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SHORT-COMMUNICATION

Breeding observations on Buff-bellied Puffbird *Notharchus swainsoni* (Piciformes: Bucconidae) at Rancho Laguna Blanca, San Pedro Department, Paraguay

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ABSTRACT: Aside from evidence of the Buff-bellied Puffbird *Notharchus swainsoni* nesting in arboreal termitaria, no breeding data is available. Here we present 100 days of observation of an active nest of the species in eastern Paraguay. The nest was active from late September to early December, and the two clutches observed were of three and four white eggs. After the first clutch failed a second one was laid. The incubation period was between 14–21 days and the fledgling period 30 days. The nest structure was cavity/with-inclined-tunnel/simple/unlined. Parent birds fed the chicks an insectivorous diet and fiercely defended the nest. This is the first detailed breeding data published for the species.

KEY-WORDS: behaviour, breeding season, eggs, re-nesting, reproduction.

The Bucconidae or puffbirds are a Neotropical family distributed from Mexico to Argentina, comprising 36 species in 10 genera (Clements *et al.* 2016). The breeding habits of the family are poorly known, though most species are monogamous, territorial, and cavity or hole nesters (Rasmussen & Collar 2002). The genus *Notharchus* consists of five large, distinctive, mainly black-and-white plumaged species that are typical of forest and forest edge habitats. Little has been reported about breeding habits in this genus, but all known species are generally, though not obligate, cavity nesters in arboreal termitaria (Skutch 1948, Sick 1993, Rasmussen & Collar 2002, Mazzoni *et al.* 2013, Vasconcelos *et al.* 2015).

Four species of puffbird occur in Paraguay, including the Atlantic Forest endemic Buff-bellied Puffbird *Notharchus swainsoni* (Gray, 1846) (Guyra Paraguay 2004), which is distributed from southern Bahia to Santa Catarina in Brazil, and inland to eastern Paraguay and Misiones Province in extreme northeastern Argentina (Alvarenga *et al.* 2002). In Paraguay, it is an uncommon inhabitant of humid forests and their interface with Cerrado, east of the Rio Paraguay (Guyra Paraguay 2005). The distribution approximates to the area once covered by the Upper Paraná Atlantic Forest (Guyra Paraguay 2005).

The breeding behaviour of Bucconids has attracted little attention from researchers. Like other members of the genus, Buff-bellied Puffbird have been observed to excavate nests in arboreal termitaria, but no further data on breeding in the species is available (Rasmussen & Collar 2002). Here we provide the first breeding data for this species from an area of interface between Atlantic Forest and Cerrado at Rancho Laguna Blanca, San Pedro Department, eastern Paraguay, based on observations of a breeding pair from September to December 2015.

Rancho Laguna Blanca (23°48'43.6''S; 56°17'41.3''W; 200 m above sea level) in northern eastern Paraguay (Fig. 1) is an 804 ha private property consisting of over 400 ha of near pristine Cerrado, a patch of degraded Atlantic Forest and areas of transitional semideciduous, semihumid gallery forest. The four main Cerrado ecotopes are present and grow on a predominately sandy substrate (Eiten 1972, 1978). The study area is based around an eponymously-named freshwater lake of 157 ha, which is possibly the only geologically true lake in Paraguay (Guyra Paraguay 2008). The property was designated as a *Reserva Natural* in 2010 for a period of five years, but this official protected status ended in January 2015.

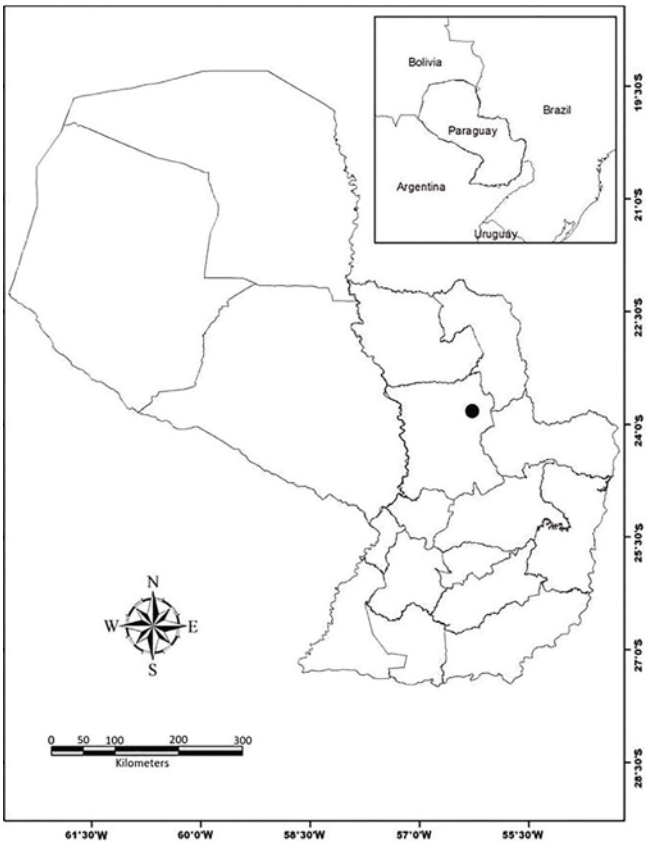

Figure 1. Location of Rancho Laguna Blanca, San Pedro Department, eastern Paraguay.

Nest building

The observation period was from 20 September to 22 December 2015 (method *ad libitum*, Altmann 1974). Observations began when tapping and scraping noises indicative of construction were audible from within the nest, these continuing throughout the following five days. The nest was in an active arboreal *Nasutitermes* sp. (Blattodea, Termitidae) termitarium situated in a *Copaifera langsdorfiii* tree (Fabacaeae) (Fig. 2A). It was positioned in a fork created by the trunk splitting into two main branches of 93 and 66 cm girths. The entrance tunnel was at a height of 3.9 m above ground. The maximum exterior dimensions of the termitarium were 53 cm high, 32 cm between supporting branches and 51 cm between entrance and rearmost surface. The nest type can be classified as cavity/with-inclined-tunnel/simple/unlined (*sensu* Simon & Pacheco 2005).

Due to only minor differences in plumage between the adults, sexual identification was not attempted, although both birds were seen frequenting the termitarium and transporting small fragments of it away from the nest. During construction, termites could be observed within the nest cavity due to disruption of the structure by the birds. Repair work by the insects later maintained a nesting chamber separate from areas of insect activity.

Eggs, incubation and nest period

To avoid disturbance during the early stages of nesting, the cavity was not examined until 4 October. The narrow, approximately circular entrance tunnel was used for inspection of the nest chamber, using a mirror attached to a piece of strong wire. One egg was present at this stage and a second was observed at a nest inspection four days later (8 October). The two ovular eggs were both brilliant white in colouration. Egg biometrics could not be obtained as the eggs could not be safely removed from the cavity without damage.

Both eggs were found broken (either predated or evicted) at the base of the nest tree on the morning of 14 October. An examination of the nest chamber at this time revealed another egg inside the nest that had not been present during a nest examination two days earlier. However, this third egg was also found broken 3.6 m from the base of the tree on 23 October. No eggs were

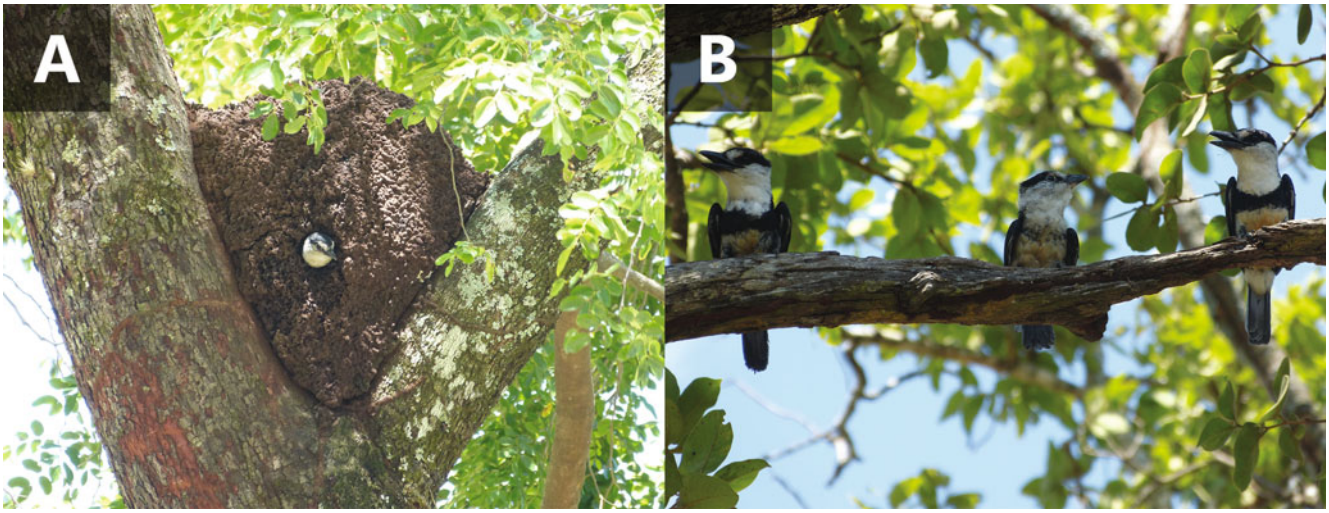

Figure 2. *Notharchus swainsoni* chick at nest entrance on 22 December 2015 (**A**). Author: A. Matthews. Fledgling *Notharchus swainsoni* (center) with parents on 18 December 2015 showing ontogenetic differences such as beak proportions, lack of clear breast band, pale orbital ring, and shorter tail (**B**). Photos: A. Matthews.

observed in the nest chamber between this point and 28 October, though the adults were frequently seen to visit the nest. However, four new eggs were found during a nest inspection on 4 November.

A hatchling was observed on 18 November, indicating an incubation period of somewhere between 14–21 days (based on minimum and maximum estimates). A second hatchling was recorded on 20 November, and a third on 22 November, suggesting approximately two day intervals between hatching dates. A fourth egg either failed to hatch or the chick was predated, as no remains were found during nest inspection after fledging.

A gaping nestling approached the nest entrance on 27 November. At this point adults were becoming increasingly aggressive towards observers. The adult birds perched on branches close to the nest and swooped directly at the observer's head, principally during insertion of the mirror but also upon approach or retreat. On occasion, the birds would emit a short and inquisitive squawk whilst tilting their head before swooping from branches approximately 2 m from the nest. On two instances, the bird collided with the observer's head during one of these defensive manoeuvres and at this point nest examination was suspended to avoid undue stress.

Nestling vocalisations first became audible on 29 November and were recorded on 1 December. These vocalisations continued past the fledging stage and can be described as repetitive sequences of high-pitched squeaks, varying slightly in pitch and frequency (recording XC302843 at www.xeno-canto.org). Hourly monitoring periods were undertaken intermittently during the mid-developmental period to identify prey selection. The observed diet of the nestlings was entirely insectivorous, and the following insect orders were recorded (number of observations in parentheses): adult (2) and larval (6) Lepidoptera, Coleoptera (4), Hymenoptera, mostly Vespoidea (11), Odonata (3), Orthoptera - grasshoppers, katydids (2), Blattodea - cockroaches (2), Auchenorrhyncha, predominantly Cicadidae (11) and Mantodea (2). The frequency of larger prey items, particularly cicadas, increased during the final stages of development.

Adults captured arthropods primarily by foliage gleaning and sally-gleaning from a fixed perch. Birds detected stationary prey and captured them on the substrate, then returned either to a favoured perch or flew directly to the nest cavity to feed the nestlings. Favoured foraging perches were used repeatedly, although foraging was not always restricted to the proximity of the nest, as the adults would sometimes be absent from the area during the observation period. Neither adult fully entered the cavity to feed the nestlings during the later stages of nesting, instead clinging to the entrance and awaiting the approach of the nestlings.

Fledging

Fledging occurred on 18 December, giving a fledging period of between 26 and 30 days. The first fledgling flew directly from the nest entrance to a nearby branch where adults were perched. Similar begging vocalisations induced feeding by the adults. At this stage the diet consisted almost exclusively of cicadas (perhaps because of their abundance at this time of year). A second chick fledged four days later, on 22 December, leaving the termitarium when neither adult was present and flying directly towards the observer, enabling it to be captured by hand. The morphometrics of the chick, taken using a 30-cm ruler and 100-g Pesola© balance are as follows: mass = 74 g; Rtail = 53 mm; wing chord = 90 mm; tarsus length = 20 mm; culmen = 20 mm; bill gape to tip = 33 mm; bill nare to tip = 18 mm. The fate of the third chick is unknown as it was not observed to leave the nest, yet neither were any remains found during the later nest inspection.

Fledglings generally resembled the adults but differed in the clearly shorter bill and tail, the lack of a dark breast band, and presence of a clear white orbital ring. The bill lacked the obvious hooked tip of adults and had an indistinctly paler tip (Fig. 2B).

Nest structure

The termitarium was abandoned following fledging and was not used for roosting or refuge even during periods of bad weather. On 28 December, the nest was dissected to obtain internal measurements of the nest chamber and tunnel. The roughly hemispherical nest dimensions were collected using a 30-cm ruler, spirit level, and protractor for tunnel incline. Its dimensions were as follows: entrance tunnel diameter = 60 × 60 mm; upward incline of entrance tunnel = 50°; length of entrance tunnel = 160 mm; distance from entrance to rear of chamber = 320 mm; length of nest chamber = 160 mm; width of nest chamber = 240 mm; height of nest chamber (range) = 60–110 mm. The interior of the nest chamber contained a large quantity of faecal matter. Arthropod remains were limited to small fragments of chitin from Coleopteran elytra; a fragment of a cicada head; three unidentified pupae that were unlikely to be related to diet and some termites that fell into the chamber during dissection of the nest.

Due to the habit of nesting in conspicuous arboreal termitaria, nests of this species are not infrequently encountered in Paraguay, but detailed nest descriptions have never been provided and no accompanying breeding data exists. Previous Paraguayan nests have been reported during September and October at heights of between 3.5 m and 12 m (Brooks *et al.* 1993, de la Peña 2010), but no further information is available.

Excavation of this nest was already underway in late September, later than the only previous reported data for Paraguay where excavation was reported to occur during July and August (de la Peña 2010). Rasmussen & Collar (2002) note that breeding takes place during September and October, but do not provide a locality for the data. However, the nest reported here was active for a much longer period, with the first brood corresponding to this season, but the resultant re-nesting following the loss of the first clutch extending the dates by several months. This suggests that, at least in Paraguay, the breeding season may be much less restricted.

Skutch (1948) observed a 10-day interval between nest completion and egg laying in Black-breasted Puffbirds *Notharchus pectoralis* (Gray, 1846) and the species was noted to lay three eggs at two day intervals in Panama, this being consistent with our observations. The only other species for which clutch size has been published in this genus is Pied Puffbird *N. tectus* (Boddaert, 1783) which is reported to lay two eggs (Rasmussen & Collar 2002). Consequently the clutch of 3 and 4 eggs reported here is apparently larger than that reported for other species, though caution is needed before drawing any firm conclusions because of the limited data available. Anecdotal data suggests that a large nest volume and the presence of a healthy termite population are important selection criteria for nesting birds (Brightsmith 2004). The presence of the insects is an undoubted advantage due to their constant nest maintenance which preserves the structural integrity of the nest chamber (Brightsmith 2004, Mazzoni *et al.* 2013). The ecological role of termitarium cavity nesting birds, particularly in secondary forest where large trees with natural cavities are rare, is an emerging area of study (Vasconcelos *et al.* 2015). The construction of such nests and their subsequent abandonment after use has been proven to provide secondary hollows for a diverse fauna of other cavity-nesting species including amongst many others owls, certain hirundines and psittacids, and even provides roosting opportunities for bats and small mammals (Sick 1993, Jullien & Cariveau 2001, Faria *et al.* 2006, Vasconcelos *et al.* 2015). The potential role of excavators such as puffbirds as keystone species in fragmented secondary forest environments is thus worthy of additional study.

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