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Eggs, Nests, and Incubation Behavior of the Moustached Wren (*Thryothorus genibarbis*) in Manu National Park, Perú

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ABSTRACT.—The genus *Thryothorus* is wide spread in the Neotropics and nesting information is known for 85% of the species. I found four nests of the Moustached Wren (*Thryothorus genibarbis*) that were dome and bulky ball-like structures with a side entrance. All nests contained two white eggs with reddish-brown blotches. Daily nest attentiveness was 58.0% and average egg temperature was 32.5° C. Incubation behavior varied among nests and also throughout the incubation period, especially during early stages. *Received 19 July 2008. Accepted 10 February 2009.*

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Thryothorus is a large New World genus with 27 species (Kroodsma and Brewer 2005); the present genus may represent several genera (Mann et al. 2006). There is considerable information about the breeding biology of these species (Brewer 2001, Kroodsma and Brewer 2005), and nests of 23 species and eggs of 20 species have been described (Brewer 2001, Kroodsma and Brewer 2005, Lebbin et al. 2007, Valderrama et al. 2007). Generally, nests have been described as a dome and bulky ball-like structure with a side entrance, made principally with fine roots and grasses. Clutch size varies between two and five eggs, and egg coloration has been described as ranging from blue-green without markings to white with heavy blotches and reddish-brown streaks (Brewer 2001, Kroodsma and Brewer 2005). Incubation length

varies from 12 to 19 days. Incubation behavior in *Thryothorus* has not been well studied and embryo development temperature has not been documented for any of the species (Brewer 2001, Kroodsma and Brewer 2005).

Lebbin et al. (2007) described the nest of the Moustached Wren (*Thryothorus genibarbis*) as a woven oblong ball-shaped dome. The purpose of my paper is to describe for the first time the eggs and incubation behavior of *T. genibarbis*.

METHODS

Study Area.—This study was conducted in the foothills adjacent to the Tono (12° 57′ 58.2″ S, 71° 34′ 05.3″ W) and San Pedro rivers (13° 03′ 19.4″ S, 71° 32′ 48.5″ W) in Manu National Park, Cusco, Perú. The Tono River site is at 930 m asl with an average temperature of 24.2° C (max-min = 30.7 to 19.3° C) and supports a pre-montane forest with a canopy height of 40 m. The San Pedro River site is in Andean cloud forest at 1,450 m asl with an average temperature of 16.2° C (max-min = 19.8 to 13.6° C).

Nest, Egg, and Incubation Measurements.—Eggs were weighed to the nearest 0.05 g with a digital pocket scale (FlipScale F2) and nests were measured to the nearest 0.1 mm with calipers. Three thermal sensors were placed in two nests: one inside the nest under the eggs, one attached to the exterior side of the nest wall, and one inside one of the eggs. A sensor was placed inside an egg by drilling a small hole in the large end of the egg, sufficiently large for the sensor to enter the egg shell, and the opening was sealed with super glue. The sensor was placed in the middle of the egg to maintain constant distance from the bird's brood patch so temperature would not vary dramatically when eggs were rotated by the incubating adult. Sensors were connected to an H8 4-channel hobo data logger (Onset Computer Corporation, http://www.onsetcomp.com).

Sensors were placed at nests the day the nest was found and temperature was recorded every minute thereafter. The sensor inside the egg provided two types of information: (1) temperatures experienced by the embryo during on-bouts (when the bird was incubating) and off-bouts (when the bird was absent from the nest), and (2) the time at which the incubating bird left or returned to the nest, as shown by rapid temperature shifts of at least 1.5° C (incubation rhythm). The sensor inside the nest provided data on nest microclimate and incubation rhythm, similar to data provided by the egg sensor. The sensor attached to the outside nest wall provided data on ambient temperature in the immediate vicinity of the nest. The Tono egg sensor malfunctioned and egg temperature data were only collected during the first 4 days of the incubation period. Incubation data were not collected at two of the San Pedro nests due to egg sensor malfunction and early predation. Six hours of direct observation were made of the nests.

Data Analysis.—The temporal pattern of incubation for both nests was obtained from temperature fluctuations detected by each nest's internal sensor and analyzed following Cooper and Miles (2005). An algorithm detected all intervals when temperatures decreased monotonically. It retrieved three quantities for each interval: duration, total decrease in temperature, and initial rate of temperature decrease. The start of an off-bout (incubation recess) was triggered when nest temperature decreased monotonically for at least 1 min and decreased at least 2° C at an initial rate of at least 0.5° C/min. The start of an on-bout (beginning of an incubation period) was triggered when temperature increased monotonically for at least 1 min at an initial rate of at least 0.5° C/min. The rate of heat loss from the egg was calculated as the difference between the last egg temperature measured before the bird left the nest during incubation recess, and the last egg temperature before the bird returned to the nest to start incubating divided by the number of minutes in each particular recess.

RESULTS

Four nests of the Moustached Wren were found with two eggs each, two of the nests were next to habitat gaps and two were on the edge of a river. I found a nest at the Tono site with one egg on 28 September 2007. The nest contained a second egg on 29 September. Only one individual bird was observed approaching and going into the nest on three separate occasions during 6 hrs. Only pieces of eggshell were found on 18 October, indicating the nest had been depredated. Three nests were found at the San Pedro site by David Ocampo and Elkin Tenorio on 19 September, 2 October, and 18 October 2008. One of the eggs from the nest found on 18 October hatched on 25 October (the other did not hatch); the completely naked nestling weighed 4.25 g and had wing and tarsus length of 8 and 10 mm, respectively. The mass of the nestling was 8.8 g while wing and tarsus

lengths were 8 and 13 mm, respectfully on 27 October. The nest was empty on 28 October.

Description of Nests and Eggs.—The dome nest structure at the Tono site was between a small creek and a tree fall gap (~200 m width), and was constructed with dry grass leaves, a few dry ferns, and tree leaves. The cup lining was of finer grass leaves. Two of the nests at the San Pedro site were next to the river edge within a patch of *Gynerium sagittatum* (Poaceae). These nests were placed between the stem and the leaves of *Gynerium sagittatum*, and were exclusively built with dry leaves of *Gynerium sagittatum* with fine grass in the cup lining. The other nest was within the stems of a *Chusquea* spp. (Poaceae) next to a tree fall gap (~100 m wide) and constructed exclusively with *Chusquea* spp. leaves; the cup lining was made of fine grasses and small pieces of snake skin.

Nests were finely constructed dome structures, 1.2 m above ground with a short entrance and downward sloping entrance port. The entrance of the nests ($n = 4$) averaged 50.3 × 48.1 mm with average wall thickness of 32.8 mm. The depth of the dome structure (from the entrance until the end of the tunnel) was 102.5 mm and the depth of the nest cup was 44.0 mm. The exterior dimensions were 87.1 × 108.1 × 131.6 mm. The downward sloping entrance port measured 356.8 mm. All eggs were white with different amounts of reddish-brown spots over their surface. The eggs averaged 20.0 × 14.8 mm with a mass of 2.4 g ($n = 8$).

Incubation Rhythm and Thermal Characteristics.—Nest attentiveness (time spent incubating) was low throughout the first 10 days of the incubation period at the Tono nest. The adult spent ($\bar{x}$ ± SE) 47 ± 2.7% of daily time incubating the eggs. Nest attentiveness was lower during the first 5 days of the incubation period, when the adult was on the nest on average 40% of the time (range = 32–45%). The adult began to spend more time on the nest on days 9 and 10, incubating 59 and 57% of the time, respectively. The San Pedro nest had high attentiveness (67%, range = 63–75%) during the last 7 days of the incubation period with the exception of day 2 (13%) when the bird had a long absence during the night.

Low nest attentiveness at the Tono site was the result of a few long daily absences taken by the attending bird (Fig. 1A, B). The incubating bird had ($\bar{x}$ ± SE) 5.4 ± 0.57 absences per day (range = 3–10) lasting 141.5 ± 7.80 min (range = 41–131 min). Incubation started after the second egg was laid (Fig. 2A). The higher nest attentiveness at the San Pedro nest was the result of more (8.8 ± 0.50) but shorter (35.6 ± 1.50 min) absences (range = 7–63 min).

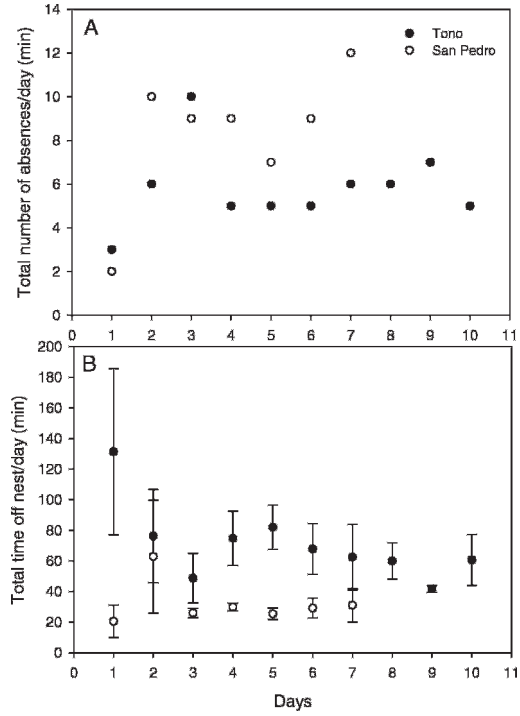

FIG. 1. Incubation behavior of *Thryothorus genibarbis*: (A) total number of absences per day, and (B) total time off nest per day. The bars represent standard errors. Day 1 at the Tono nest (solid circles) corresponds to 30 September 2007 and at the San Pedro nest (open circles) to 18 October 2008.

Eggs at the Tono nest maintained an overall average (±SE) temperature of 33.9 ± 0.20° C (Fig. 2A) when an adult was on the nest, and decreased to as low as 24.3 ± 0.32° C during incubation recesses. Egg temperatures were similar at the San Pedro nest when an adult was on the nest (34.8 ± 0.12° C; Fig. 2B), and decreased to 25.0 ± 0.38° C during incubation recesses.

Inner nest temperatures fluctuated similarly to ambient temperature at the Tono nest (Fig. 2C), but the inner nest temperature at the San Pedro nest fluctuated independently of ambient temperature (Fig. 2D). The external sensor recorded ambient temperatures fluctuations between 24 and 15° C at the Tono nest (Fig. 2E). The San Pedro nest had similar ambient temperature fluctuations between 14 and 26° C (Fig. 2F). Daily egg heat

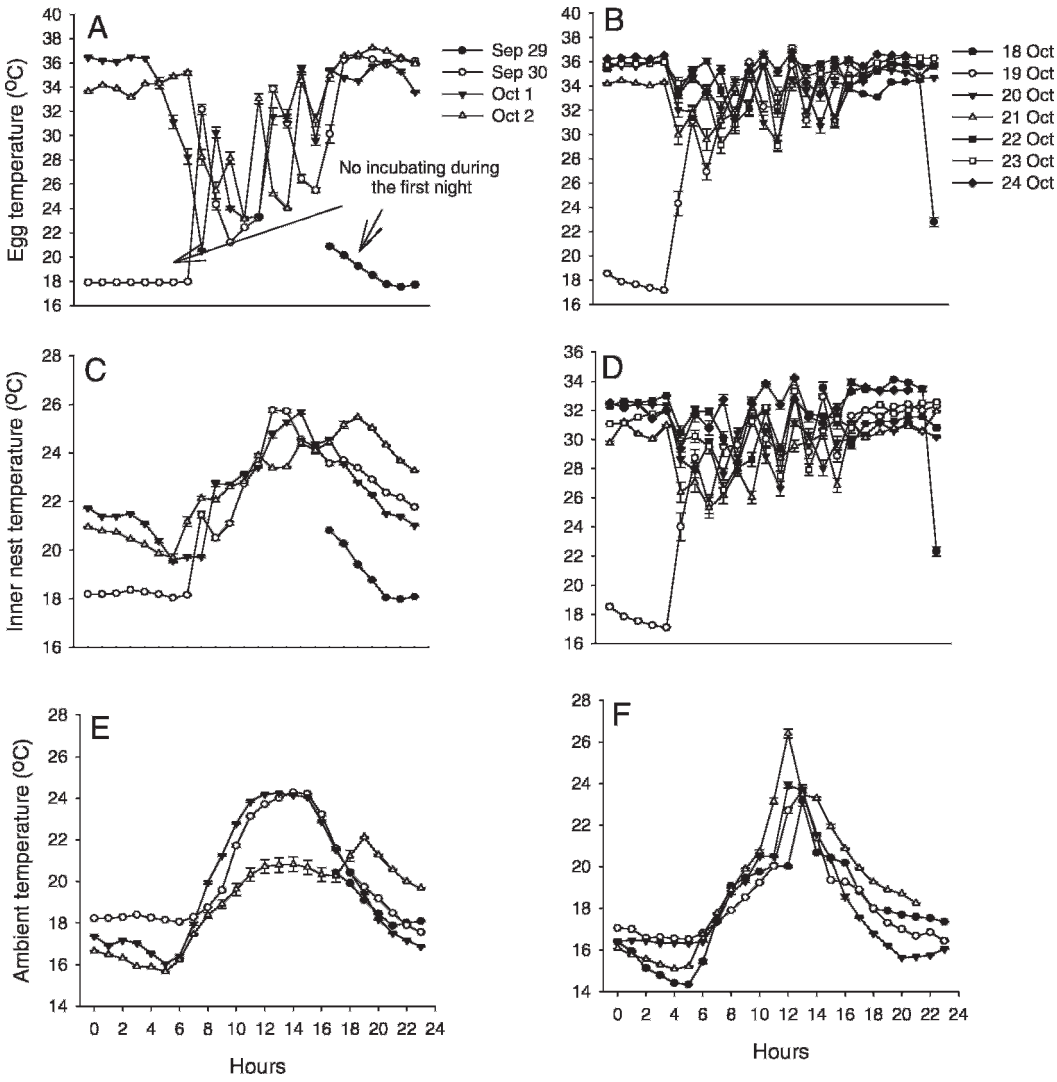

FIG. 2. Thermal characteristics of eggs, nest, and environment around nests during incubation, showing (A and B) hourly average egg temperature, (C and D) hourly average nest temperature, and (E and F) hourly average ambient temperature around the nest. A, C, and E correspond to the Tono nest, and B, D, and F to the San Pedro nest.

loss during incubation recess was lower at the Tono nest (0.2 ± 0.04° C/min) compared to the San Pedro nest (0.4 ± 0.02° C/min).

Inner nest temperatures varied less than ambient temperatures. Temperatures at the Tono nest averaged 3.5 ± 0.02° C higher than the ambient temperatures when the adult was on the nest. This difference was higher at the San Pedro nest (12.2 ± 0.34° C). This was a small difference compared to differences between egg and ambient temperatures (16.1 ± 0.06° C), and between egg and nest temperatures (12.6 ± 0.04° C) when the adult was incubating at the Tono nest. Differences between egg and ambient temperatures at the San Pedro nest were similar (15.8 ± 0.06° C), but differences between egg and nest temperatures were not as high (3.6 ± 0.11° C).

DISCUSSION

The dome nest with a short entrance built with grasses and the white eggs with reddish-brown spots of *T. genibarbis* were similar to those of other *Thryothorus* (Brewer 2001, Kroodsma and Brewer 2005). *T. genibarbis* incubation attentive-

ness (58%) was low when compared to tropical bird species (69.4%; Martin et al. 2007), and average egg temperature (32.5° C) was also low (34.4° C; Martin et al. 2007). Lebbin et al. (2007) observed *T. genibarbis* building a nest but did not follow its fate. The materials and dimensions of the woven oblong ball-shaped dome constructed with dry grasses and twigs were similar to those in this study. Dormitory nests lack the entrance (Skutch 1960, Sick 1993), which was not the case for the nest reported by Lebbin et al. (2007).

The two-egg clutch size for *T. genibarbis* is within the range of clutch sizes reported for *Thryothorus*, which vary between two and five eggs (Brewer 2001, Kroodsma and Brewer 2005). Similarly, egg coloration varies from blue-green without markings to white with heavy blotches and reddish-brown streaks. All eggs have been described as white with the exception of three species (*T. pleurostictus*, *T. rufalbus*, *T. sinaloa*; Brewer 2001) that have blue-green eggs. The genus *Thryothorus* likely represents several genera (Mann et al. 2006), which may explain clutch size and egg color variation among *Thryothorus* species.

All published studies indicate *Thryothorus* has female-only incubation with the exception of one report where bi-parental incubation was observed (Skutch 1960, 1972; Brewer 2001). Low nest attentiveness in both monitored nests in my study suggests that only a single bird (presumably the female) incubated, as species with bi-parental incubation have much higher nest attentiveness (>85%; Deeming 2002, Martin et al. 2007).

Incubation behavior varied between the two nests closely followed in this study. Nest attentiveness was low throughout the first 10 days of incubation at the Tono nest; time on the nest increased from 37.9% during the first 3 days to 55.1% during the last 3 days as incubation progressed. The San Pedro nest had higher and less variable incubation attentiveness (62.7–75.3%) during the last 7 days of the incubation period (before the egg hatched). This variation in incubation behavior influenced egg temperature, where the nest with higher incubation attentiveness (San Pedro) maintained egg temperatures 2° C higher. These differences can be the result of different investment decisions during the incubation period where time on the nest increased as incubation proceeds as observed for other tropical bird species (Martin et al. 2007). These differences in incubation behavior can also be the result of different selection pressures (e.g., predation risk, ambient temperature) and experience of wrens at different elevations. More studies on neotropical avian incubation may help elucidate factors that may influence variation in incubation behavior among and between neotropical bird species.

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