

The Wilson Journal *of Ornithology*

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*Published by the
Wilson Ornithological Society*



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ABSTRACT.—Laughing Falcons (*Herpetotheres cachinnans*) are common, medium-sized falconids that occur throughout the Neotropical region and marginally in the Nearctic American continent. There is little data on their breeding biology with the only information available based on scattered records. Here, we report data on 11 nests of *H. cachinnans* from the Pantanal, Brazil, including four in nest-boxes, between 2007–2008. The breeding season occurred between July–December, which is in accordance with the few records for this region. Records of two eggs or nestlings were found in 28% ($n = 3$) of nests, while the remaining 72% ($n = 8$) had one egg or nestling. The eggs were rounded and buff with brown markings or dark brown or purplish

brown with darker markings. The hatchlings, even when a few days old, are pale buff overall in plumage with the distinctive black mask, typical of the adults. An undescribed vocalization of the nestling was recorded, which is similar to an uncommon vocal type emitted by the adults when disturbed. The study reveals novel data on the use of nest-boxes and on the breeding biology of the species, and reinforces the importance of such studies on its conservation. Received 26 July 2013. Accepted 30 November 2013.

Key words: breeding biology, cavity, Falconidae, *Herpetotheres*, nest-box, nesting.

Laughing Falcons (*Herpetotheres cachinnans*) are widespread falconids that occur in the Neotropical region and marginally in the Nearctic American continent. In Brazil they are encountered throughout the country, with a few scattered records in the extreme southern part of their distribution (White et al. 1994, Ferguson-Lees and Christie 2001). They are medium-sized falcons, weighing ~600 g (male) to 700 g (female), and are characterized by a white or pale buff plumage overall, brown wings, a tail with three or four buff bands, and a large head with a distinctive black mask extending from the eyes to the nape, traits that make the species unmistakable (White et al. 1994, Ferguson-Lees and Christie 2001, Parker et al. 2012). In spite of being widespread and considered common throughout most of their range, they can be considered rare and even in decline in some regions (White et al. 1994, Ferguson-Lees and Christie 2001), perhaps because of a decline of their specialized diet, composed primarily of snakes, venomous (e.g., *Micrurus* spp., *Crotalus durissus*) and non-venomous (Wetmore 1965, Ferguson-Lees and Christie 2001, DuVal et al. 2006, Specht et al. 2008), and/or because of reduced availability of cavities for nesting that may limit their success in areas with high human disturbance (Wetmore 1965).

The breeding season of this species may vary across its distribution, occurring in April in Mexico, February in Guatemala south to Costa Rica and January in northern Argentina (White et al. 1994). In Brazil, the breeding biology of the species is poorly known – one nest was reported with nestlings in September (Specht et al. 2008). The species nests in cavities or depressions, placed in somewhat exposed situations, either in an isolated tree or above the height of the surrounding vegetation (Parker et al. 2012). One or two eggs are laid, and the female does

all the incubating, though both parents take care of the nestlings. Nestlings leave the nest 50–59 days after hatching (Skutch 1999, Ferguson-Lees and Christie 2001, Parker et al. 2012).

The vocal repertoire of the species is composed by a variety of different songs and calls. In general, the species delivers mostly short nasal laughing calls and a full advertisement song consisting of a long, rhythmic, broadcasting series that can last >9 min when a pair is duetting (Ferguson-Lees and Christie 2001). Few data exist concerning vocalizations of juveniles or nestlings, but some calls are reported for nestlings from the second week after hatching (Parker et al. 2012).

Here, we present new data on the breeding biology of *Herpetotheres cachinnans* based on eleven nests from the southern Pantanal near Miranda, Brazil, and provide novel data on the use of nest-boxes by the species, as well as details on the eggs, nestlings, plumage of the juveniles, and an undescribed vocalization of nestlings.

METHODS

Study Area.—The data presented here were collected in the Pantanal region, at the Refúgio Ecológico Caiman (19° 51'–19° 58' S, 56° 17'–56° 24' W) and nearby localities, in the municipality of Miranda, State of Mato Grosso do Sul, Brazil (Fig. 1). The region is located in the Cerrado domain (Ab'Saber 2003), and represents a mosaic of habitats which includes different vegetation types, such as *Cerrado stricto sensu* (savanna woodland, with trees reaching up to 7 m high), gallery-forests, grasslands, open areas, and the typical *Capões* or *Cordilheiras*, which consist of large woodlots of tall *Cerrado* forest, situated close to aquatic habitats such as saline lakes and freshwater lagoons (Eiten 1991, Harris et al. 2005).

Data Collection.—The data presented here were collected under the auspices of the Hyacinth Macaw Project, which has been monitoring nests of Hyacinth Macaw (*Anodorhynchus hyacinthinus*) in the Pantanal region, mainly in the state of Mato Grosso do Sul, since 1990 (Guedes 2004a). One aspect of the project has been to provide artificial nests for the Hyacinth Macaws, in order to mitigate a possible shortage of natural nest cavities for the species. In addition to *A. hyacinthinus*, these artificial nests have been used by 17 bird species, including *H. cachinnans* (Guedes 2004b). The wooden nest-boxes are rectangular in structure and measure 40 × 50 × 60 cm, with a circular entrance 15 cm wide. The



FIG. 1. Map depicting the region of the Brazilian Pantanal, on the border Brazil-Bolivia-Paraguay. Star represents the study area where the nests of Laughing Falcons were monitored, in the Pantanal, Mato Grosso do Sul, Brazil.

floor of the nest-boxes are covered with wood-chips and installed in large trees (see Guedes 2008 for more details on the project and the artificial nests). Between 2007–2008, we monitored natural cavities previously known to be occupied by Hyacinth Macaws during the reproductive season, which occurs mostly between July–December. The nests were monitored on average once a month with observations made using binoculars and by climbing trees using ascending and rappelling techniques. The nests, eggs, nestlings, and juveniles were photographed with digital cameras SONY DSC-P73 and NIKON E4600. Vocalizations of a nestling were extracted from a video recording and corresponding spectrograms produced using Adobe Audition 3.0 and MS Photoshop. The recording is available at XenoCanto.org under the access number 126969.

RESULTS AND DISCUSSION

We found a total of 11 nests occupied by Laughing Falcons - seven natural cavities and four

artificial nests (information about each nest is depicted in Table 1; Fig. 2). All nests were found between early July–December and one of them was occupied in 2007 and 2008. This result is in accordance with a nest reported in southeastern Brazil, which was recorded between early September and late October (Specht et al. 2008).

All the Laughing Falcons' nests, both natural cavities and nest-boxes, reported here were also previously used by Hyacinth Macaws. The nests were in big trees surrounded by vegetation in the typical *capões* or *cordilheiras*, with one nest recorded on the border of a *cordilheira*, close to a pasture, in a nest-box installed on a Braúna tree (*Schinopsis brasiliensis*). Most of the natural cavities were found in Manduvi trees (*Sterculia apetala*, Fig. 2a), a species known to host more than 95% of the Hyacinth Macaws' nests (Guedes and Harper 1995). In the Pantanal, this tree grows in natural forest fragments, *cordilheiras* and *capões*, and in order to be able to provide a potential cavity nest, it needs to be older than

TABLE 1. Information about Laughing Falcons' nests, eggs, and nestlings found 2007–2008 in the Pantanal, Mato Grosso do Sul, Brazil. Id: nest identification; N: internal Id number of the Hyacinth Macaw Project; Type: NC = Natural cavity or AN = Artificial nest; T1: First time of monitoring; stage: egg (e), nestling (n), young (y) or egg depredated (†); T2: Second time of monitoring; LT: Last day of monitoring the nest.

Id	N	Type	T1	Stage	T2	Stage	LT	Stage	Observation
2007									
N1	355	NC	09 August	1e	12 September	†	–	–	Occupied by Hyacinth Macaw on 12 September
N2	211	NC	10 September	1e	05 October	In	30 October	1y	On 10 December the nest was empty
N3	237	NC	14 September	1e	27 September	1e	08 November	†	Occupied by Collared Forest-Falcon on 8 November
N4	2112	AN	27 October	1e	03 December	1e	13 December	In	–
N5	207	NC	05 November	1e	12 December	†	–	–	Nest empty on 12 December
N6	245	NC	September	1e	October	†	–	–	Precise day of T1 not known
2008									
N7	183	NC	28 August	0	03 November	In	13 November	–	On 28 August the adult was inside the nest
N8	366	NC	25 July	2e	16 September	2n	–	–	On 10 November the nestlings were gone and the nest was occupied by <i>Ramphtastos toco</i>
N9	2096	AN	04 September	2e	16 September	†	–	–	Precise day of the death not known
N10	2112	AN	03 September	1e	19 September	1e	14 October	In	On 30 November the nest was empty
N11	2139	AN	22 October	2e	10 November	2n	–	–	On 29 November the nest was empty



FIG. 2. Nests of Laughing Falcon (*Herpetotheres cachinnans*) in the Pantanal, Brazil. A – Natural nest (N8) active in 2007; B – Artificial nest occupied in 2007 (N4) and 2008 (N10).

60 years and reach a diameter at breast height of more than 70 cm (Santos et al. 2006).

From the 11 nests monitored, eight nests had one egg or nestling, while only three had two eggs or nestlings, totaling 14 eggs. The eggs were rounded and buff with brown markings, dark brown or purplish brown with darker markings (Fig. 3), and one egg studied weighed 60 g, measured 56.7 mm in length and 44.3 mm in width, much like what has been observed in others studies (Wolfe 1954, Skutch 1999, Specht et al. 2008). The color patterns of the eggs are slightly different from that reported by other authors, who mention them as being white with a great amount of medium-sized dark brown spots (Wolfe 1954, Specht et al. 2008). The dark purple coloration of some eggs observed is very similar to those of Collared Forest-Falcon (*Micrastur semitorquatus*) as reported in the literature and observed on other occasions at the study site (Barbosa et al. 2014). The clutch size varied from 1–2 eggs/nestlings, as already suggested in the literature (Wolfe 1954, Skutch 1999, Ferguson-Lees and Christie 2001), but in 72% of the nests ($n = 8$) only one egg or nestling was observed, as in some known studies (Skutch 1999, Miller et al. 2010). Many factors have been already mentioned as influencing clutch size in different

groups of birds, including latitude and prey availability, among others (Jetz et al. 2008). Based on our data, we can infer that latitude does not appear to influence clutch size in *H. cachinnans*, but other factors, such as prey availability or type, may have an effect.

From the 11 nests recorded, six were found in the breeding season of 2007 and five in 2008. One of the artificial nests (N 2112) found in 2007 was reoccupied by the species in the following year, possibly by the same pair. Among the 11 nests, roughly 45% ($n = 5$) were depredated while as eggs. The remaining nests consisted of four nests with one nestling each and two nests with two nestlings each.

On 7 August 2007, when monitoring nest N3 a couple of Laughing Falcons were observed defending the nest, which upon inspection was empty. Thirty-eight days later, on 14 September, only one adult individual was present and one egg was inside the nest. Thirteen days later, on 27 September, the egg was observed to be intact and an adult individual was present nearby the nest. However, 42 days later on 8 November, the egg was gone and an adult Collared Forest-Falcon had occupied the nest and laid two eggs. In the Pantanal, these species compete with each other for cavities and with other species, such as

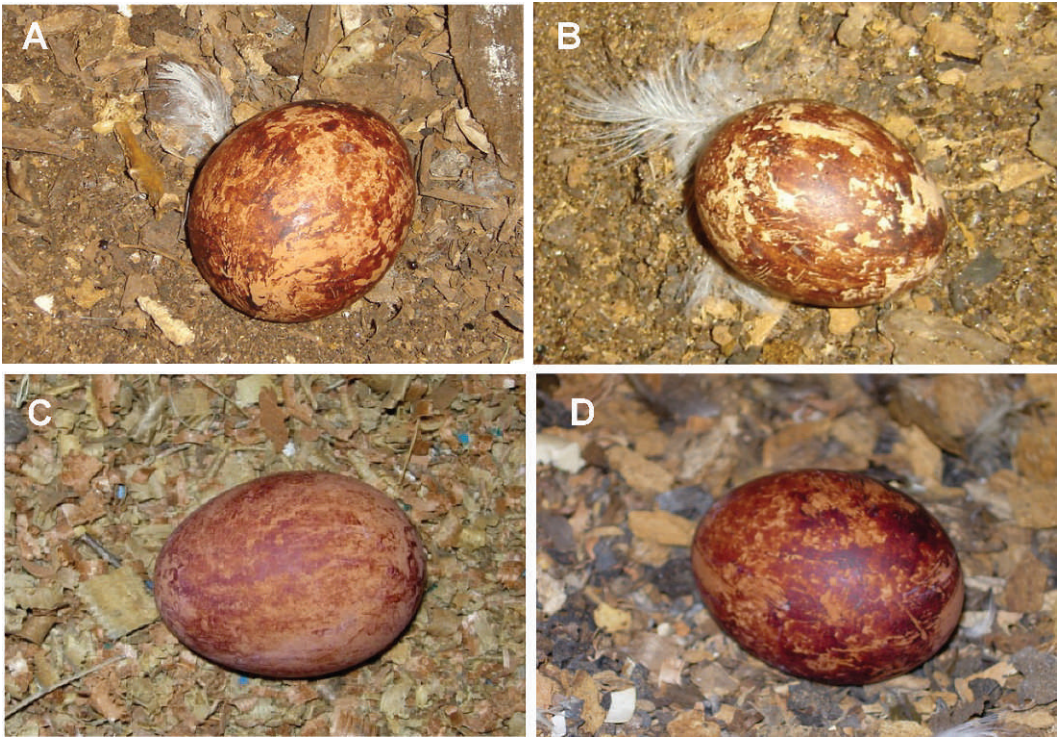


FIG. 3. Eggs of Laughing Falcon from nests recorded in 2007 in the Pantanal, state of Mato Grosso do Sul, Brazil, in different nests and months: A (N1) August; B (N3) September; C (N4) October; D (N5) November.

Hyacinth Macaws (Guedes 2004b, Barbosa et al. 2014).

The nestlings observed were very similar in plumage to each other, with the body and wings covered in pale buff plumes, and their distinctive black face masks already evident (Fig. 4A). In one of the nests monitored, a nestling ~1 month old was just a little larger and very similar to the first plumage observed, consisting of pale buff overall, but with brownish wing coverts and dark thin stripes in the head (Fig. 4C). We were not able to check that nest in the following weeks and in the last observations, roughly 1 month later, the young was not in the nest anymore and no adults were seen. We are unable to determine the fate of this nest, though it is plausible the nestling fledged.

Four of the eleven clutches were located in nest-boxes. In one of them (N4), we found an egg on 27 October 2007 with the parents close by and vocalizing actively (Fig. 3C). On 3 December, the egg was still there and the parents were present nearby. Ten days later, we recorded a nestling about 3–4 days old, which was photographed and

had its vocalization recorded. The calls recorded from this nestling may represent an undescribed vocalization of the species. The calls consisted of short phrases composed of 6–10 notes, lasting 1.5–2 secs, slightly descending in frequency and repeated randomly (Fig. 5). All the single notes varied from 0.5–1 kHz in frequency and 0.1 secs in time, except the first note which is more than two times longer and slightly higher in frequency than the rest. This vocalization is somewhat similar to that emitted by adults when under threat, as they felt on the occasions when we were present nearby their nests. It also consists of short phrases, lasting about 2 sec, composed by roughly 10 notes slightly descending in frequency and with the first note longer and higher in frequency than the remaining (KVCB, pers. obs.). In spite of the similarity between the vocalization of the nestling and the adult and that both are observed when the birds are under some threat, it is still unknown if they are delivered in the same behavioral context. A few other vocalizations have been reported for Laughing Falcon chicks, all of them coming from chicks 2 weeks old or older. Apparent food begging



FIG. 4. Nestlings of Laughing Falcon (*Herpetotheres cachinnans*) from natural nests in the Pantanal, Mato Grosso do Sul, Brazil. A and C: October 2007 (N2); B: July 2008 (N8).

calls, cackle calls during handling and a soft “wah” call were delivered by chicks from 15–40 days old (Parker et al. 2012). However, there is no mention in the literature of the vocalization type we report here, or from chicks of such an early age (3–4 days old).

From the seven natural nests, four were seemingly depredated (N1, N3, N5 and N6), as

the eggs disappeared without any sign or remains found. Thus, from the seven nests recorded, only three were successful. The fact that the species breeds only once a year and lays 1–2 eggs each time (White et al. 1994, Specht et al. 2008) and may compete for nest cavities also highlights the importance of the use of nest-boxes in the reproduction of the species.

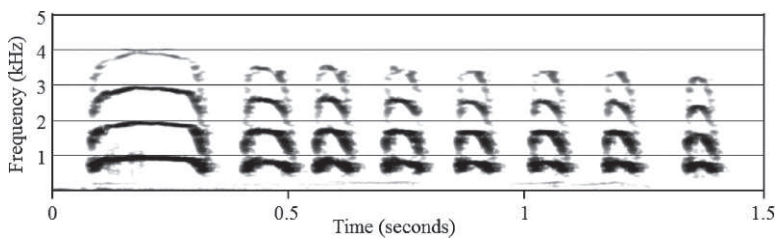


FIG. 5. Spectrogram of the vocalization delivered by the nestling of Laughing Falcons in the Pantanal, Brazil. The recording is available at Xeno-Canto.org under access number 126969.

The results presented here reveal new information on the breeding biology of Laughing Falcons, refining the proximal dates of the breeding season of the species in the Pantanal region, providing new descriptions of egg coloration, new information concerning the plumage of the young and a noteworthy, possibly undescribed vocalization of a nestling. From a conservation perspective, this study stresses the importance of monitoring nests of cavity-nesting birds, especially of those experiencing population declines.

Although reports exist of Laughing Falcons using nest-boxes for nesting (Guedes 2004b), this paper provides novel and detailed data on the breeding biology of the species and indicates that Laughing Falcons may successfully reproduce in such nests. Our data also reinforce the importance of large, natural cavities for the reproduction of many bird species and, furthermore, highlight the potential importance of artificial nests, such as nest-boxes, as a conservation tool in situations where there is a genuine shortage of available cavities for nesting.

ACKNOWLEDGMENTS

We are indebted to the Hyacinth Macaw Project partners, especially to Universidade Anhanguera Uniderp, Fundação Toyota do Brasil, Refúgio Ecológico Caiman, Parrots International and Bradesco Capitalização. We also thank all our collaborators for their support, particularly to C. C. Corrêa and E. R. Guedes for their valuable help during the fieldwork. We are also very grateful to R. Watson, M. B. Brown and two anonymous reviewers for their valuable suggestions and comments on the manuscript.

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