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Nesting of the Fulvous-breasted Flatbill (*Rhynchocyclus fulvipectus*) in Southeastern Perú

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ABSTRACT.—The Fulvous-breasted Flatbill (*Rhynchocyclus fulvipectus*) has an Andean distribution from Colombia and Venezuela to northeastern Bolivia between 750 and 2,300 m elevation. We describe the nesting behavior, nest, eggs, and nestlings of this species in the buffer zone of Manu National Park at Cock of the Rock Field Station, Cusco, Peru, from August through December 2009. We monitored seven nests using data loggers to describe incubation patterns and conducted direct observations of provisioning behavior. The two-egg clutch size and pear-shaped nest structure were consistent with previous reports. Incubation lasted 24 days ($n = 1$) and nestlings were in the nest for at least 29 days. We only observed one parent incubating (presumably the female) with average nest attentiveness of 64%, which decreased as the incubation period progressed. The adult made 10 to 15 foraging trips per day ($n = 21$) during incubation, when it spent on average ($\pm$SD) 32.9 $\pm$ 2.8 min during incubation bouts and 23.1 $\pm$ 6.3 min during foraging bouts ($n = 3$ nests). Nestlings were able to regulate their body temperature after the feathers were fully developed; however, their body temperature (37° C) was lower compared to adults. We confirmed *Rhynchocyclus* nests exclusively along creeks or rivers and also revealed long incubation and nestling periods, which may be more common than expected in tropical mountain areas. There was a decrease in nest attentiveness through time, contradicting previous findings on neotropical passerine species. *Received 27 September 2010. Accepted 27 February 2011.*

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The genus *Rhynchocyclus* encompasses four species distributed from southern Mexico to northeastern Bolivia, eastern Venezuela, and

Brazil (Ridgely and Tudor 1994, Fitzpatrick et al. 2004). The genus *Rhynchocyclus* is in the Flatbill clade, which includes the genus *Tolmomyias* (Lanyon 1988, Tello and Bates 2007, Ohlson et al. 2008) as a sister taxon. The nests of both *Tolmomyias* and *Rynchocyclus* have been described as pear-shaped structures with a tubular side entrance in the base made with sticks, fibers, and dry leaves (Parker and Parker 1982, Hilty and Brown 1986, Fitzpatrick et al. 2004, Greeney et al. 2004, Brumfield and Maillard 2007).

The Fulvous-breasted Flatbill (*Rhynchocyclus fulvipectus*) is commonly found close to rivers and small creeks in secondary montane forest and shrubby edge vegetation between 750 and 2,300 m (Ridgely and Tudor 1994, Fitzpatrick et al. 2004, Schulenberg et al. 2007). It is known that clutch size varies from one to three eggs, which are white with reddish dots on the widest end (Sclater and Salvin 1879, Fitzpatrick et al. 2004, Greeney et al. 2004). The only information about the nestling period is from a nest found by Greeney et al. (2004) in Ecuador that had an incomplete incubation period of 18 days and a full length nestling period of 27 days. Despite the large distribution of this species in South America, it is uncommon throughout its range and its lethargic behavior may underlie the lack of nesting information for it (Hilty and Brown 1986). Detailed studies about the nesting biology of any species of the genus *Rhynchocyclus* are lacking (Fitzpatrick et al. 2004); our study was designed to provide the first complete description of the nesting biology of the Fulvous-breasted Flatbill.

METHODS

Study Area.—This study was conducted in the Kcosñipata Valley at Cock of the Rock Field Station in the buffer area of Manu National Park, Cusco, Perú (13° 0.39′ 19.40″ S, 71° 3.29′ 48.50″ W) from August through December 2009. The station is at 1,450 m in an Andean cloud forest with a canopy height of 25 m, average temperature of 18.3° C (min–max = 12.1 to 26.6° C), and average precipitation of 521 mm with a rainy season from November through April and a dry season from May through August.

Nest, Eggs, and Nestling Measurements.—We obtained measurements of the nests, eggs, and nestlings. We took internal and external measurements for five of seven nests, and described and weighed the different nest materials and layers. We measured the length, width, and mass of the eggs. We took daily morphological measurements of the nestlings that included wing and tarsus length, and body mass; we also made qualitative descriptions every other day. We measured nestling body temperature using a thermocouple (Onset Computer Corporation, Pocasset, MA, USA) that we inserted into the cloaca. Body temperatures were taken to estimate when nestlings were able to regulate their body temperatures (when they became endothermic). We measured body temperature as soon as we took each nestling from the nest after placing each nestling on a plastic lid for 3 min (to prevent variation in loss of body heat due to the ground being hot or cold). The thermocouple tip was cleaned with alcohol between measurements, and was coated with petroleum jelly to reduce stress created by insertion. We also conducted direct observations of provisioning for 1.5 hrs at one nest on 2 different days for a total of 3 hrs. All mass measurements had an accuracy of 0.05 g (FlipScale F2; My Weigh, Phoenix, AZ, USA) and measurements of length/width were taken with a caliper with an accuracy of 0.1 mm.

Incubation Patterns.—We monitored incubation behavior at three nests on different days for a total of 21 days using two thermal sensors. One of the sensors was placed under the eggs, providing incubation rhythm and nest microclimate information, and the second was attached to the external face of the nest wall, providing ambient temperature. Both sensors were connected to a U-12 HOBO data-logger (Onset Computer Corporation, Pocasset, MA, USA) programmed to record temperatures every minute.

Incubation Rhythm Analysis.—We quantified the length and number of temperature fluctuation events produced by foraging trips (cooling periods) and returning to the nest to incubate (warming periods), following Cooper and Miles (2005). This procedure allowed us to estimate nest temperature fluctuations, number and length of foraging and incubating trips, and percentage of time the adult was incubating the eggs (Londoño 2009).

RESULTS

We found seven nests of which six contained two eggs each and one had only one egg. Four nests were depredated and one nest was destroyed when the branch upon which it was built fell into the river. We found an empty nest on 20 October 2009 and 7 days later (27 Oct) the nest contained

one egg; the second egg was laid the following day. The first egg hatched on 19 November and the second the following day, for an incubation period of 24 days. The nestlings died 15 days after hatch as a result of a landslide that knocked down the nesting tree. The other nest with eggs that was studied successfully hatched on 15 November, and the nestling was still in the nest on 13 December when we left the station; thus, the nestling period was at least 29 days.

Nest and Eggs.—All nests were hanging and attached to the end of tree branches above small creeks. The nest was a dome structure with a side entrance opening towards the ground. Nests had extra nesting material above the dome, changing the general shape of the nest to resemble the shape of a pear.

Nests were composed of two layers. The external layer, which included extra material attached mainly to the upper part of the nest, weighed ($\bar{x}$ ± SD) 100.1 ± 38.7 g (n = 3) and was composed mainly of long bamboo (*Guadua* spp.) fibers (60%) as well as mosses, fern leaves, and dry roots with pieces of bark (40%). The inner layer weighed 26.5 ± 16.3 g (n = 3) and was mainly composed of dry bamboo leaves (95%) and fine white roots (5%).

The average (± SD) height of the nest above water was 2.1 ± 0.4 m (n = 7). The external measurements of the nest were 147.5 ± 55.8 mm × 156.9 ± 43.0 mm × 179.6 ± 6.7 mm (length, width, and height, respectively; n = 5). The nest entrance was 44.4 ± 10.8 × 39.0 ± 10.5 mm (length and width, respectively; n = 5), average nest thickness was 23.6 ± 5.5 mm, and distance from the entrance of the vertical tunnel to the roof was 81.5 mm (n = 1). The length of the cup was 122.5 ± 19.3 mm (n = 5) and cup depth was 49.8 ± 8.2 mm. The extra nest material above the dome nest measured 206.6 ± 89.7 mm in length × 94.1 ± 20.1 mm in width.

Most eggs were white with small reddish dots at the larger end, but the eggs were entirely white in two clutches. The eggs measured 24.4 ± 0.6 × 16.8 ± 0.5 mm (n = 13) and fresh weight was 3.5 ± 0.3 g (n = 6).

Incubation Patterns.—The average nest temperature was 34.4° C (22.1–41.7° C) when the female was on the nest, and decreased to 29.8° C (20.1–38.9° C) during foraging bouts. We observed daily incubation patterns for 21 days at three nests. Generally, the incubating birds made their first daily foraging trip a few minutes after sunrise (between 0515 and 0639 hrs) and returned to the nest for continuous night incubation between 1609 and 1825 hrs.

We only observed one parent incubating the eggs (presumably the female, based on the low nest attentiveness, <85%; Deeming 2002); it made on average 12.6 trips/day (min–max = 10–15 trips/day, n = 21). Incubation bouts at one nest lasted on average 33.6 min (5–82 min, n = 265) and foraging bouts averaged 22.4 min (9–104 min). The number of trips increased at the first nest through time from 11 to 13 trips/day during the first 5 days to 12–15 trips/day during the last 10 days. The average duration of incubation bouts was similar during the 16 days the nest was monitored (34.2 ± 4.7 min) with a small decrease during the last 3 days (28.3 ± 3.2 min). The average duration of foraging trips varied little during the 16 days, but longer trips (up to 74 min) were recorded during the last few days, especially during the last 3 days (Fig. 1A–C). The number of trips per day for the second nest during the last 3 days of the incubation period was 12, incubation bouts lasted on average 29.7 min (28–32 min), and foraging bouts lasted on average 29.9 min (11–104 min) (Fig. 1D). We observed 11.5 trips/day for the third nest with an average duration of incubation bouts of 34.7 (31–38 min) with foraging bouts lasting on average 17.6 min (10–30 min).

Average daily nest attentiveness was 64% and varied between 51 and 75% (n = 21). Nest attentiveness for the nest for which we had incubation data between days 7 and 22 of the incubation period was higher (66%; 65–68%) during the first 5 days and decreased during the last 10 days (63%; 57–67%). We documented low nest attentiveness for the second nest during the last 3 days of the incubation period: 55% (51–61%). The third nest had a nest attentiveness of 74–75% during 3 days before it was predated.

Nestlings.—The nestlings weighed 3.1 ± 0.4 g (n = 3) on day of hatch, the skin was pink-orange, the eyes were closed, and there was gray down on the back and wings. Pin feathers started to emerge from the skin 5 days after hatching and, 13 days after hatching, feathers started to emerge from the pins; feathers were yellow on the flanks and olive over the rest of the body. The feathers completely emerged by day 27, except around the bill and the tail feathers. Nestlings gained mass ($\bar{x}$ ± SD) at a rate of 1.5 ± 0.1 g/day (n = 3) during the first 17 days, reaching a mass of 30.45 g (Fig. 2A).

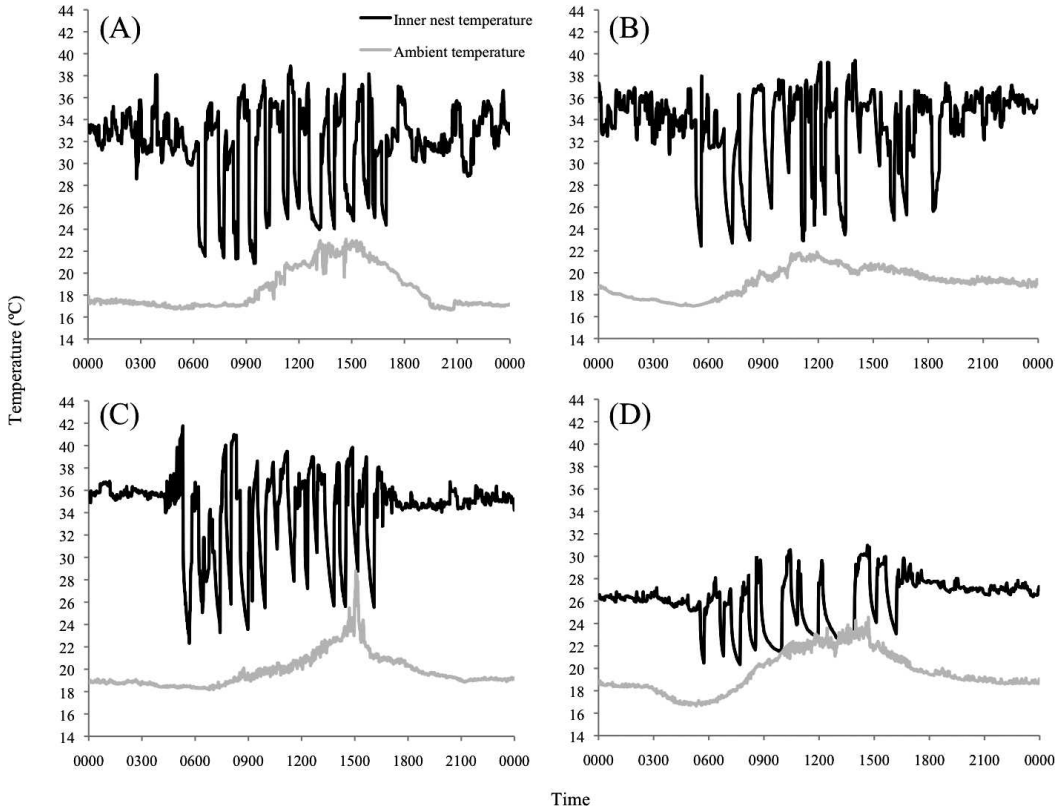

FIG. 1. Incubation patterns of the Fulvous-breasted Flatbill during 24 hrs and different days in two nests: (A) day 7, (B) day 12, and (C) day 24 of incubation of the first nest, and (D) last day of the incubation period of the second nest.

Nestling mass decreased to 27.85 g after day 17, where it remained until the last measurement (day 29), when the nestling was completely covered with feathers and active. Recently hatched nestlings (day 1) had a tarsus length of 8 mm and a wing length of 7 mm ($n = 3$), and grew at a rate of 0.7 and 2.9 mm/day, respectively, reaching a length of 22 and 64 mm on day 29.

The average body temperature of nestlings during the first 16 days was 31.6° C (27.88–33.63° C), and body temperature decreased 4.08° C in 3 min after nestlings were removed from the nest. The change in body temperature after day 17 was smaller (between 1 and 2° C) and, for the last 2 days (28 and 29), the nestling was able to regulate its body temperature at 37.34° C (Fig. 2B). We left the sensor in one nest after one of the eggs hatched, and quantified 29 trips/day, which is 14 trips higher than the maximum number during incubation. The presumed female had short incubation bouts (<7 min) and variable foraging bouts between 10 and 45 min after hatching of young.

We conducted direct provisioning observations at the first nest when the nestlings were 4 and 7 days age from 1645 to 1745 and 0837 to 0937 hrs, respectively. We only observed one parent visiting the nest per provisioning trip, but cannot be sure that only one parent fed the nestlings. The parent made four and three trips/hr, respectively, and stayed inside the nest for 5 min on average during each provisioning trip. We could not document the prey type brought by the parent to the nest or where the parent was foraging.

DISCUSSION

The eggs and nests in our study were similar to those previously reported for this species (Greeney et al. 2004, Brumfield and Maillard 2007). The incubation period was long compared to other neotropical passerine birds (Tieleman et al. 2004; Auer et al. 2007; Martin et al. 2007;

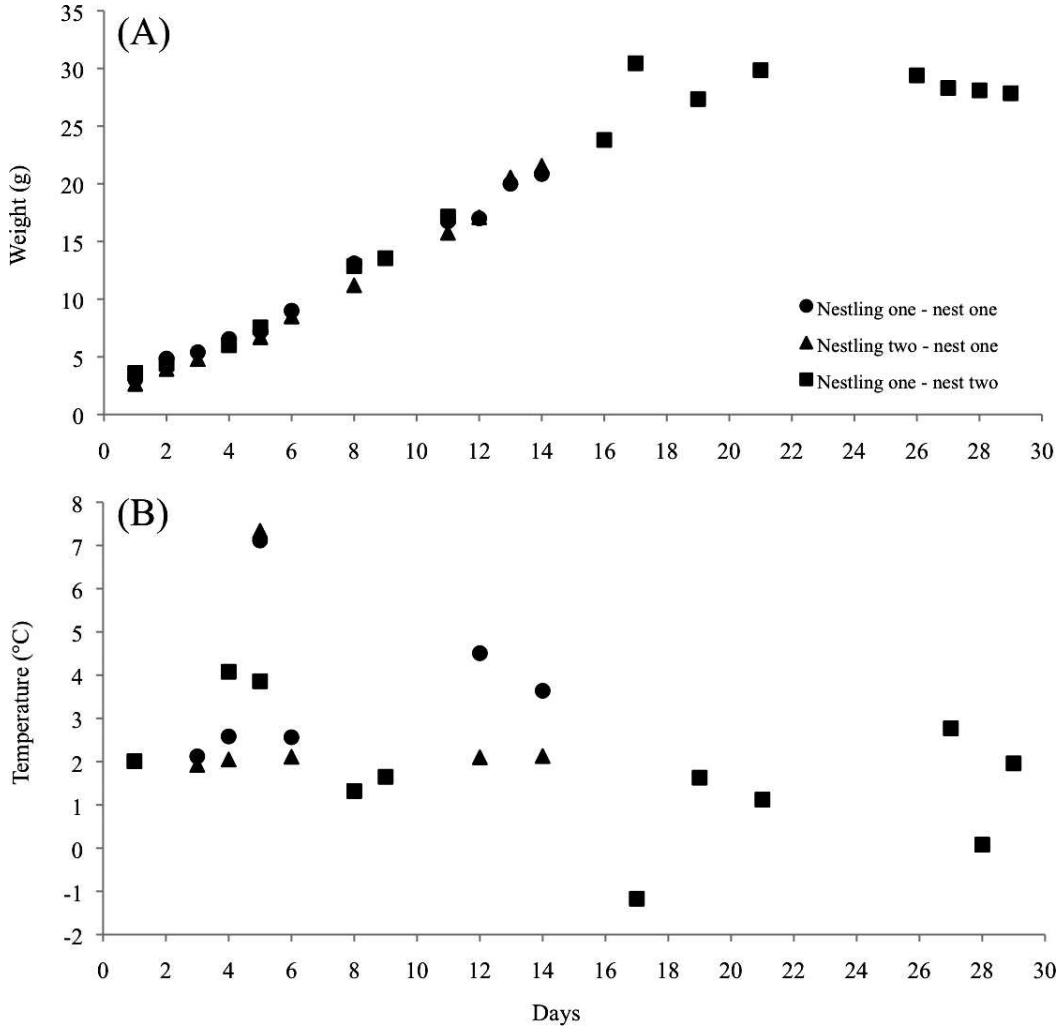

FIG. 2. Nestling development and body temperature in two nests of the Fulvous-breasted Flatbill. (A) Mass increment of three nestlings from two different nests. The circles and triangles correspond to two nestlings from the first nest and the square corresponds to the single nestling from the second nest. (B) Daily nestling temperature loss throughout the nestling period after exposing nestlings to environmental temperature for 3 min. Symbols are the same as in A.

GAL, unpubl. data), and 6 days longer than the partial period reported for this species by Greeney et al. (2004). The nestling period was also long but similar to the 27 days reported by Greeney et al. (2004). Nest location was also similar to previous studies: over small creeks inside the forest and attached to branches and epiphytes between 3 and 12 m high (Parker and Parker 1982, Greeney et al. 2004, Brumfield and Maillard 2007). Nest materials, location, and shape are similar among *Rhynchocyclus* species (Fitzpatrick et al. 2004); those described for the sister group (*Tolmomyias* spp.) were classified as a closed/retort/pensile structure with a vertical/downward tube (Simón and Pacheco 2005).

The clutch size in our study is consistent with that previously reported for *R. fulvipectus* and other species of this genus (1–3 eggs; Parker and Parker 1982, Fitzpatrick et al. 2004, Greeney et al. 2004, Brumfield and Maillard 2007). Nestling body mass when fully feathered was 4 g higher than the reported adult mass (23.1 g) (Dunning 2008).

The nestling was able to regulate body temperature after it was fully feathered, but this

temperature (37° C) was lower than average bird body temperature (40° C) (Gill 2007). Dunn (1975) suggested that altricial nestlings became endothermic when nestling body mass was 60–70% of their parents body mass. However, Ricklefs and Hainsworth (1968) suggested endothermy in nestling birds is not influenced by body mass. They suggested endothermy is proportional to the length of the nestling period, where nestlings of species with shorter nestling periods will become endothermic faster than species with longer nestling periods. Our study suggests thermoregulation occurs when the feathers are completely developed. However, further studies of other species are necessary to evaluate if endothermy correlates with completion of feather development.

Nest attentiveness was 64%, which is similar to other neotropical passerine species (Tieleman et al. 2004, Auer et al. 2007, Martin et al. 2007). However, unlike previously documented increases in nest attentiveness throughout the incubation period in neotropical passerines (Martin et al. 2007, Londoño 2009), *R. fulvipectus* decreased time on the nest as incubation period progressed. This reduction resulted from a small change in the number of trips (17%). Time on the nest decreased a few days prior to egg hatching for both nests, but the behavior used by the two individuals to decrease time on the nest differed. The female at the first nest increased the number of trips, but the female at the second nest increased length of foraging bouts. This suggests tropical birds have multiple ways to regulate egg temperature during incubation to successfully reach egg hatching within and between species. Intrinsic factors may have an important role on behavioral decisions during incubation.

Our study reinforces the specificity of the genus *Rynchocyclus* for nesting sites along creeks, and indicates *R. fulvipectus* has longer incubation and nestling periods compared to other tropical species (Tieleman 2004, Auer et al. 2007, Martin et al. 2007).

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