleere 1999). In most cases, this is likely related to the abundance of food resources, particularly insect abundance. The *Caatinga* is an extremely seasonal environment, and most breeding seems to take place during the beginning of the rainy season, when insect abundance peaks in the region (Vasconcelos *et al.* 2010). The rainy season in Curaçá, which lasts a few months, seems to be the preferred season to breed for most species (Mazar Barnett *et al.* 2014), including the Pygmy Nightjar. From the 27 breeding events we report

**TABLE 1.** Breeding records of the Pygmy Nightjar (*Nyctipolus hirundinaceus*) currently available, including estimated date, coordinates, season when it was laid, and references. Date of eggs is represented by the actual date when they were found and photographed, whereas date of chicks represents our estimate of the date when the egg was laid, considering a 16-day incubation period.

Race	Locality	State	Coordinates	Date	Year	Season	Author	Reference
<b>Eggs</b> <i>hirundinaceus</i>	Curaçá	Bahia	09°09'S, 39°45'W	6 January	1997	Early rainy	This study	
			"	8 January	1997	Early rainy	This study	
			"	24 January	1997	Early rainy	This study	
			"	3 February	1997	Early rainy	This study	
			"	20 October	2008	Dry	A. Grosset	Ingels et al. 2014
			"	20 October	2008	Dry	A. Grosset	Ingels et al. 2014
			"	1 September	2009	Dry	T. Silva	WA59203
			"	1 July	2009	Early dry	J. Medkraft	WA32531
			"	1 November	2010	Late dry	A. Netto	WA232763
			"	14 January	2012	Late rainy	O. Borges	WA548127
<i>cearae</i>	Morada Nova	Ceará	05°07'S, 38°22'W	20 October	2008	Dry	A. Grosset	Ingels et al. 2014
			"	20 October	2008	Dry	A. Grosset	Ingels et al. 2014
	Ipueira	Rio Grande do Norte	06°28'S, 37°23'W	1 September	2009	Dry	T. Silva	WA59203
	São Mamede	Paraíba	06°56'S, 37°06'W	1 July	2009	Early dry	J. Medkraft	WA32531
	Massapé	Ceará	03°31'S, 40°20'W	1 November	2010	Late dry	A. Netto	WA232763
	Manoel Vitorino	Bahia	14°08'S, 40°14'W	14 January	2012	Late rainy	O. Borges	WA548127
	Jaguaribara	Ceará	05°40'S, 38°37'W	28 May	2013	Late rainy	K. Serra	WA973865
	Potengi	Ceará	07°04'S, 40°05'W	18 November	2013	Late dry	This study	WA1156756
			"	23 March	2014	Rainy	This study	
			"	26 March	2014	Rainy	This study	
		"	31 May	2014	Late rainy	This study	Fig. 3	
<b>Chicks</b> <i>hirundinaceus</i>	Mamonas	Minas Gerais	16°08'S, 43°32'W	6 March	2005	Rainy	E. Luiz	WA172359
	Boa Nova	Bahia	14°21'S, 40°12'W	20 February	2007	Late rainy	E. Luiz	WA167354
			"	24 February	2007	Late rainy	E. Luiz	WA167358
	Massapé	Ceará	03°31'S, 40°20'W	12 October	2009	Dry	A. Netto	WA75163
	Quixadá	Ceará	04°58'S, 39°00'W	29 June	2009	Late rainy	R. Bessa	WA182099
	Equador	Rio Grande do Norte	06°56'S, 36°43'W	15 February	2009	Early rainy	L. Gonzaga	WA343446
	São Mamede	Paraíba	06°56'S, 37°06'W	21 April	2009	Rainy	J. Medkraft	WA22688
			"	17 May	2009	Late rainy	J. Medkraft	WA26653
			"	13 February	2010	Rainy	J. Medkraft	WA118078
	Quixadá	Ceará	04°58'S, 39°00'W	9 June	2011	Late rainy	C. Albano	WA390021
	Parelhas	Rio Grande do Norte	06°41'S, 36°39'W	21 April	2011	Rainy	L. Gonzaga	WA355490
	Potengi	Ceará	07°04'S, 40°05'W	1 February	2014	Early rainy	This study	WA1285132

in this paper (Table 1), 20 (c.75%) occurred during the early rainy, rainy, or late rainy seasons. One case occurred during the early dry, four during the dry, and two during the late dry season (Table 1). Interestingly, all of the seven dry-season breeding records were observed in Ceará, Paraíba, and Rio Grande do Norte, within the range of the race *cearae*. None of the nesting records further south (presumably within the range of the nominate race) were found during the dry season (Table 1). But this does not seem to be the rule, as rainy-season breeders have also been reported in all regions (Table 1). On the other hand, none of the breeding records of the nominate race were found during the dry season.

Rainfall in the *Caatinga*, however, can be dramatically erratic, and can sometimes fail to arrive in any given year (Ab'Saber 1977). This region is well known for long and fierce draughts that can extend for up to two years. It is possible that local changes in the seasonal patterns of rainfall may explain these differences, and it would be necessary to collect rainfall and breeding data in the same years to make warranted correlations. On the other hand, ground-nesting nightjars must deal with the danger of heavy rainfall, which may drown the chick or cool the eggs. Blackish Nightjars living on *inselbergs* in French Guiana and Suriname only breed during the dry season, refraining from breeding when monthly precipitation exceeds c. 300 mm of rain (Ingels *et al.* 1984). In the case of the Pygmy Nightjar, it seems that the total annual rainfall in the *Caatinga* is low enough and it rarely rains more than 200 mm/month, so that avoiding the rainy season may not be necessary.

Data on the breeding of the Atlantic Forest race (*vielliardi*) are not yet available, but given the isolated nature of the three allopatric populations of Pygmy Nightjar, the seasonal timing of reproduction may represent an important pre-zygotic isolating mechanism worth exploring in future studies.

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