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Breeding ecology of Rufous Potoo *Nyctibius bracteatus* in central Amazonian Brazil

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SUMMARY.—The smallest potoo, Rufous Potoo *Nyctibius bracteatus* is a little-known and inconspicuous species of the understorey in Amazonian *terra firme* forests, where it roosts by day. Currently, there are few published observations describing its natural history and reproductive ecology. We present data on nest and egg characteristics, nestling appearance, behaviour and development, and parental care, based on three different nests in three consecutive years at Reserva Florestal Adolpho Ducke, Manaus, central Amazonian Brazil. All nests had similar characteristics and the single egg at one nest was cream-coloured with brown spots. The young at one nest fledged when c.40 days old, but the other two nests were both predated by ant swarms, constituting the first report of such predation in the Nyctibiidae.

The seven species of potoos comprise the exclusively Neotropical family Nyctibiidae, whose centre of diversity is Amazonia (Cohn-Haft 1999). In central Amazonian Brazil, five species occur, with the others in the Andes (Andean Potoo *Nyctibius maculosus*) and Central America and the Greater Antilles (Northern Potoo *N. jamaicensis*), respectively. One of the principal distinctive features of potoos is their habit of remaining motionless by day, mimicking the branches on which they perch, often almost unnoticeable to human eyes (Cohn-Haft 1999). Whilst most species occur in the forest canopy and midstorey, Rufous Potoo *N. bracteatus* inhabits the understorey of Amazonian forests (Cohn-Haft & Kirwan 2020).

Rufous Potoo is the smallest potoo (21–25 cm) and is restricted to the Amazon lowlands, from western Amazonia east to the Rio Tapajós (Cohn-Haft 1999, Solano-Ugalde 2011). Molecular studies revealed that *N. bracteatus* represents the oldest lineage in the family (Brumfield *et al.* 1997, Braun & Huddleston 2009, Costa 2014, White *et al.* 2017) and, due to its unique morphological and behavioural characteristics, a monotypic genus *Phyllaemulor* has been erected to accommodate the species (Costa *et al.* 2018). Despite being the only understorey potoo (Ingels *et al.* 2008, Cleere 2010), which might make *N. bracteatus* easier to observe, its breeding ecology is poorly known, and few published data are available on even basic aspects of the species' natural history (Cohn-Haft 1999, Cleere 2010, Solano-Ugalde 2011). The species is unique in that by day it mimics suspended dead leaves, whereas all other potoos mimic branches and stumps (Cohn-Haft 1999, Lopes & Anjos 2005, Mendonça *et al.* 2009, Cestari *et al.* 2011, Costa *et al.* 2018).

Rufous Potoo lays a single egg sited atop a smaller tree stump (Cohn-Haft 1989, Cisneros-Heredia 2006, Ingels *et al.* 2008). A recent study suggested that reproductive ecology and behaviour recall those of other potoos, but reinforced the need for additional studies (Vinueza-Hidalgo *et al.* 2019). Here we present novel data on the species' breeding, based on observations at three nests in central Amazonian Brazil, and discuss egg morphology, parental care, and nestling appearance, development and behaviour.

Methods

Our study was conducted at Reserva Florestal Adolpho Ducke (RFAD; Fig. 1), north of Manaus, Amazonas, Brazil (02°55'56.88"S, 59°58'26.58"W). The reserve protects approximately 10,000 ha of well-drained, relatively undisturbed *terra firme* forest not subject to seasonal flooding (Ribeiro *et al.* 1999). Canopy is *c.*30–37 m high, with scattered emergents reaching 40–45 m, and the understorey is dominated by palms (Ribeiro *et al.* 1999). The rainy season typically extends from November to May, with a dry season in June–October (Marques Filho *et al.* 1981). Some 409 species of birds have been reported from the region north of Manaus (Cohn-Haft *et al.* 1997, Rutt *et al.* 2017), of which at least 289 have been recorded at RFAD (Willis 1977). On 5 September 2015, a singing Rufous Potoo was heard around 18.00 h from the main trail, *c.*400 m from the RFAD headquarters. After five song sequences, the bird was found perched in the top of a dead tree where it remained for 15 minutes. After four days, a bird was seen again on the same roost (Fig. 2), rocking characteristically back and forth like a dead leaf (Cohn-Haft 1999, Solano-Ugalde 2011, Costa *et al.* 2018). It was perched on a live but broken *Inga* sp. sapling, which we subsequently discovered was the nest (for measurements see Table 1).

We collected data at three nests during 2015–17. In 2015, observations were made weekly between 5 September and 9 November. In 2016, they were again made weekly, during 5 September–5 October. In 2017, the third nest was observed for only one week, 5–12 September. During our observations, we photographed and video-recorded the presence of an egg or chick, and adult behaviour, and recorded nest measurements (height

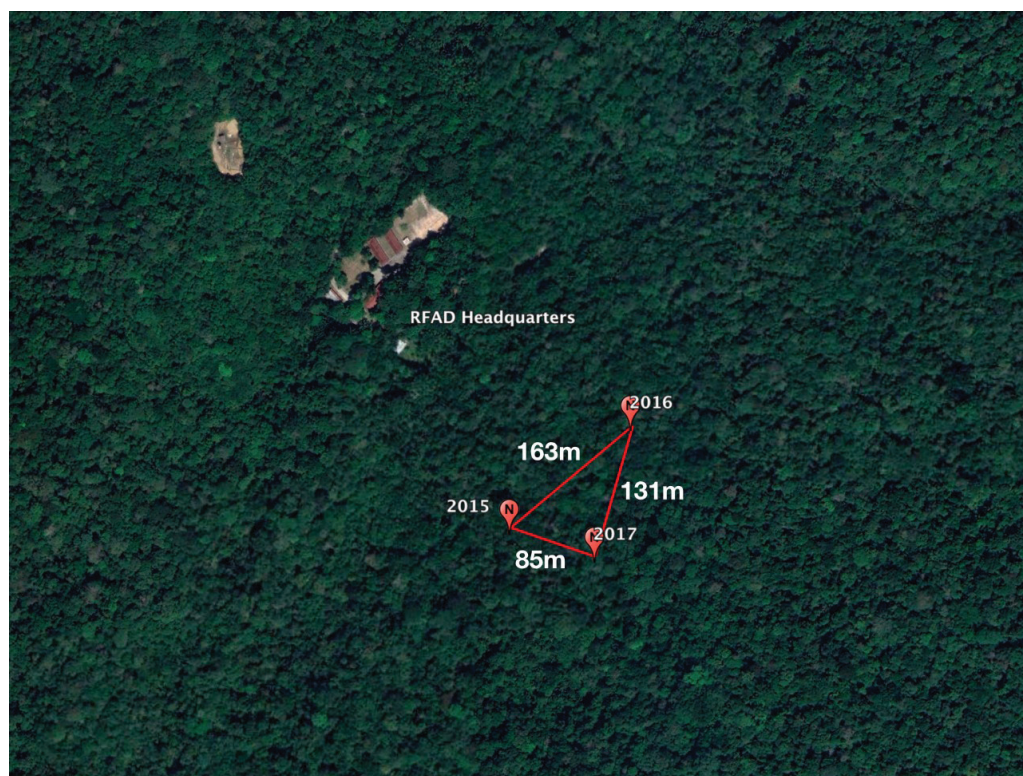


Figure 1. Map of the Reserva Florestal Adolpho Ducke, north of Manaus, Amazonas, Brazil, and the distances between the three nests.

TABLE 1
Measurements at two nests of Rufous Potoo *Nyctibius bracteatus* at the Reserva Florestal Adolpho Ducke, north of Manaus, in central Amazonian Brazil

Nest ^a	2015	2017
Height above ground	4.3 m	5.1 m
Diameter at breast height	not measured	37.3 mm
External diameter of nest	27.7 mm	33.8 mm
Internal diameter of nest	19.8 mm	28.2 mm
Depth of nest	23.1 mm	22.2 mm

^a The nest tree in 2016 was not studied in detail because it was damaged before it could be measured.



Figure 2. Adult Rufous Potoo *Nyctibius bracteatus* on the nest, Reserva Florestal Adolpho Ducke, north of Manaus, Amazonas, Brazil, 2015 (Marcelo Henrique Mello Barreiros)

above ground, diameter at breast height, depth, internal and external diameter). On each visit, we recorded the presence of an egg or chick, and the adult’s movements. Photos and videos were made using a Canon 5D MK III digital camera and a 300 mm-lens. At the 2016 nest, we measured the egg and took a blood sample (50 µl from brachial venipuncture stored in 95% ethanol in 1-ml microtubes) from the adult incubating by day to determine its sex. Additionally, we installed a camera trap (Bushnell HD) c.2 m from the nest, which monitored activity at the site over 240 hours during both day and night.

Results

Interestingly, we found potoos nesting in the same general area during all three years of the study, 85–163 m apart from each other (Fig. 1). At all three nests, a single egg was incubated by one adult, while the other adult remained nearby, once being observed flying over the nest and the incubating adult. We visited the roost site in 2015 several times, and



Figure 3. Nestling Rufous Potoo *Nyctibius bracteatus* observed alone on the nest for the first time, Reserva Florestal Adolpho Ducke, north of Manaus, Amazonas, Brazil, 2015 (Marcelo Henrique Mello Barreiros)

on 28 September we confirmed the presence of a nest. The adult was rocking frequently, and we noticed dishevelled feathers on its belly. After two hours, the chick emerged from below the adult. After confirming the presence of the chick, we continued to document its growth and changes in appearance. Both the adult and chick made rocking motions, apparently more frequently when the wind blew in the understorey, time when they often used to stretch their wings. The adult also rocked when a group of monkeys (Brown Capuchin *Sapajus apella*) passed over the nest and when an understorey mixed-species flock came close. Similar behaviour was observed by Vinuesa-Hidalgo *et al.* (2019) in Ecuador, with the bird adopting an alarm posture (slow rocking motion) when approached too closely. On 19 October the chick was alone on the nest for the first time (Fig. 3). We continued to monitor the nest until 9 November, when the chick was first observed away from the nest tree (Table 2).

Almost a year later, on 6 September 2016, MB, Bret Whitney and Pepe Rojas found another nest c.160 m from that in 2015. It was again atop a dead tree, 4.05 m tall. After several visits, we confirmed that the egg had not hatched, so used a ladder to scale the tree, carefully removed the adult from the nest and measured the egg that was placed in a shallow depression. The egg was pale beige with medium and dark brown blotches, mainly at the blunt end. It measured 26.77×19.56 mm, mass 5.3 g (Fig. 4). The images collected by the camera trap showed that on 5 October the nestling was predated by an ant swarm (ML 369270341), after which the adult was no longer seen in the vicinity. The blood sample we took from the adult incubating during the day determined that it was a male.

The next year, at 18.07 h on 5 September 2017, MB & Bret Whitney, with colleagues from Instituto Nacional de Pesquisas da Amazônia, Manaus, heard a *N. bracteatus* singing in the same area and found an adult perched on a broken branch of a different live tree (Fig. 5). This nest differed from the others in that it was on a very slightly angled branch, not an

TABLE 2

Adult and chick behaviour and plumage development at the nest in 2015, from the first days after hatching until the day the young left the nest.

Date	Behaviour	Chick appearance
28/9/2015	Nestling observed for first time; adult perched nearby.	Basically pale beige.
29/9/2015	Adult and nestling on nest. Nestling more active and visible (head protruding from adult's belly)	Basically white.
9/10/2015	Nestling partially visible. Both birds observed making the rocking motion. Adult alert while chick constantly scratched and defecated.	Pale; no feathers on face; wings and tail rachis developing. First feathers light brown with dark brown tips.
14/10/2015	Adult and nestling observed stretching their wings and performing rocking movements.	Face and body with mid-brown feathers and more dark brown tips noted. Medium brown primaries also had dark tips.
16/10/2015	Adult facing differently and chick more obvious. This was the last time we saw the adult brooding the fledgling by day.	Darker, especially on the back. Both wings and tail longer. All feather tips darker, almost black.
19/10/2015	Nestling observed alone on nest for first time. One adult was seen perched on a horizontal branch c.20m away.	Longer contour feathers with darker tips noted. Difference between darker back and paler belly easily visible. The pointed feathers over the eyes, evident on adults, now present. Iris brighter than a few days earlier.
25/10/2015	Chick notably larger and performing a rocking motion. No adults seen.	Rufous coloration, predominant in adults, starting to be evident, especially on wing and tail feathers. First white spots on back and wings now visible.
1/11/2015	An adult fed the young at dusk a few times, remaining less than a minute at the nest.	Rufous colour, especially on primaries and tail, more evident. Smaller black spots on feather tips and more white feathers with black tips visible. Some bars on tail.
7/11/2015	The last day when the chick was observed at the nest.	Rufous tail feathers much longer and barred. Also, wings longer, and secondaries had some narrow bars. Body feathers in general darker and uniform, with some brighter brown feathers on belly.
9/11/2015	Fledgling seen away from nest, perched on a branch c.3 m from the nest and lower than it.	Very long and heavily barred tail feathers, more rufous on back and head. Primaries light brown and secondaries rufous with black tips.



Figure 4. Egg of Rufous Potoo *Nyctibius bracteatus*, Reserva Florestal Adolpho Ducke, north of Manaus, Amazonas, Brazil, 2016 (Gabriel Augusto Leite)



Figure 5. Adult Rufous Potoo *Nyctibius bracteatus* on the nest, Reserva Florestal Adolpho Ducke, north of Manaus, Amazonas, Brazil, 2017 (Marcelo Henrique Mello Barreiros)

absolutely vertical stump. The next day we found a small chick, but on our next visit on 11 September, we found the chick dead surrounded by ants, and the adult gone.

Discussion

The breeding biology of Common Potoo *Nyctibius griseus* has been well documented (e.g., Mendonça *et al.* 2009, Cestari *et al.* 2011), however, the other species are poorly known. The eggs of *N. griseus* are white in general with brown and lilac spots (Goeldi 1896, Lopes & Anjos 2005, Mendonça *et al.* 2009, Cestari *et al.* 2011) similar to those of Great Potoo *N. grandis* (Cohn-Haft 1997). Eggs of *N. jamaicensis* are described as white with grey-brown and purplish blotches at the large end (Holyoak 2001). Those of Long-tailed Potoo *N. aethereus*, White-winged Potoo *N. leucopterus* and *N. maculosus* are all undescribed. In this study, we found a single egg, pale beige with medium and dark brown blotches, concentrated at the blunt end, which matches the description provided by Cohn-Haft (1989), a photograph in Suriname (<https://twitter.com/MarcHoogeslag/status/1464201735560384512>) and a video of the young at the same nest in Suriname (<https://www.youtube.com/watch?v=FvijvfaTalc>). Mean nest height was 4.48 m, which is higher than the nests described by Ingels *et al.* (2008) in French Guiana (2.25 m) and Vinueza-Hidalgo (2019) in Ecuador (2.8–3.0 m), but lower than the average for all other species of potoos, whose nests are typically sited 1.25–34.0 m higher (Cohn-Haft 1989, Lopes & Anjos 2005, Ingels *et al.* 2008, Cestari *et al.* 2011).

The first report of a *N. bracteatus* nest was in September 1981, also north of Manaus (Cohn-Haft 1989), in the same month, suggesting that in this part of Amazonia the species consistently breeds in September. The nests reported in French Guiana were from October 1999, during the dry season, and January 2006, at the start of the rainy season (Ingels *et al.* 2008), whilst in Ecuador a nest was found in August, in the dry season (Vinueza-Hidalgo

et al. 2019). In Ecuador, both the adult and young remained at the same roost for *c.*20 days (Vinueza-Hidalgo *et al.* 2019), a similar period to that we observed, as the adult was no longer present on the same branch during the day when the young was *c.*21 days old. Data on *N. griseus* suggest adults stay with the fledging for *c.*25 days after hatching (Cestari *et al.* 2011, Sazima 2011). If we consider the entire period from hatching to the young fledging, the Ecuadorian study evidenced a period of *c.*54–56 days (Vinueza-Hidalgo *et al.* 2019). Ingels *et al.* (2008) suggested that *N. bracteatus* has a fledging period of *c.*2 months, like other potoos for which data are available; however, in our study the young was observed on a different branch when it was just *c.*40 days old. The adult we caught at dusk was sexed as a male; Cohn-Haft (1989) also found that individuals at nests during daytime were males.

Of the three nests we studied, only one was successful—the other two failed due to ant predation. Indeed, predation is the primary source of nestling mortality (Martin 1995, Robinson *et al.* 2000), but data on the role of ant swarms in these losses is scarce in the literature. There are many observations of ant swarms preying on nests, for example: nests of hummingbirds (Sick 1997), and a nest of Chestnut-bellied Euphonia *Euphonia pectoralis* in the Atlantic Forest (Pizo 2000). Such predation at a nest of *N. bracteatus* is unprecedented for the genus and, although the species is not considered threatened, it is uncommon throughout its distribution (Cohn-Haft & Kirwan 2020).

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