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First Description of the Breeding Biology and Natural History of the Ochre-breasted Brush Finch (*Atlapetes semirufus*) in Venezuela

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ABSTRACT.—We provide the first description of the eggs, breeding biology, and natural history of the Ochre-breasted Brush Finch (*Atlapetes semirufus*). We found 37 nests over four breeding seasons (2004–2007) in Yacambú National Park, Venezuela. Nesting activity started in late April and continued until early June suggesting single-brooded behavior despite a typical tropical clutch size of two eggs ($\bar{x}$ = 1.89) that were laid on consecutive days. Egg mass averaged 3.38 g and 11.6% of adult female mass. The incubation and nestling periods averaged 14.9 and 10.5 days, respectively. Only females incubated and the percent time they spent incubating did not change between early and late incubation. Females brooded 42.7% of the time when nestlings were 2 days of age and 20.5% when 9 days of age. Both parents provisioned young at a low rate (3.9 trips/hr) and nestling growth rate (k = 0.45) was also slow. Nest predation rates were relatively high with daily mortality rates of 0.058 and 0.067 during incubation and nestling stages, respectively. *Received 31 January 2007. Accepted 18 February 2008.*

The Ochre-breasted Brush Finch (*Atlapetes semirufus*) is restricted to Colombia and Venezuela (Hilty and Brown 1986, Hilty 2003) with an altitudinal range of 1,600–3,500 m in Colombia and 600–2,700 m in Venezuela (Hilty and Brown 1986, Remsen and Graves 1995, Stotz et al. 1996, Hilty 2003). This species is protected in several national parks in both countries and does not present immediate conservation challenges (IUCN 2007). Despite being a common bird (Ridgely and Tudor 1994), its breeding biology and life history remain largely unknown.

The objectives of our paper are to: (1) provide data on previously unknown life history traits, and (2) add to the knowledge of the natural history and breeding biology of the Ochre-breasted Brush Finch. Data were collected by field and video observations at 37 nests in four consecutive breeding seasons from 2004 to 2007. The work was conducted in Yacambú National Park at the northern end of the Andes in Venezuela (09° 42′ N, 69° 42′ W) at 1,350–2,000 m elevation. The park is in a mountainous area and has primary cloud forest and a small area of secondary forest (Fierro-Calderón and Martin 2007). The latter is where Ochre-breasted Brush Finches occur most often.

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OBSERVATIONS

Nests and Nest Placement.—We searched for nests from the beginning of March until early July each year using two methods: (1) behavioral observation of parents, and (2) systematic search (Martin and Geupel 1993). Systematic search implies a thorough inspection through all suitable nesting habitat. It was usually conducted after seeing a pair exhibiting nesting behavior.

Ochre-breasted Brush Finches were fairly common in our study site and were easily seen and heard, and typically occurred as pairs. Our study plots ranged in altitude from 1,350 to 2,000 m elevation; however, we only detected this species below 1,600 m. Nests were in disturbed habitats: trail sides and secondary growth forests in well-lighted, grassy or vine-covered environments. Nests were usually concealed in grasses, vines or bushes, between 0.2 and 3 m above ground. Foraging activity occurred in the same habitat.

Breeding Season.—The breeding season starts in March, when the dry season is ending, and lasts until July, in about the middle of the rainy season. The earliest nest was found on 21 March and contained two fresh eggs, based on candling. Breeding activity was highest in late April through late May (Fig. 1).

Gender Difference and Roles.—Gender of

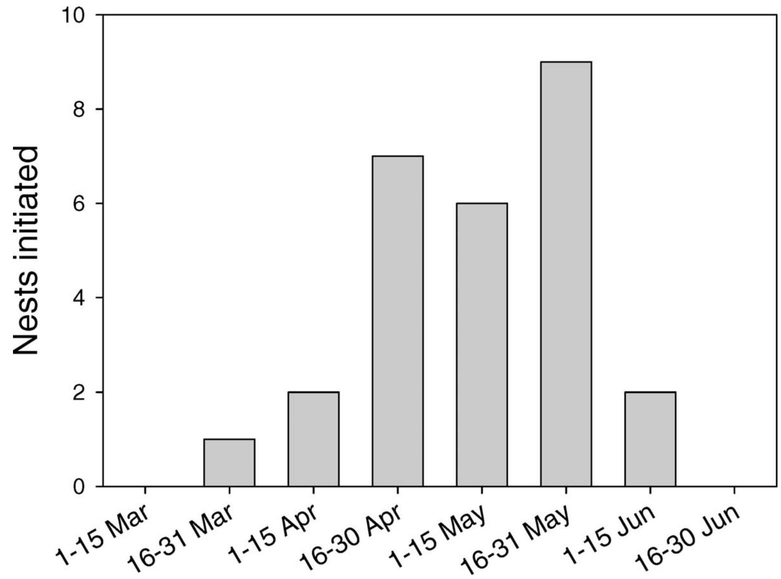

FIG. 1. Timing of bi-weekly nest initiation (n = 19) from early March to late June, 2004–2007 for Ochre-breasted Brush Finch at Yacambú National Park, Lara, Venezuela.

Ochre-breasted Brush Finches cannot be accurately assigned based on plumage. Roles of males and females during different periods of nesting were identified using behavior, video recording, and data from mist-netting. Pairs were together during nest building, but only one adult actually collected material and constructed the nest while the other bird followed and apparently guarded its mate. Only one adult incubated based on video recordings, and only females had developed brood patches among mist-netted birds. Thus, we assume that only the female builds the nest and incubates.

Nest Building and Laying.—The time the female used to build a nest and lay eggs varied throughout the breeding season. It usually took ~1 week to build a complete nest at the beginning of the season and another week to lay the first egg. A female took only 8 days to build a nest and lay a first egg towards the end of the season, after having lost her previous nest to predation.

The nest of *Atlapetes semirufus* is an open-cup usually built with thick grasses on the outside, at times complemented with small sticks on the outer edge. The lining consisted of thin grasses and rootlets. The inside color varies between yellow and brown, depending on materials used (Fig. 2).

We measured outer diameter (from edge to edge), inner diameter (cup), outer height (exterior bottom-to-top) and inner height (bottom-to-top of cup) of 29 nests. Nests averaged [± SE] 6.79 ± 0.12 cm in inner diameter, 12.59 ± 0.32 cm in outer diameter, 4.94 ± 0.13 cm in inner height, and 9.24 ± 0.32 cm in outer height.

Clutch Size and Eggs.—Clutch size was measured only for nests found during nest building or laying stages and was the number that did not change on subsequent days. Clutch size was two eggs in all but two nests and averaged [± SE] 1.89 ± 0.06 eggs (n = 28). Eggs were laid on consecutive days and were white with reddish-brown spots (Fig. 2). Spots were usually concentrated at the large end of the eggs, but may be more uniformly distributed; spots of a few eggs were faint and almost lacking. We weighed 24 eggs at 13 nests between day zero and day 3 of the incubation period using an ACCULAB portable electronic scale (precision 0.001 g). Fresh mass of eggs averaged [± SE] 3.38 ± 0.04 g. Adult male and female mass averaged 29.25 ± 0.33 g (n = 32) based on birds captured in mist nets throughout the breeding season. Thus, fresh egg mass represented 11.6% of the adult mass.

Incubation.—The incubation period was

FIG. 2. Nest and eggs of Ochre-breasted Brush Finch in Yacambú National Park. Photograph by A. M. Niklison.

measured as the number of days between the last egg laid and the last egg hatched (Briskie and Sealy 1990, Martin 2002). This period was measured only for nests found during the pre-laying or laying period and for which hatching day was observed. Nests were checked every other day, except at stage-changing events, such as start of incubation, hatching, and fledging, when nests were checked daily or twice daily. The mean [± SE] incubation period was 14.86 ± 0.26 days (n = 7). We assessed incubation behavior and nest attentiveness (percent of time adults spend on the nest incubating) by video filming nests for 6–8 hrs starting within 30 min of sunrise (Martin and Ghalambor 1999, Martin et al. 2007). Nests were filmed once during early and once during late incubation when possible. The mean duration of on- and off-bouts in early incubation was 34:17 and 15:34 (min:sec), respectively, and during late incubation was 44:49 and 15:24 (min:sec). Nest attentiveness averaged 69.4% (n = 1) on the third day of incubation, 70.6% (n = 1) in middle incubation (day 6), and 74.4% ± 0.35 (n = 3) during late incubation (last 4 days).

Nestling Period.—Hatching was synchronous in all nests of the Ochre-breasted Brush Finch. The nestling period length was 10.5 days (n = 2). Nestlings are able to jump from the nest when they feel threatened, at times as early as day 7, when their primary pin feathers are just breaking their sheaths (i.e., the day that feathers of the 8th primary break their sheaths). Brooding behavior (percent of time females spent brooding nestlings) and parental provisioning rates were measured using video recordings for 6–8 hrs beginning within 30 min of sunrise. Females brooded 42.7% (n = 1) of the time on day 2 of the nestling period and 20.5% (n = 1) of the time on day 9. Both males and females provision the young based on videos showing both adults at the nest simultaneously. The provisioning rate on day 2 of the nestling stage was 3.66 trips/hr (n = 1) and was similar on day 9 at 4.20 trips/hr (n = 1).

We measured tarsus length of nestlings using Mitutoyo digital calipers and body mass

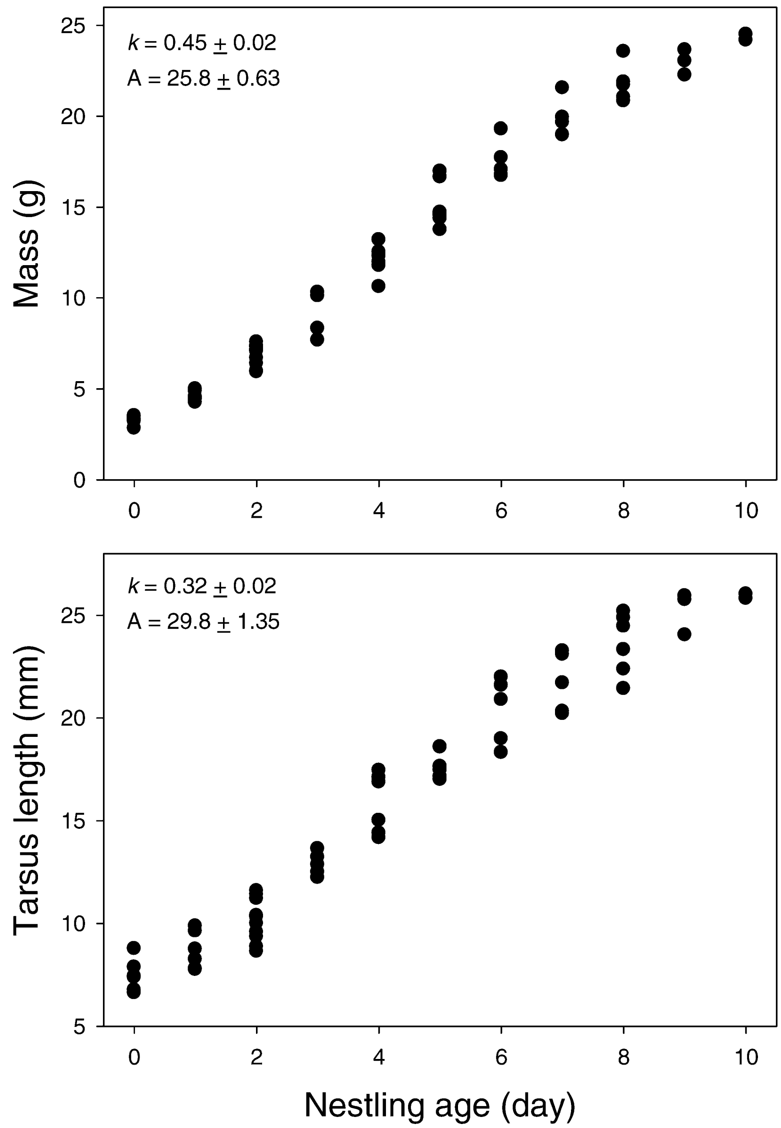

FIG. 3. Ochre-breasted Brush Finch nestling growth of mass and tarsus length with age. Growth rate constant (*k*) and asymptotic size (A) are indicated in each plot.

using ACCULAB digital electronic scales. Nestlings were measured every other day. We estimated growth rate following Remeš and Martin (2002) using the logistic growth function to estimate the growth rate constant (*k*) and asymptotic size (A). The estimated growth rate based on body mass was faster than when based on tarsus length (Fig. 3).

Nest Predation.—Predation accounted for all nesting mortality. We calculated daily nest predation rates using the Mayfield method (Mayfield 1975, Hensler and Nichols 1981). Daily predation rates ($\bar{x} \pm$ SE) were 0.070 ± 0.016 for the incubation period, 0.068 ± 0.025 for the nestling period, and 0.069 ± 0.013 (n = 37 nests; 378.5 exposure days) for the total nesting period including egg laying.

DISCUSSION

Ochre-breasted Brush Finches have an array of breeding features similar to those of congeneric species. Nest placement and shape were similar to that of the Pale-headed Brush Finch (*A. pallidiceps*) (Oppel et al. 2003, 2004), White-naped Brush Finch (*A. albinucha)* (Cisneros Palacios 2005), and Yellow-striped Brush Finch (*A. citrinellus*) (Luis Biancucci, pers. obs.). The clutch size was within the range reported for the genus; clutch size for *A. albinucha* in Mexico was two eggs based on a single nest (Cisneros Palacios 2005), one to three eggs for *A. pallidiceps* in Ecuador (Oppel et al. 2003), one egg for *A. leucopis* ($n = 1$; Salaman et al. 1998), and two eggs for *A. citrinellus* in Argentina ($n = 3$; T. E. Martin, unpubl. data). Only the female in *A. pallidiceps* appeared to build the nest and incubate the eggs (Oppel et al. 2003), similar to our observations for *A. semirufus*.

Two closely related species, Chestnut-capped Brush Finch (*Buarremon brunneinucha*) and Stripe-headed Brush Finch (*B. torquatus*) also occur in our study site. The former usually prefers more forested habitat with good canopy cover. The latter nests in vines and bushes, but does not hide the nest between grass clumps as we observed for the Ochre-breasted Brush Finch. However, there is some nest site overlap between *Buarremon torquatus* and *A. semirufus* (Luis Biancucci, pers. obs.).

Our data are sparse but suggestive of a single brood per season; we did not observe birds attempting a second brood after a successful previous nest, and the season is sufficiently short that single-brooded behavior seems most likely. Single-brooded behavior was also observed for the closely-related Pale-headed Brush Finch (Oppel et al. 2003). This contrasts with most emberizines in North America, which are more commonly double-brooded (Martin 1995). The related genera, *Junco* and *Pipilo* (Klicka et al. 2000, Yuri and Mindell 2002, Carson and Spicer 2003) are both multi-brooded (Martin 1995). This pattern is opposite to the generally accepted view that tropical birds have more broods per season than north temperate relatives (Martin 1996).

The incubation period was similar to related tropical and subtropical species. The incubation period of the congener *A. pallidiceps* in Ecuador was 14 days (Oppel et al. 2003), similar to the 14.9 days that we found for *A. semirufus*. In Argentina, the Stripe-headed Brush Finch had an incubation period of 15.75 $\pm$ 0.17 days (Auer et al. 2007), and the Saffron-billed Sparrow (*Arremon flavirostris*) averaged 15.31 $\pm$ 0.25 days (Martin 2002, Auer et al. 2007). Related emberizine species in high elevation Arizona have shorter incubation periods: 12.6 days for Green-tailed Towhee (*Pipilo chlorurus*) and 12.4 days for Gray-headed Junco (*Junco hyemalis caniceps*) (Martin 2002).

Nest attentiveness was higher than for related species in Argentina where the same sampling protocols were used. The Stripe-headed Brush Finch averaged 54.8% and Saffron-billed Sparrow averaged 62.5% (Auer et al. 2007), while attentiveness averaged 71.5% for *A. semirufus*. Nest attentiveness of tropical species is commonly lower than north temperate relatives (Martin 2002, Chalfoun and Martin 2007), but the Ochre-breasted Brush Finch was similar to related species in Arizona; Green-tailed Towhee averaged 70.7% and Gray-headed Junco averaged 75.1% (Martin 2002). Nest attentiveness can affect length of the incubation period (Price 1998, Martin 2002, Martin et al. 2007), but cannot explain the difference in incubation period between *A. semirufus* and northern relatives.

The nestling period (10.5 days) was shorter than for Stripe-headed Brush Finch (12.75 $\pm$ 0.21 days) and Saffron-billed Sparrow (12.16 $\pm$ 0.24 days) in Argentina (Auer et al. 2007), but similar to related species in Arizona where it was 11.1 days for Green-tailed Towhee and 11.0 days for Gray-headed Junco (T. E. Martin, unpubl. data). Provisioning rates were about half the rate that parents fed nestlings in related species in Arizona based on the same sampling methods (Martin et al. 2000). Growth rates were slow compared with north temperate emberizines. For example, the growth rate constant based on mass was $k = 0.45 \pm 0.02$ compared with 0.53 ± 0.01 for 31 north temperate emberizine species (Remeš and Martin 2002). This slow growth matches general expectations for tropical birds (Ricklefs 1968, 1976).

The Ochre-breasted Brush Finch has a smaller clutch size, longer incubation period, and lower provisioning rates than related north temperate species, as is common for tropical birds (Martin et al. 2000, 2007). However, the Ochre-breasted Brush Finch also exhibits several traits that are not typical of tropical birds and are more similar to north temperate relatives such as similar nestling period and nest attentiveness.

In contrast to conventional views (Martin 1996), it also appeared to have fewer broods than related north-temperate species despite a smaller clutch size and similar breeding season length. These data suggest that more work is needed on breeding biology of tropical birds to clarify perceived patterns of life history differences among latitudes.

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