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ARTICLE

Black-collared Hawk *Busarellus nigricollis* in French Guiana: distribution, population size and breeding biology

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ABSTRACT: The Black-collared Hawk *Busarellus nigricollis* is widespread from southern Mexico throughout Central America and east of the Andes in South America. Although rather common in most of its distribution range, little is known about its breeding biology as nests are often built in inaccessible areas. The discovery in 2013 of four nests of this hawk in the coastal region of French Guiana, where it is found near brackish or fresh water in semi-open to open country, allowed us to increase our knowledge of its breeding behavior. The population is estimated at *c.* 200 pairs. Aerial displays of a breeding pair cover a large area around the nest tree. The nest is a large structure of sticks with a shallow cup lined with finer branches and a layer of twigs with leaves. It is mostly built at a height between 15 and 35 m, in the crown of an isolated tree or in a tree crown emerging above the surrounding vegetation. A single egg per nest is laid in French Guiana. The fledgling period for one nest was 55 days. Both male and female incubate and feed the nestling, although the female's share in both activities is more important. During the entire nesting period male and female add fresh twigs with leaves and to a lesser extent, fine dead branches to the nest.

KEY-WORDS: conservation, Neotropical raptor, reproduction biology, status.

INTRODUCTION

The Black-collared Hawk *Busarellus nigricollis* (Latham, 1790) is widespread from southern Mexico to northern Argentina and Uruguay, throughout Central America, northern Venezuela, the Guianas and Brazil, and east of the Andes in Colombia, Ecuador, Peru and Bolivia (Bierregaard-Jr. *et al.* 2016, GRIN 2015). It is a common resident of semi-open to open areas near brackish water (mangroves, tidal marshes) and near fresh water (wooded swamps, marshes, ricefields, dikes, ponds, pools), but also along forest-fringed creeks and rivers and on islands in rivers. It mostly occurs singly, or in pairs during the reproduction period (GRIN 2015). It mainly feeds on fish, but occasionally also on large aquatic insects, mollusks, crustaceans, toads, frogs, lizards, snakes, rodents, waterbird chicks and more rarely a juvenile caiman (Bierregaard-Jr. *et al.* 2016*)*. When watching for prey, it perches low in bushes or trees along or over water. Although widespread, its breeding biology is poorly known, maybe because it often breeds in extensive, inaccessible areas (mangroves, swampy savannas, tidal marshes) (Evangelista *et al*. 2012, GRIN 2015, Bierregaard-Jr. *et al*. 2016).

Breeding of *B. nigricollis* in French Guiana was first recorded by Tostain *et al*. (1992), reporting three observations of breeding behavior between 1984 and 1989: a pair with a juvenile (30 August 1984, marshes of Kaw, *c*. 04°29'N; 52°02'W), an occupied nest (1 July 1987, marshes of Malmanoury, *c.* 05°20'N; 52°47'W) and a displaying pair (30 April 1989, swampy savannas of Matiti, *c*. 05°07'N; 52°35'W). More recently, four breeding sites were recorded in the database Faune-Guyane (2015): the marshes of Panato (*c.* 05°45'N; 53°56'W), the marshes of Pripris de Yiyi (*c*. 05°27'N; 53°05'W), the swampy savannas of Matiti and the marshes of Leblond (*c.* 04°55'N; 52°20'W) (Figure 1). In this paper, we provide new information on the distribution, population size and breeding biology of Black-collared Hawk in French Guiana.

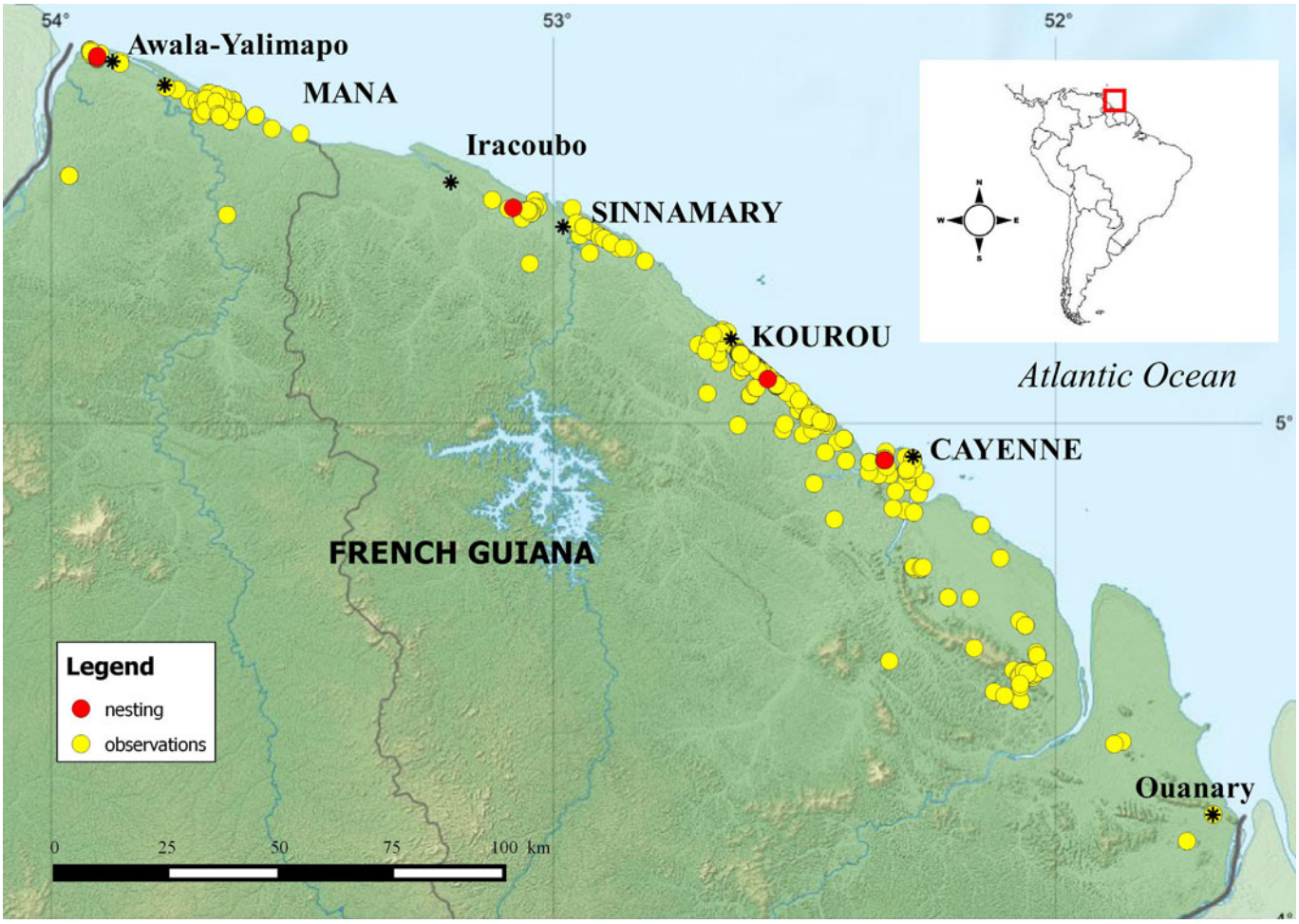

FIGURE 1. Map with distribution of Black-collared Hawk *Busarellus nigricollis* in French Guiana. Yellow dots: observations, red dots: nesting sites (from left to right): marshes of Panato, marshes of Pripris de Yiyi, swampy savannas of Matiti and marshes of Leblond. Nests 1, 2 and 3 were found near Kourou, and nest 4 near Cayenne. All records were obtained between 1984 and 2016.

METHODS

Distribution and population size

The GEPOG association (Groupe d'Étude et de Protection des Oiseaux en Guyane), involved in the study and conservation of French Guianan birds, has developped a citizen science tool, the database Faune-Guyane to report faunal observations by its members. The following data are noted for each observation: date, name of locality and its coordinates, number of individuals observed, behavior, and name of observer. Stored in this database are 815 observations of the Black-collared Hawk collected by birdwatchers and ornithologists between 1984 and 2016. These observations were used to describe its geographical distribution and to estimate the size of the population in French Guiana.

Breeding biology

The study of the behavior during the breeding season was conducted from January to October 2013 at four nests. The first study area was situated in the swampy savannas of Matiti, also called pastures of Guatemala, because of the local cattle breeding activities. More precisely, the area is situated between road D13 and the RN1 near Guatemala, a landing stage on the right bank of the Kourou River, opposite of the town of Kourou. A survey was carried out in 2010 in the area by the consulting office Biotope in order to estimate the impact of a future sand extraction project of 48 ha on the local avifauna. During that survey, two active nests of *B. nigricollis* were discovered on the site (nest 1 and nest 2, Figure 1). In January 2013, after the opening of the sand quarry, nest 1 was found on the ground, while nest 2 was still on the tree. The distance between both nests was *c.* 450 m. A third nest (nest 3) was found in March 2013 by workers, and was located close to the sand quarry, *c.* 850 m from nest 2 and *c.* 1300 m from nest 1. A second study area was situated in the marshes of Leblond, near the capital Cayenne. Between 1 May and 3 August 2013, an active nest (nest 4) was visited six times by Gil Jacotot to note the presence or the absence of the adults and later of the nestling. For all four nests, we noted: height, dimensions and the species of the tree whenever possible.

From January 2013 on, the behavior of the breeding

pair of *B. nigricollis* was studied at nests 2 and 4. Aerial displays, courtship behavior and general activities were regularly observed with binoculars. This first monitoring was conducted to note the period of egg-laying and the movements of the breeding pair.

Nesting activities were filmed at nest 2 only, using a Panasonic UW-R36 waterproof camera, a MPEG4 PV-1000 format ASF-60 GB digital recorder, a 32 GB HC Class 4 memory card and a 12 V battery. All equipment was installed above the nest during the absence of the breeding pair in order to minimize disturbance. Batteries and memory card were changed once a week. Video recordings were triggered by the movements of the adults (arrival, departure, feeding activities) or by grooming movements of both adults and nestling, and were automatically stopped after 30 sec. During the day, the video sequences were filmed in black-and-white or in color, depending on light conditions. At night, the camera automatically switched to infrared mode.

RESULTS

Distribution and population size

In French Guiana, *B. nigricollis* seems mainly restricted to the coastal region, with rare observations at man-made ponds near inland localities such as Régina (04°19'N; 52°08'W) and Cacao (04°33'N; 52°30'W). Along the coast, *B. nigricollis* were observed at 56 different sites between Awala-Yalimapo (05°44'N; 53°56'W) and Ouanary (04°13'N; 51°40'W) (Figure 1) (Tostain *et al*. 1992, Faune-Guyane 2015). Assuming that one pair is nesting at each site, the population of *B. nigricollis* in French Guiana is at least 50 pairs.

Breeding biology

The four nest sites were quite similar. The nests were located on large trees like a Courbaril *Hymenaea courbaril* (nest 2) and a leafless Ceiba *Ceiba pentandra* (nest 3). They were built in the fork of secondary branches at a height between 15 and 35 m. They can be described as a *c.* 50 cm thick structure of dead branches with a diameter of *c.* 80 cm, and a shallow cup lined with finer material.

As nest 1 was found on the ground in 2013 and no aerial displays or nest building activities were observed, the nesting site was considered abandoned. Yet, nests 2, 3 and 4 were active in 2013.

Collecting data: A camera was installed on 29 June 2013 above nest 2, because it was the most accessible nest. From 29 June to the fledging of the nestling on 30 August 2013, 2618 video sequences were recorded, 1361 during the day and 1257 at night. Among those 2618 video sequences, 286 were collected during the incubation period (113 day and 173 night sequences) and 2332 during the nestling period (1248 day and 1084 night sequences). During the nestling period, video sequences on 19 days, from 3 to 8 August and from 17 to 29 August, were not recorded due to battery issues. Little information was provided by nightly video sequences except for the presence and sex of the adult on the nest.

Pre-breeding behavior: According to our observations in 2013, the pair of Black-collared Hawks of nest 2 first arrived in the area of the nest tree in March. The sex of the adults was distinguished by slight differences in color pattern and the size difference, the female being an estimated 20% larger and heavier, and having less and lighter black shaft streaks on the back than the male (Figure 2).

FIGURE 2. Pair of Black-collared Hawks *Busarellus nigricollis* on nest 2 with one egg (arrow). The female (left) is larger than the male (right), and has less and lighter black shaft streaks on the back. Photo taken on 6 July 2013.

During visits on 16 January, 22 February, 1 and 13 March and 11 April, no *B. nigricollis* were seen in the nest tree. However, on 1 and 13 March, display flights in the nesting area by a pair of *B. nigricollis* were observed by VP. The adults were flying high up in the air, following each other closely in undulating flights and dives, often while screaming. In May, observations were made indicating the beginning of courtship behavior: the presence of an

adult on the nest, a copulation on 7 May (Michel Giraud-Audine, pers. comm.) and a display flight above the nest tree on 11 May. Similar observations were reported at nest 4 in the marshes of Leblond. A pair was observed there on 1 and 11 May 2013 by Gil Jacotot (pers. comm.).

Incubation period: When the camera was installed at nest 2 on 29 June, one egg was found in the nest (Figure 3). At night, the egg was incubated by the female only. In the morning, the female was relieved by the male between 06:51 h at the earliest and 11:24 h at the latest. Change-overs happened twice to four times a day, with the incubating adult flying off just before the arrival of the other adult. Thus the egg was never left alone for extended periods.

FIGURE 3. Nest 2 with one egg of Black-collared Hawk *Busarellus nigricollis*. The nest is neatly lined with leafy twigs. Photo taken on 29 June 2013.

During nine days of the incubation period, 40 video sequences were triggered by the male and 50 by the female. During these nine days, no nuptial feeding of the female was observed. On 7 July, 30 min before the egg hatched, the female brought a fish to the nest. This prey was partly consumed by the female and the leftovers were eaten by the male, after which he resumed incubation. The nestling hatched at 16:45 h while the male was incubating and with the female standing next to him on the nest. After the egg hatched, the adults ate the egg shells and left the nest, leaving the nestling unprotected. However, only ten minutes later, the female returned to the nest and started to brood the nestling. It was not fed the day it hatched.

Similar observations were reported for nest 4. On 1 and 10 May, a pair of *B. nigricollis* was seen standing on the nest. On 23 June, an adult was observed sitting on the nest and appeared to be incubating.

Nestling period: At nest 2, the nestling period lasted 55 days between hatching of the egg (7 July) and fledging of the nestling (30 August). Among the 609 video sequences recorded from 7 July to 30 August in the nestling period of nest 2, 59 were triggered by the male and 590 by the female. The video sequences triggered by the male were mostly associated with bringing food or leafed twigs and fine branches to the nest. During the entire nestling period, only the female was present on the nest at night. However, the male was probably sleeping in the nest tree. The nestling was never left alone at night, and until the age of 20 days (27 July), the female brooded it. Thereafter, she was still present on the nest but was usually sitting next to the nestling, preferably face to face with it. During hot sunny days, the female sometimes shaded the nestling, or the nestling itself moved into the shadow of the female. During rain showers, she stood close to the nestling or was even brooding it to protect it from the rain.

At nest 4 in the marshes of Leblond, the nestling was seen in the nest on 20 July and again seven days later. On 3 August the nest was empty and neither adults nor juvenile were seen in the nesting area.

Feeding of the nestling: A total of 156 feedings were recorded. Only four feedings were performed by the male, on the morning of 14 and 15 July when the nestling was respectively seven and eight days old. The other 152 feedings were performed by the female.

The nestling was fed by the female for the first time on 8 July at 09:31 h, 12 h after hatching. However at 06:34 h, 3 h earlier, the male had already arrived at the nest with a fish. He ate a few pieces, then the female grabbed the remains and left the nest, followed by the male, without the nestling being fed.

Prey was brought to the nest at any time of the day, with the earliest feeding at 06:22 h on 9 July and the latest at 18:54 h on 22 July. Generally, the number of bits of prey given during a feeding session was less than 10, with an exception of 50 small pieces of a very large fish given in 14 min on 20 July when the nestling was 13 days old. The nestling was never seen to butcher prey itself.

A total of 96 prey items were brought to the nest during the 36 days of the nestling period that the camera was functional. The male brought 26 items and the female 70. Fish of the families Cichlidae, Callichthyidae (*Hoplosternum littorale*, local name: Atipa) and Erythrinidae (*Erythrinus erythrinus*, local name: Coulan), and *Hoplias malabaricus*, local name: Patagaï) represented 68 items. Four items were large tadpoles of the frog *Pseudis paradoxus*, one item a small snake and 23 items could not be identified.

Fledging: On 26 July, the nestling of nest 2 could stand on its feet without support of its wings. On 30 July, the nestling already flapped its wings to exercise its wing muscles. The black flight feathers, a few cm long, were already visible.

On 30 August, the last day that the nestling was in the nest, the female was feeding it from 12:06 to 12:17 h, with bits of fish. Thereafter, the nestling stood on the rim

of the nest and looked actively around. At 13:22 h, the nestling was perching on a branch at 1 m from the nest where it stayed for 38 min. It definitively left the nest at 14:00 h. The camera remained active for a few more days, however neither the fledgling nor the adults returned to the nest.

The nestling was born on 7 July and left the nest on 30 August, which makes a nestling period of 55 days. After fledging, two adult *B. nigricollis*, most probable the nesting pair, were seen in the nesting area with a juvenile on 23 September. Again on 5 October, an adult with a juvenile was seen. Thus, a juvenile seems to stay with the adults at least for two months after fledging.

Nest sanitation and maintenance: The female regularly removed prey remains from the nest, likely to avoid attracting flies. The nestling ejected its droppings sitting on the rim of the nest from 15 July on, when eight days old. From 25 July on, when 18 days old, the nestling moved cleverly around in the nest and it started to stand on the edge of the nest to eject its droppings.

During nine days of the incubation period, six fresh leafy boughs and one dead branch were recorded to be added to the nest, five by the female and two by the male. During 36 days of the nestling period, a total of 52 leafy boughs and dead branches were brought to the nest, 39 by the female and 13 by the male (Figure 3 & 4).

FIGURE 4. Female of Black-collared Hawk *Busarellus nigricollis* with nestling in nest 2 lined with leafy twigs. Photo taken on 12 July 2013.

Hazards for the nestling: On 7 July, the adults left the nest after the egg hatched, leaving the new born nestling unprotected. Immediately, a large blowfly (Calliphoridae) alighted on it, flying off, however, when the nestling made movements.

During four nights, a common vampire bat *Desmodus rotundus* was filmed while attacking the nestling. On 11 and 15 July when the nestling was respectively four and eight days old, the vampire was detected by the female which chased it with wing beats. On 13 and 15 August when the nestling was respectively 37 and 39 days old, the bat arrived without waking up the female and could bite the nestling. The first time, the nestling made movements so that the vampire flew off without feeding. The second time, however, the vampire could feed for 3 min before the nestling made movements so that the vampire flew off.

On 29 July at 15:00 h, the female with feathers ruffled, actively protected the nestling by holding her open wings over it, while screaming several times. She had probably detected a possible predator flying overhead.

Nesting season: At nest 2, display flights already started in March. The egg appeared to be laid in early June and the nestling fledged at the end of August. After fledging, the adults with the juvenile were seen in the nesting area for two more months, September and October. Thus, the nesting season seems to extend from March to October, from the arrival in the nesting area and first courtship activities until the last observations of the adults with the juvenile in the nesting area. At nest 4, the nestling fledged at the end of July.

DISCUSSION

Distribution

In French Guiana, the Black-collared Hawk is rather common in humid zones of the coastal region and absent from the forested interior (Faune-Guyane 2015) (Figure 1). In adjacent Suriname, it is common in the coastal region, uncommon in the northern savannas and rare in the forested interior (Ribot 2015).

At least 50 pairs breed in the coastal region of French Guiana. We suppose, however, that in vast favorable, but difficult to visit areas, such as the marshes of Panato near Awala-Yalimapo, the rice fields of Mana (*c.* 05°38'N; 53°40'W), the marshes of Pripris de Yiyi, the swampy savannas of Matiti, and the marshes of Kaw, up to 10 pairs may nest. As many parts of the available habitat are inaccessible, an estimated 100 pairs is a reasonable minimum, and the population may even reach as much as 200 pairs.

The population size of *B. nigricollis* in French Guiana is not known to have declined in recent years.

However, its restricted habitat is severely threatened by mining projects, by conversion into farmland or pastures, and by urbanization projects, resulting in reduced food availability and a loss of nesting sites. For these reasons, combined with the small population size, and although *B. nigricollis* is globally evaluated as "Least concern" (LC) by BirdLife International (2016), Claessens *et al*. (2016) propose to classify it as "Vulnerable" (VU) on at French Guiana, according to the IUCN red list criteria. They also estimated the population between 100 and 200 pairs, an estimate equal to, but independent from the one provided by Biotope (2014).

Breeding biology

Nests: As *B. nigricollis* is often nesting in inaccessible parts of mangroves, tidal marshes and swampy savannas, it is not surprising that until now only one nest in French Guiana (Tostain *et al*. 1992), six nests in Suriname (Haverschmidt & Mees 1994), six nests in Argentina (Di Giacomo 2005) and one nest in Brazil (Bertassoni *et al*. 2012) have been described in literature for South America. All these nests were rather large structures of sticks with a low cup lined with finer material, built in a fork of supporting branches (Figure 4), high up in the crown of an isolated tree in a clearing or in a tree crown rising above the surrounding vegetation. The height of six nests in the Chaco province of Argentine varied between 9 and 17 m (Di Giacomo 2005) and the height of a nest in the Brazilian Pantanal was *c.* 15 m (Bertassoni *et al*. 2012). In French Guiana, three nests were built at a height of *c*. 15 m, two others between 20 and 25 m, and one much higher at *c.* 35 m.

Nests seem to be re-used as proven by nest 2 which was used in 2010 and again in 2013. The re-use of old nests was not yet mentioned in literature (GRIN 2015, Bierregaard-Jr. *et al*. 2016). Given the small distance between nests 1 and 3 (1.3 km), nest 3 was probably constructed in 2013 by the breeding pair which used nest 1 in 2010.

Clutch size: In literature, clutch size of *B. nigricollis* is given as 1 or 2 eggs (GRIN 2015, Bierregaard-Jr. *et al*. 2016). Likewise the egg collection of the Western Foundation of Vertebrate Zoology houses two 2-egg clutches collected in Trinidad and Guyana respectively, and three 1-egg clutches collected in Paraguary (René Corado pers. comm.). Another clutch of two eggs was also collected in Guyana (Kreuger 1963). In Suriname, two nests contained one egg, and one nest one nestling (Haverschmidt & Mees 1994). In Argentina, three nests contained one egg and one nest one nestling (Di Giacomo 2005).

In this study, nest 2 contained one egg, nest 4 one nestling and two pairs were observed with one fledgling (Faune-Guyane 2015). However, one nestling, fledgling or juvenile accompanying a pair of adults does not mean a 1-egg clutch, as sibling competition leading to the death of the youngest nestling (cainism) is widespread among raptors (Newton 1979, Thiollay 1994, Ferguson-Lees & Christie 2001).

Incubation period: The website *Oiseaux d'Argentine* (Canalblog 2011) mentions that only the female of *B. nigricollis* incubates and that the incubation period is 35 to 40 days. It is unclear, however, on what reference(s) these statements are based on. Accipitridae of similar size as *B. nigricollis* such as the Zone-tailed Hawk *Buteo albonotatus* (Kaup, 1847) and the Common Black Hawk *Buteogallus anthracinus* (W. Deppe, 1830), have an incubation period of, respectively, 28 to 34, and 37 to 40 days (Ferguson-Lees & Christie 2001).

From our observations at nest 2, it is also clear that both female and male incubate, although the female's investment is more important. The male incubates for short periods during the day only. However, it is difficult to learn the real share of each adult because of the method used in this study. Indeed, activities like incubation lead to movements that are not sufficient to trigger the camera. Thus, missing video sequences make a quantitative analysis impossible.

Nestling period: The fledgling period for the nestling in nest 2 was 55 days. Our observations of a pair accompanied by a juvenile in the area of nest 2 after the nestling fledged, suggest that juveniles remain with adults for at least another two months. This period was estimated at two nests in Argentina to be between 59 and 66 days (Di Giacomo 2005).

Nest sanitation and maintenance: Nest sanitation is carried out by the female removing food remains from the nest, and from the age of eight days on, the nestling defecated outside the nest, behavior also described for other Accipitridae (Bierregaard-Jr. 1984). Both male and female of *B. nigricollis* add twigs with fresh leaves and, to a lesser extent, fine dead branches to the nest during the entire nesting period, more frequently during the nestling than during the incubation period. This unexplained behavior is rather common among medium-sized and large raptors (Newton 1979, Thiollay 1994).

Nesting season: In Suriname, Ribot (2015) mentions 17 nests with either one egg or a nestling, or two adults with a fledgling, one in May, three each in June, July and August, four in September, two in October and one in December. In Guyana, eggs were collected in April (GRIN 2015) and a clutch of incubated eggs in August (René Corado, pers. comm.). The nesting season seems to extend from March to October in French Guiana. Therefore, it seems that in French Guiana, Suriname and Guyana, where the monthly rainfall pattern is similar (CRU 2015), the breeding season of *B. nigricollis* starts in

the rainy season in the first half of the year. At most nests, however, nestlings, fledglings and juveniles, demanding a constant supply of food, are present during the drier months of the second half of the year. Di Giacomo (2005) also reports six active nests found in Argentina between mid-July and mid-November, which corresponds to the second half of the dry season in the Chaco province. In Paraguay where the dry season in the second half of the year is less pronounced, one clutch was collected in August and two in September (René Corado pers. comm.).

In the HBW Alive account of the Black-collared Hawk *B. nigricollis*, Bierregaard-Jr. *et al.* (2016) mention under "breeding": very poorly known. The study of four nests discovered in 2013 in the coastal region of French Guiana and especially the monitoring of the activities at one nest with a camera and a digital recorder, greatly add to the knowledge of the breeding biology of this hawk. At this monitored nest, we followed the activities of the male and female during the incubation period, and then the behavior of the male, female and nestling during the nestling period. Recordings also allowed us to identify prey items fed to the nestling, to witness sanitation and maintenance of the nest, and hazards for the nestling. Our observations are consistent with what is already known of the breeding behavior of the Black-collared Hawk.

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