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First Nesting Information for the Orange-eared Tanager (*Chlorochrysa calliparea*)

Manuel A. Sánchez Martínez[1,4] and Gustavo A. Londoño[2,3]

ABSTRACT.—The Orange-eared Tanager (*Chlorochrysa calliparea*) occurs from southern Colombia to northern Bolivia between 900 and 2,000 m elevation. We describe for the first time the nest of the genus *Chlorochrysa*, based on five nests of *C. calliparea*, and provide information on incubation and nestling growth from August through December 2009 and 2010 in Manu National Park, Cusco, Peru. The Orange-eared Tanager has a distinct and unique nest location in clumps of moss hanging from horizontal branches, previously unknown among tanagers. The nest structure, however, was similar to that of most tanagers. We observed use of a nest-like structure as a dormitory, not previously reported for the Thraupidae. Clutch size was one egg and the nestling period was 21 days. The female made an average of 8.8 foraging trips/day from the nest which lasted on average 33.1 min with nest attentiveness of 58.9%. The small clutch suggests close affinity with mountain tanagers. *Received 24 February 2011. Accepted 31 October 2011.*

The tanager genus *Chlorochrysa* (Thraupidae) is considered to be sister to the clade comprising *Stephanophorus, Diuca, Neothraupis, Lophospingus, Cissopis, Schistoclamys,* and *Paroaria*. The *Chlorochrysa* and *Stephanophorus—Paroaria* clade is in turn sister to the group of colorful mountain tanagers (Sedano and Burns 2010). There are three species in the genus *Chlorochrysa* (*C. calliparaea, C. nitidissima,* and *C. phoenicotis*) with exclusively South American distributions in the Andean foothills from Venezuela to Bolivia with an elevational distribution from 1,000 to 1,800 m in low/wet outlying ridges within the Andes region, where mossy cloud forest is generally found. The genus is characterized by their long and slender bills, strong tarsi, and a small patch of distinctive club-shape feathers on the ear-coverts (Hilty and Brown 1986, Isler and Isler 1999, Ridgely and Tudor 2009).

The breeding biology of the Orange-eared Tanager (*Chlorochrysa calliparea*) is almost unknown. There is only one brief description of a cup nest of the Glistening-green Tanager (*C. phoenicotis*) hollowed in moss on the side of a limb in the middle strata (Hilty and Brown 1986). We describe for the first time the nest for the genus *Chlorochrysa* based on five nests of *C. calliparea*, and detailed information on incubation and nestling growth.

METHODS

Study Area.—This study occurred at the Cock-of-the-Rock Lodge (13° 03′ 19.4″ S, 71° 32′ 48.5″ W) managed by the Peruvian non-governmental organization (NGO) Peru Verde. It is in the buffer area of Manu National Park, Cusco, Peru, on the eastern slope of the Andes at the confluence of the San Pedro and Kcosñipata rivers. The Reserve covers an elevation gradient from1,000 to 2,000 m, and protects a cloud forest with abundant mosses and epiphytes, a canopy height of 25 m, and average temperature of 16.15 °C (min-max = 13.6 to 19.8 °C) with a rainy season between November and April and a dry season from May to August.

Nest, Egg, Incubation, and Nestling Measurements.—Daily nest searches were conducted by six researchers each year between August and December 2009 and 2010 (10 hrs/day, 6 days/week). Each researcher had a unique plot of 10–15 ha throughout the field season. We found five active nests of *C. calliparea*. Most nests had an egg or a nestling, but one was found during the building stage. We measured length and width of eggs when found with a caliper to the nearest 0.1 mm and mass with a digital pocket scale (FlipScale F2, Phoenix, AZ, USA) to the nearest 0.05 g. We placed two small thermal sensors (2 × 1 mm), one inside the nest under the egg and the other next to the external surface of the nest wall. The thermal sensors were attached to a U12 four-

[1] Departamento de Biología, Universidad del Valle, A.A. 25360, Cali-Colombia.
[2] Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, FL 32611, USA.
[3] Department of Biology, 227 Bartram Hall, University of Florida, P. O. Box 118525, Gainesville, FL 32611, USA.
[4] Corresponding author;
e-mail: manusama79@gmail.com

FIG. 1. Nest and egg of the Orange-eared Tanager (*C. calliparea*). (A) Mossy clump on a horizontal branch where nests were located. (B) Cup nest inside the mossy clump. (C) Inner view of the cup nest showing nest layers and materials. (D) White egg with brown spots.

channel hobo data logger (Onset Computer Corporation, http://www.onsetcomp.com, Cape Cod, MA, USA), which stored thermal data every minute for 15 days. We visited the nest 3 days after the sensors were placed to check if they were producing accurate data, and again after 12 days to download data. We then made daily visits to record the exact hatching day. We collected daily measurements on wing, tarsus, and mass of the nestling. We described nestlings every other day. We took nest measurements to the nearest 0.1 mm with a caliper and, when the egg or nestling was depredated (or fledged), collected the nest and described the materials of each nest layer.

Incubation Rhythm Analysis.—Incubation behavior was obtained by analyzing the thermal changes recorded by the thermal sensor under the egg. Cooper and Miles (2005) developed an algorithm to detect all intervals when temperatures decrease monotonically. This algorithm retrieved three quantities for each interval: duration, total decrease in temperature, and initial rate of temperature decrease. For example, the start of a foraging trip (incubation recess) was when the 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.

We calculated the nestling growth rate to compare it with other passerine species using a logistic equation, $W(t) = A/(1 + e^{[-K(t - ti)]})$, proposed by Ricklefs (1967). $W(t)$ is the mass at age t, A is the asymptote of the growth curve, K is a constant scaling rate of growth, t_i is the inflection point on the time axis where growth becomes asymptotic, and e is the base natural logarithm.

RESULTS

The five nests of the Orange-eared Tanager were between 1,299 and 1,376 m elevation; all were found when an adult flushed from the nest (except 1 that was found during construction), and all contained one egg or one nestling. Each nest was built within thick mossy clumps hanging from horizontal branches.

We found three nests during the 2009 field season. The first, found on 5 October containing a

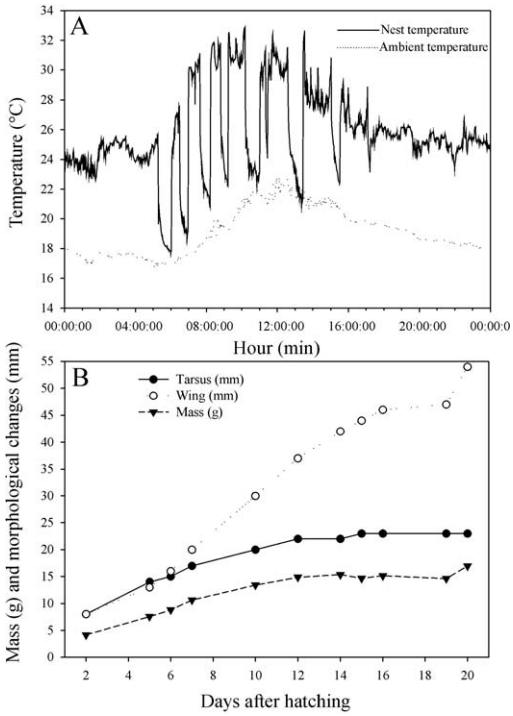

FIG. 2. Incubation rhythm and nestling growth of *C. calliparea*: (A) 24 hrs of incubation of one individual *C. calliparea* in 2010, and (B) nestling growth during the entire nestling period for one nest during 2009.

fresh egg, was 2.25 m above ground in a small tree. The second, found on 11 October, contained a developed egg and was 3.5 m above ground in a small tree. The last nest was on 13 October on a small tree next to a trail 3.5 m above ground. It contained a fully feathered nestling that flushed from the nest the following day. We found two active nests during the 2010 field season. The first contained a fresh egg on 21 October and was in secondary forest next to a large gap 3 m above ground. The second was on 8 November when we observed a male carrying nest material to a middle-sized tree 4 m above ground; on 20 November the nest contained a fresh egg.

In addition, an individual was flushed at dusk from a hanging moss structure (resembling a globular nest) above a frequently used trail between September and December. We did not observe an egg, nestling, or activity during the day and believe this structure served as a dormitory. We know this structure was used frequently as we placed a leaf on the entrance at least two times a week and it was removed. The globular structure was 2 m above ground on a small tree and the inner measurements were 65.6 × 48.4 mm with a wall thickness of 17.6 mm. The horizontal entrance was 94.8 mm in length and the external dimensions were 108.8 × 81.6 × 355.5 mm (length, width, and height).

Descriptions of Nests and Eggs.—The cup nest was built within a natural clump of moss hanging from horizontal branches of small or middle-sized trees (Fig. 1A). Nests were placed within clumps of moss and had one or two side entrances. The location of the nest on mossy clumps made it difficult to loca[illegible]ight (Fig. 1A, B). Nests were composed of t[illegible]stinctive layers; the external layer weighed ($\xi \pm$ SD) 3.96 ± 1.4 g ($n = 5$) and was composed mainly of mosses (60%), and fern rachises and dry roots (40%). The internal layer weighed 2.30 ± 2.1 g ($n = 5$) and was composed of fine monocot fiber (60%) and soft seed fluff of bromeliads (40%) (Fig. 1C). The five nests were in the forest interior at an average height from the ground of 2.58 m (min-max = 2 to 4 m; $n = 5$). The average internal dimensions were 55.2 × 48.9 mm with a wall thickness of 19.6 mm and depth of 32.6 mm; the external dimensions were 93.3 × 76.4 mm with a height of 48.9 mm.

Four of the five nests had single eggs. The eggs were white with small light–brown speckles, located principally at the large end of the egg. The density of the speckles was high and the large end of the egg appears brown (Fig. 1D). The brown speckles decrease rapidly in density toward the smallest end of the egg. Eggs ($\xi \pm$ SD) measured 22.1 ± 0.91 × 15.5 mm ± 0.38 ($n = 4$) and fresh weight (embryo development had not started) was 2.9 ± 0.3 g ($n = 3$).

Incubation Rhythm.—We documented incubation behavior for two nests during 120 hrs (5 complete days), where the adults left the nest to forage on average 8.8 times/day that lasted on average 33.1 min (min-max = 3 to 88; Fig. 2A). The nest found in 2009 was monitored only for 24 hrs as the egg hatched the day after the sensor was placed in the nest. The adult made 13 foraging trips during this 24 hrs that lasted on average 21.1 min (min-max = 3 to 55). The temperature during incubation was 31.5 °C (min-max = 27.8 to 34.7) and decreased to 26.1 °C (min-max = 22.9 to 30.4) when the adult was absent. We monitored one nest during 5 complete days in 2010; this individual left the nest at dawn between 0516 and 0529 hrs, and the first eight foraging trips lasted on average 54.5 ± 25.5 min.

The last trip before continuous incubation during night occurred in early afternoon between 1301 and 1501 hrs and lasted on average 31.75 ± 19.4 min. The adult spent on average 58.9 ± 8.1% of the time incubating the egg during these 5 days. The bird made an average of 7.8 foraging trips/day (min-max = 6 to 9) that lasted on average 36.1 min (min-max = 11.3 to 66). Nest temperature fluctuated between 30.1 and 15.1 °C, and the average nest temperature during incubation was 26.2 °C (min-max = 22.3 to 31.4) decreasing to 23.5 °C (min-max = 20.7 to 26.7) when the adult was absent. We could not confirm directly how many individuals incubated, but we only saw the female entering or leaving the nest. The low nest attentiveness (58.9%; Deeming 2002) and data from other tanager species (Isler and Isler 1999) suggest that only the females incubate.

Nestling Description.—Two of five nests had nestlings. One nest was found with an egg on 11 October 2009 which hatched in the afternoon on 12 October. We monitored the nest until 2 November when the nestling successfully left the nest; thus, the nestling period was 21 days. The first day the nestling had black down on the head, back, rump, shoulder, and flanks, the skin color was a pale yellow, the eyes were closed, the commissures were yellow, and the tip of the bill was black. The eyes began to open on day 7 and by day 9, the eyes were completely open. The feather sheath breaking through the skin was a green color on the head, wings, back, flanks, rump, and abdomen, but the nestling still had down, and the bill was totally black. The bill was completely black on day 14; the nestling had a yellow eye ring, green feathers all over the body, and blue feathers on the abdomen. The nestling was fully feathered on day 20 and the tail feathers were almost completely emerged from the sheaths. The next day the nestling left the nest. It weighed 4.15 g on hatching, and gained mass at a rate of 0.8 g/day during the first 14 days, reaching a mass of 15.35 g. The mass ranged between 14.60 and 15.15 g on following days, finally reaching 16.95 g on day 21. The calculated specific rate of growth (K) was 0.26. Recently hatched nestlings (day 2) had a tarsus length of 8 mm and a wing length of 8 mm, and grew at a rate of 1.1 mm/day and 2.6 mm/day, respectively, reaching a length of 23 and 54 mm on day 20 (Fig. 2B). The second nest with a fully feathered nestling was empty the following day. The nestling weight was 16.3 g when found on 13 October and the tarsus and wing measured 22 and 53 mm, respectively.

DISCUSSION

Hilty and Brown (1986) published the only nest information known for the genus *Chlorochrysa*; a brief description of the nest of the Glistening-green Tanager. Our study provides the first detailed description of the nests, eggs, and nesting biology of a member of the genus *Chlorochrysa*. The cup nest of the Orange-eared Tanager is similar to that of most tanagers (Isler and Isler 1999), but the nest location in hanging mossy clumps from horizontal branches seems to be unique to this genus (Hilty and Brown 1986) and different from other tanagers (Isler and Isler 1999). The clutch size is one egg (Stiles and Skutch 1989, Isler and Isler 1999, Martin et al. 2006, our study). One-egg clutches are not common among neotropical passerines but members of the mountain tanager clade, which is sister to the *Chlorochrysa* and *Stephanophorus—Paroaria* clade (Sedano and Burns 2010), also have a clutch size of one egg (G. A. Londoño, unpubl. data). Thus, it is possible this trait is present in other neotropical passerines. The concentration of brown spots at the large end of the egg in *C. calliparea* differs from other members of the subfamily Thaupinae that commonly have white eggs covered with dense spots or lines all over the egg surfaces (Greeney et al. 1998, Isler and Isler 1999). We are not aware of any other tanager using a nest-like structure as a dormitory. The growth rate of *C. calliparea* nestling when contrasted with other passerine species was slower than temperate passerine birds (Remeš and Martin 2002), and was also slow compared with tropical passerines (Greeney 2008).

We believe the unique location of a cup nest inside dense clumps of moss on horizontal branches has made it difficult to locate *Chlorochrysa* nests. We hope this paper will encourage researchers to look for these nests and investigate if the unusual nesting habits described for *C. calliparea* apply to other species of this genus.

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LITERATURE CITED

COOPER, C. B. AND H. MILES. 2005. New software for quantifying incubation behavior from time-series recordings. Journal of Field Ornithology 76:352–356.

DEEMING, D. C. 2002. Behaviour patterns during incubation. Pages 63–86 *in* Avian incubation behavior, environment, and evolution (D. C. Deeming, Editor). Oxford University Press, New York, USA.

GREENEY, H. F. 2008. Nestling growth and plumage development of the Spotted Barbtail (*Premnoplex brunnescens*). Kempffiana 4:21–29.

GREENEY, H. F., M. LYSINGER, T. WALLA, AND J. CLARK. 1998. First description of the nest and egg of the Tanager Finch (*Oreothraupis arremonops* Sclater 1855) with additional notes on behavior. Ornithologica Neotropical 9:205–207.

HILTY, S. L. AND W. L. BROWN. 1986. A guide to the birds of Colombia. Princeton University Press, Princeton, New Jersey, USA.

ISLER, M. L. AND P. R. ISLER. 1999. The tanagers. Smithsonian Institution Press, Washington, D.C., USA.

MARTIN, T. E., R. D. BASSAR, S. K. BASSAR, J. J. FONTAINE, P. LLOYD, H. MATHEWSON, A. NIKLISON, AND A. CHALFOUN. 2006. Life history and ecological correlates of geographic variation in egg and clutch mass among passerine species. Evolution 60:390–398.

REMEŠ, V. AND T. E. MARTIN. 2002. Environmental influences on the evolution of growth and developmental rates in passerines. Evolution 56:2505–2518.

RICKLEFS, R. E. 1967. A graphical method of fitting equations to growth curves. Ecology 48:978–980.

RIDGELY, R. S. AND G. TUDOR. 2009. Field guide to the songbirds of South America. University of Texas Press, Austin, USA.

SEDANO, R. E. AND K. J. BURNS. 2010. Are the Northern Andes a species pump for neotropical birds? Phylogenetics and biogeography of a clade of neotropical tanagers (Aves: Thraupini). Journal of Biogeography 37:325–343.

STILES, F. G. AND A. F. SKUTCH. 1989. A guide to the birds of Costa Rica. Cornell University Press, Ithaca, New York, USA.