ORNITOLOGÍA NEOTROPICAL
(2023) 34: 11–16
DOI: 10.58843/ornneo.v34i1.883
ORIGINAL ARTICLE

Sociedad de Ornitología Neotropical

OBSERVATIONS ON INCUBATION, NESTLING GROWTH, AND PARENTAL CARE OF THE ORANGE-BELLIED EUPHONIA *EUPHONIA XANTHOGASTER*

Jeff Port[1*] · Fuabcua Khang[1] · Jose Simbaña[2] · Harold F. Greeney[2]

[1] Department of Biological Sciences, Bethel University, St. Paul, MN 55112, USA.
[2] Yanayacu Biological Station & Center for Creative Studies, Cosanga, c/o Foch 721 y Amazonas, Quito, Ecuador.
E-mail: Jeff Port · jport@bethel.edu

Abstract · We present the first observations of nestling growth and parental care behaviors in the Orange-bellied Euphonia *Euphonia xanthogaster*. We also add to the body of knowledge on clutch size, incubation, and fledgling periods and nest sanitation activities and present egg measurements from three *E. x. quitensis* and three *E. x. brevirostris* nests from Ecuador. Clutch sizes and nestling development were similar to those described for other *Euphonia* species, and eggs and nests followed previous descriptions for the species. The incubation period was 14 days and fledging approximately 21 days. We used 246 hours of recorded observations from two nests found in February of 2002 and 2006 in tropical montane forest near the Yanayacu Biological Station in Cosanga, Ecuador, to document feeding, parental care and sanitation behaviors. Recording at one nest began at the onset of incubation and continued through fledging, while the other was recorded after hatch and through fledging. Males were not observed to participate in incubation or brooding but participated significantly in feeding nestlings. Males alternated feeding visits with the female during the observed period, but females spent significantly more time at the nest, likely due to greater investment in brooding and nest sanitation. Both sexes were observed to make coordinated misdirection flights, with the male performing the majority. Females only performed misdirection flights after hatch.

Resumen · Observaciones sobre la incubación, el crecimiento de los pichones y el cuidado parental de la eufonia ventrinaranja *Euphonia xanthogaster*

Presentamos las primeras observaciones del crecimiento de los pichones y los comportamientos de cuidado parental en la eufonia ventrinaranja *Euphonia xanthogaster*. También proveemos información sobre las medidas de huevos, los períodos de incubación y emplumamiento, y las actividades de saneamiento del nido. Presentamos las medidas de los huevos de tres nidos de *E. x. quitensis* y tres de *E. x. brevirostris* en Ecuador. Los tamaños de los huevos y el desarrollo de los pichones fueron similares a los descritos para otras especies de *Euphonia,* y los huevos y nidos siguieron las descripciones previas para la especie. El período de incubación fue de 14 días y el de crecimiento de los pichones de aproximadamente 21 días. Utilizamos 246 horas de observaciones de dos nidos encontrados en febrero de 2002 y 2006 en el bosque montano tropical cerca de la Estación Biológica Yanayacu en Cosanga, Ecuador, para documentar los comportamientos de alimentación, cuidado parental y saneamiento del nido. La grabación en uno de los nidos comenzó al inicio de la incubación y continuó hasta el emplumamiento, mientras que el otro se grabó después de la eclosión y durante el emplumamiento. No se observó que los machos participaran en la incubación o el empollamiento, pero participaron significativamente en la alimentación de los polluelos. Los machos alternaron las visitas de alimentación con las hembras durante el período observado, pero las hembras invirtieron mucho más tiempo en el nido, probablemente debido a una mayor inversión en empollamiento y saneamiento del nido. Se observó que ambos sexos hacían vuelos defensivos coordinados, con el macho realizando la mayoría. Las hembras solo realizaron vuelos defensivos después de la eclosión.

Keywords: *Coordinated misdirection · Fringillidae · Nestling development · Parental behavior*

INTRODUCTION

The Orange-bellied Euphonia *Euphonia xanthogaster* is native to primary and secondary forests of Panama south to Venezuela, Colombia, Ecuador, Perú, Guyana, and Bolivia, ranging up to 2600 m a.s.l., with a smaller isolated population found in the Atlantic coastal forests of Brazil (Hilty 2020). Eleven subspecies have been proposed, with three —*E. x. chocoensis*, *E. x. quitensis,* and *E. x. brevirostris*— described in Ecuador. Currently a species of "Least Concern" (BirdLife International 2022), it is commonly found in forest edges and forest clearings. The Orange-bellied Euphonia is known to forage in pairs or small groups and follow mixed flocks in all forest strata (Hilty & Brown 1986, Isler & Isler 1987). Males and females can be distinguished from each other by dif-

Submitted 07 Jan 2021 · First decision 18 Mar 2021 · Acceptance 04 Jan 2023 · Online publication 21 Mar 2023
Communicated by Carlos Bosque

ferences in plumage pattern and color (Hilty & Brown 1986).

Distinctive features of the euphonias include the highly specialized frugivorous diet, which is associated with the absence of a gizzard (Clark 1913, Wetmore 1914). Although some euphonias are reported to eat insects (Pérez-Rivera 1991), Orange-bellied Euphonias are largely frugivorous with over 40 plant species identified as food sources, including mistletoes, *Ficus*, *Miconia*, *Cecropia*, and various Araceae (Isler & Isler 1987, Kerbs 2015). Nests of the 28 species of the genus *Euphonia* (Hilty 2020, Imfeld et al. 2020) are typically domed or globular structures with a side entrance (Isler & Isler 1987, Zuccon et al. 2012, Collar et al. 2018). Described *E. xanthogaster* nests are typically constructed about two meters above the ground, with the inside hollow and commonly composed of moss and other fibers from epiphytes (Cisneros-Heredia 2006, Solano-Ugalde et al. 2007), and are often built on branches but they may also be placed in holes of trees (Kirwan 2009). The Orange-bellied Euphonia typically lays two to three eggs (Hilty 2020). The eggs are usually short, sub-elliptical shaped, colored white with small cinnamon or dark red spots and flecks that become denser and form a wreath around the larger end (Isler & Isler 1987, Solano-Ugalde et al. 2007, Marini et al. 2012, Greeney et al. 2018).

In a number of euphonia species, only the female incubates *(Chlorophonia elegantissima*, Fragoso et al. 2021; *E. chlorotica*, Perella et al. 2017; *E. hirundinacea,* Skutch 1954, Sargent 1993; *E. imitans*, Skutch 1954; *E. luteicapilla*, Skutch 1954; *E. minuta*, Skutch 1972; *E. pectoralis*, Di Sallo et al. 2019), while individuals of both sexes have been reported to feed the nestlings in seven species (*E. chlorotica*, Perella et al. 2017; *C. cyanocephala*, Wright et al. 2017; *C. elegantissima*, Fragoso et al. 2021; *E. laniirostris*, Barnard 1954; *E. luteicapilla*, Skutch 1954; *E. minuta*, Skutch 1972; and *E. pectoralis*, Di Sallo et al. 2019). A report of a single nest of *E. xanthogaster* noted the male was not observed entering the nest during the nestling period (Cisneros-Heredia 2006).

While nests and eggs have been previously described (Phelps 1954, Solano-Ugalde et al. 2007, Greeney et al. 2018), most basic information on the reproductive biology of *E. xanthogaster* remains unknown. Nestling development and parental care and investment remain undescribed. Here we report on the clutch size, incubation period, nestling development, feeding, nest sanitation, and parental care activities of male and female *E. xanthogaster* from two nests, along with egg and nestling weights from an additional four nests.

METHODS

Egg measurements were obtained from six nests, three from the Cosanga area (0°36'S, 77°53'W; putatively *E. x. brevirostris,* Bonaparte 1851), and three (putatively *E. xanthogaster quitensis,* Nelson 1912) located in the vicinity of Tinalandia Lodge, near Alluriquin (0°17'51.26S, 79°03'06.50W), Buenaventura (1°27'59.94S, 80°06'00.01W), and Mindo (0°02'55.81S, 78°46'50.34W), Ecuador. Eggs at each nest were measured during a single visit by recording three replicate weights, with the average value reported to the nearest tenth millimeter and gram. In two Cosanga nests, hatching occurred synchronously; nestling weights were recorded one and two days after hatching in one of the nests, and one day after hatch and again one week post-hatch in the second nest. All weights are reported as mean ± standard error (SE).

We examined parental care and nestling behavior at two of the *E. xanthogaster* nests located near Cosanga. Nests were located approximately 2 m above the ground on a mossy vine and epiphyte clump, and were constructed of moss, rootlets, and *Chusquea* sp. leaves. Nest activity was filmed with a tripod-mounted camera positioned near the ground and 3–5 m from the nests, and operated continuously during daylight hours (ca. 0600–1800). Observations were made between 17–26 February 2002 and 16 February–8 March 2006 for a total of 246 hours, beginning with the onset of incubation of one nest and through the nestling periods of both nests. Video analysis was completed utilizing VLC software (VideoLan 2.2.1).

Data transcribed from the videos included number of visits, visit duration and frequency along with nest activity patterns and behaviors of both sexes. Analysis focused on adult investment in incubation, brooding, and feeding. Visit duration was defined as the time an adult entered the nest until it exited it. Frequency of visits is reported as the number of visits per nestling per hour. To compare male and female behaviors, two tailed t-tests were performed and considered statistically significant when the P-value was < 0.05. Visits and visit times are reported as mean ± standard error (SE). Male and female were easily distinguishable by the plumage differences.

RESULTS

Eggs and incubation. Completed clutches contained three eggs in all observed nests (N = 6 nests). Mean length of eggs in three *brevirostris* nests was 18.4 ± 0.10 mm (N = 6 eggs), mean width 13.0 ± 0.08 mm (N = 6 eggs), and mean weight 1.6 ± 0.03 g (N = 9 eggs). Mean length of eggs in three *quitensis* nests was 19.0 ± 0.2 mm (N = 9 eggs), mean width 13.2 ± 0.1 mm (N = 9 eggs), and mean weight 1.5 ± 0.01 g (N = 3 eggs). Incubation behavior was recorded at a single nest, using 130 hours of observations beginning with the laying of the 3rd egg and the onset of incubation and spanning 14 days until hatch. Only the female incubated, although the male was seen accompanying the female to the nest throughout the incubation period. During observed incubation, the female averaged 42:59 min ± 5:19 min per on bout, and off bouts averaged 20:55 min ± 2:03 min (N = 116). During the incubation period, the eggs were attended 64.4% of the observed hours (N = 130.18 hours). The female averaged 7.73 ± 0.74 visits per day (N = 14 days) during incubation. The incubation period was 14 days for one nest.

Nestling growth and development. Mean weight of nestlings at one day post hatch at two *brevirostris* nests was 1.3 ± 0.01 g (N = 2), two days post hatch 1.7 ± 0.07 g (N = 3), and 6.8 ± 0.41 g (N = 3) by eight days after hatch. Adults vary between 9-16 g (Hilty 2020).

At hatching (*ca*. 1 g; Day 0; Figure 1, row 1), nestlings had orangish pink skin, including the tarsi and toes, but with large dusky spots on the head where the developing eyes could be

Figure 1. *Euphonia xanthogaster brevirostris* nestlings 0–6 day old. Hatching-day nestlings were photographed by HFG in mid March 2003 at Yanayacu Biological Station (YBS). The remainder were photographed by JS in February of 2009 at YBS.

seen through the skin. Nails were dusky, as was the distal half of the bill and most of the culmen. Basally, the bill was pink except for the bright white, slightly inflated rictal flanges. The tomia of both, the mandible and maxilla, were also bright white, with the inner margins of the flanges and tomia washed with yellow, most intensely and extensively at the corners of the gape. The mouth lining was red and the egg tooth was small and pale gray, barely contrasting with the dusky tip of the maxilla. Chicks hatched with two rows of widely spaced, wispy tufts of natal down, one on either side of the spine, which extended from the scapular region to the lower back. Three to five tufts of natal down adorned the alar tracts, and several were present at the rear of the capital tract. Once the down had dried and expanded, within several hours of hatching, it was so fine and wispy to be barely visible, making the young nestlings appear nearly naked. During the first day or two after hatching, the skin lost its orangish coloration, becoming dusky pinkish, and the yellow wash on white portions of the bill and gape became more extensive and brighter (Figure 1, row 2).

Six days after hatching (Figure 1, row 4), the nestlings' eyes were just beginning to open and the dark areas of the developing contour feathers were visible below the skin on the alar, spinal, capital, ventral sternal, and femoral feather tracts. By day 8 (Figure 2, row 1), flight feather pins were just beginning to emerge through the skin and the subcutaneous development of the tail feathers was visible. Feather development was extensive on all contour feather tracts, but only those of the spinal tract were beginning to emerge through the skin. The bright rictal flanges and tomia were largely bright yellow, strongly contrasting with the deep magenta mouth lining and blacking tip of the bill. About ten days after hatching (Figure 2, row 2) the pin feathers of the flight feathers were well developed but remained unbroken, while those of the rectrices were just beginning to break through the skin. Contour feathers had emerged through the skin on most major feather tracts and had begun to break their sheaths. Emerging feathers were yellowish on the femoral and lower portions of the ventral sternal tracts, greenish or dusky in other regions. Feather development on the head and capital tract appeared to lag a day or two behind development on most other portions of the body.

Their eyes did not fully open until around 11–12 days of age, at which point flight feathers emerged from their sheaths.

Fifteen days after hatching (Figure 2, row 3) the contour

Figure 2. *Euphonia xanthogaster brevirostris* nestlings 8–20 day old. All nestlings photographed by JS at Yanayacu Biological Station. The fledgling (also *E. x. brevirostris*), of unknown age, was still being fed by adults when photographed by HFG 14 November 2015 at Chontayacu, northeast of Archidona, 1100 m.

feathers of all areas except the head had emerged, roughly one third to one half of the way from their sheaths. This gave them a largely feathered appearance, but emerging feathers did not yet fully cover the spinal, femoral, and ventral apteria. Most of the head, including the face and crown, remained largely bare, with green contour feathers just beginning to break their sheaths on the hindcrown. Their tarsi and toes were now mostly gray or dusky pinkish, their bills remained contrastingly colored as described above. At twenty days of age (Figure 2, row 4), one to three days prior to fledging, nestlings were fully alert and, after being handled, remained in the nest only if returned with their heads facing the rear of the nest chamber and their exit blocked for 20–30 seconds. Their wings were almost fully developed, with only the basal 2–3 mm of the primaries remaining sheathed. Their tail feathers, however, remained partially sheathed and only 10–12 mm long. Their bodies and heads were fully covered with feathers, predominantly bright olive green above with yellowish highlights on the wings and face. The breast and flanks were yellow-green, the throat and lower breast were grayish, becoming buffy on the lower belly and vent. During the final days before fledging, their bills became largely black, retaining only a thin whitish line along the tomia. The rictal flanges remained inflated, but lost most of the yellow, becoming noticeably duller white, but still strongly contrasting with the black bill (Figure 2, row 4). Their mouth linings became largely dull red or pinkish. Fledglings retained the coloration and patterning of females, with juvenile males developing a black facial mask by the end of the first year and complete adult plumage by the second year (Hilty 2020).

Parental care. Parental care behaviors were quantified based on 70 hours of observations at a single nest in 2002 and 46.25 hours from a second nest in 2006. The 2006 nest failed when the nestlings were six days old. Nestlings from the 2002 nest were approximately one week old when discovered and observations took place until the disappearance of the young 14 days later (approximately 20 days after hatch). The young may have fledged, but departure was not observed.

For the 2002 nest, the adults averaged 1.2 ± 0.39 visits/nestling/h (3 nestlings, N = 250 visits), and the male and female typically alternated visits to the nest. The male averaged 0:4 ± 0:10 per visit (min:s; N = 118 visits) while the female averaged 1:38 ± 0:02 (N = 131 visits over the same time period), a significant difference in time spent visiting the nest between the sexes (t-test, T-stat = 5.45, $P < 0.001$) that was consistent throughout the observations. Due to the structure of the nest and the position of the camera, it was impossible to consis-

tently document behaviors inside the nest but when observed, the longer female visits were generally due to brief periods of brooding, nest maintenance, and sanitation before the adult departed. The male was observed performing nest maintenance but not brooding.

For both nests, adult visits were regularly distributed throughout the day (Index of Dispersion; Fowler et al. 1998). For the 2006 nest, adults averaged 0.81 ± 0.04 visits/nestling/h (3 nestlings, N = 100). The female made 65.0 % (N = 100) of visits after hatch. Once hatching occurred, the male began entering the nest and feeding the young but the female still invested more in the breeding effort, primarily through brooding. Post-hatch, in addition to a greater number of visits, the female spent an average of 22:04 ± 3:16 min:s per visit (N = 65 visits) inside the nest brooding and feeding, while the male averaged 0:37 ± 0:14 min:s per visit (N = 35 visits), a statistically significant difference (t-test, T-stat = 6.55, P < 0.001). Since the nestlings were depredated within the first week after hatch, this pattern only reflects behavior early in the nestling period. The male was observed performing nest maintenance but not brooding.

Males and females typically returned to the nest together with the female frequently visiting first, while the male flew past the nest in an apparent coordinated misdirection flight. Coordinated misdirection flights were observed in 53 of 201 visits to the 2006 nest (26.3% of visits) with the male performing the misdirection 70% of the time and the female 30%. For the 2002 nest, the male performed all but one of the observed misdirection flights (20 of 21). All observations at the 2002 nest occurred post hatch. In the 2006 nest, the female was not observed performing misdirection flights during the incubation period, but performed 16 of 26 misdirection flights after hatch as she returned to the nest with the male to feed and brood the young.

The female was observed consuming fecal material at one nest on 25 occasions and may have carried material away on one occasion, although it was impossible to confirm due to poor light and camera angle. Fecal material was generally runny with poor structure, and appeared challenging for the adult to remove and consume, likely similar to those described by Di Sallo et al. (2019) for *E. pectoralis*. Frequently, the female consumed multiple fecal masses per visit. The male was observed to consume fecal material on only a single occasion.

DISCUSSION

Limited participation by male euphonias in incubation and brooding is typical for the genus (Isler & Isler 1987) and has been noted in *E. hirundinacea* (Skutch 1954, Sargent 1993), *E. xanthogaster* (Cisneros-Heredia 2006), *E. chlorotica* (Perella et al. 2017), *C. cyanocephala* (Wright et al. 2017), and *E. pectoralis* (Di Sallo et al. 2019), and we confirm from our observations that the male did not participate in incubation or brooding. Females also typically perform nest sanitation (Janni et al. 2008, Di Sallo et al. 2019). We observed the male at one nest consume a fecal sac and, although many sources suggest male euphonias do not contribute to nest sanitation, it has been reported elsewhere in the literature for *E. xanthogaster* (Janni et al. 2008) and *C. cyanocephala* (Wright et al. 2017).

In contrast to what was observed for a single *E. xanthogaster* nest by Cisneros-Heredia (2006), males did provide significant care at both observed nests. Males at both nests provided significant parental care in the form of provisioning, alternating feeding visits with the female, and were also the primary performers of misdirection flights throughout the nesting period. Misdirection flights have been described for a number of species. Skutch (1954) noted them in a variety of species —including *E. hirundinacea*, *E. imitans*, *C. occipitalis*, *Todirostrum cinereum*, and *Poecilotriccus sylvia*— although Skutch interpreted them as a race that is frequently won by the female. Gulson-Castillo et al. (2018) suggests this behavior is widespread among Neotropical birds, being found among at least 28 species across five families, and that the behavior serves as a visual distraction to predators as nesting individuals approach the nest. The behavior has been documented among 11 euphonia species including *E. chlorotica* (Kirwan 2009), *C. cyanocephala* (Wright et al. 2017), *C. elegantissima* (Fragoso et al. 2021), *E. gouldi* (as described in Gulson-Castillo et al. 2018), *E. hirundinacea* (Sargent 1993), *E. imitans* (Skutch 1972), *E. luteicapilla* (Skutch 1954), *E. minuta* (Skutch 1972), *E. pectoralis* (Di Sallo et al. 2019), *E. rufiventris* (as reported in Gulson-Castillo et al. 2018), and *E. xanthogaster* (Cisneros-Heredia 2006) and is likely widespread across the genus.

Overall, the form and coloration of the nests were similar to the descriptions of previous authors (Cisneros-Heredia 2006, Solano-Ugalde et al. 2007). Likewise, the development of nestlings was similar to observations for other *Euphonia* (*E. hirundinacea*, Skutch 1954; *E. minuta*, Skutch 1972; *E. pectoralis* Di Sallo et al. 2019). Since we did not observe fledging, we were unable to confirm the length of the nestling period, although it was likely 20–21 days for one nest. Nestling periods are reported to be 15–21 days for *Euphonia* species (for a summary of published data, see Di Sallo et al. 2019). Egg coloration, clutch size, patterns of parental care, and nest sanitation are also consistent with observations reported for other species of *Euphonia*, although key information on the natural history of many *Euphonia* species remains poorly known.

ACKNOWLEDGEMENTS

We thank researchers at the Yanayacu Biological Station in Cosanga, Ecuador, for their help in recording nest footage and nest information. We also thank Kristina Cockle, Carlos Bosque, and anonymous reviewers for comments to improve the manuscript. The work of JLP and FK was supported by grants from Bethel University. The field work of HFG is supported in part by Field Guides Inc., and by J. V. Moore and M. Kaplan through the Population Biology Foundation.

REFERENCES

Barnard, GC (1954) Notes on the nesting of the Thick-billed Euphonia in the Panama Canal Zone. *The Condor* 56: 98–101.

BirdLife International (2022) Species factsheet: *Euphonia xanthogaster*. Available at http://www.birdlife.org on [Accessed 29 December 2022].

Bonaparte, CL (1851) Note sur les Tangaras, leurs affinités, et descriptions

d'espèces nouvelles. *Revue et Magasin de Zoologie Pure et Appliquée* 3: 129–138.

Cisneros-Heredia, D (2006) Notes on breeding, behaviour and distribution of some birds in Ecuador. *Bulletin of the British Ornithologists' Club* 126: 153–164.

Clark, HL (1913) Anatomical notes on some genera of passerine birds. *Auk* 30: 262–267.

Collar, N, I Newton & A Bonan (2018) Finches (Fringillidae). *In* J del Hoyo, A Elliott, J Sargatal, DA Christie & E de Juana (eds). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona, Spain. Available at https://www.hbw.com/node/52376 [Accessed 03 November 2022].

Di Sallo, FG, A Bodrati, & K Cockle (2019) Nesting and natural history of the Chestnut-bellied Euphonia (*Euphonia pectoralis*) in Misiones, Argentina and comparison with other species in the genus. *Ornitologia Neotropical* 30: 19–26.

Fowler, J, L Cohen & P Jarvis (1998) Practical statistics for field biology, 2nd ed. John Wiley and Sons, Chichester, U.K.

Fragoso, C, V Sosa & P Rojas (2021) Nesting behavior of the Elegant Euphonia (*Euphonia elegantissima*, Aves: Fringillidae) in urban and suburban sites of east Mexico*. Acta Zoologica Mexicana* 37: 1–19.

Greeney, HF, D Gualingua, M Read, C Puertas, L Evans, O Baihua & RP Killackey (2018) Rapid inventory, preliminary annotated checklist, and breeding records of the birds (Aves) of the Boanamo indigenous community, Orellana Province, Ecuador*, Neotropical Biodiversity* 4: 10–44.

Gulson-Castillo, ER, HF Greeney & BG Freeman (2018) Coordinated misdirection: a probable anti-nest predation behavior widespread in Neotropical birds. *The Wilson Journal of Ornithology* 130: 583–590.

Hilty, S & WL Brown (1986) A guide to the birds of Colombia. Princeton University Press. Princeton, NJ.

Hilty, S (2020) Orange-bellied Euphonia (*Euphonia xanthogaster*). *In* J del Hoyo, A Elliott, J Sargatal, DA Christie & E de Juana (eds). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona, Spain. Available at https://www.hbw.com/node/61802 [Accessed 03 November 2022].

Imfeld, TS, FK Barker & RT Brumfield (2020) Mitochondrial genomes and thousands of ultraconserved elements resolve the taxonomy and historical biogeography of the *Euphonia* and *Chlorophonia* finches (Passeriformes: Fringillidae). *The Auk: Ornithological Advances*, 137:1-25.

Isler, ML & PR Isler (1987) *The tanagers. Natural History, Distribution, and Identification*. Smithsonian Institution Press, Washington, D.C., USA.

Janni, O, G Boano, M Pavia & G Gertosio (2008) Notes on the breeding of birds in Yanachaga- Chemillén National Park, Peru. *Cotinga* 30: 42–46.

Kerbs, B (2016) *Xanthosoma undipes* as a food source for Black-chinned Mountain-Tanager (*Anisognathus notabilis*) and the Orange-bellied Euphonia (*Euphonia xanthogaster*) in northwest Ecuador. *Ornitología Neotropical* 26: 103–107.

Kirwan, G (2009) Notes on the breeding ecology and seasonality of some Brazilian birds. *Revista Brasileira de Ornitologia* 17: 121–136.

Marini MA, FJA Borges, LE Lopes, NOM Sousa, DT Gressler, LR Santos, LV Paiva, et al (2012) Breeding biology of birds in the Cerrado of Central Brazil. *Ornitologia Neotropical* 23: 385–405.

Nelson, EW (1912) Descriptions of new genera, species and subspecies of birds from Panama, Colombia and Ecuador. *Smithsonian Miscellaneous Collections* 60: 1–25.

Perella, DF, PV Davanco, LS Oliveira, LMS Sousa & MR Francisco (2017) Reproductive aspects of the Purple-throated Euphonia, *Euphonia hlorotica* (Aves: Fringillidae) in southeastern Brazil, and first record of the species nesting inside a vespiary. *Zoologia* 34: e19989.

Pérez-Rivera, RA (1991) Change in diet and foraging behavior of the Antillean Euphonia in Puerto Rico after Hurricane Hugo. *Journal of Field Ornithology* 62: 474–478.

Phelps, KD (1954) Cien de las Más Conocidas Aves Venezolanas. Editorial Lectura, Caracas, Venezuela.

Sargent, S (1993) Nesting biology of the Yellow-throated Euphonia: Large clutch size in a neotropical frugivore. *Wilson Bulletin* 105: 285–300.

Skutch, AF (1954) *Life histories of Central American birds: families Fringillidae, Thraupidae, Icteridae, Parulidae and Coerebidae* (No. 598.29728 S629). Cooper Ornithological Society, Berkeley, California, USA.

Skutch, AF (1972) Studies of tropical American birds. Nuttall Ornithology Club N° 10, Cambridge, Massachusetts, USA.

Solano-Ugalde A, A Arcos-Torres & HF Greeney (2007) Additional breeding records for selected avian species in northwest Ecuador. *Boletín SAO* 17: 17–25.

Videolan Organization (2013) VLC media player. Available at www.videolan.org [Accessed 02 February 2018).

Wetmore, A (1914) The development of the stomach in the euphonias. *The Auk* 31: 458–461.

Wright, Z., J Port & HF Greeney (2017) Male and Female Parental Care in Golden-rumped Euphonia (*Euphonia cyanocephala*). *Ornitologia Colombiana* 16: eNB07

Zuccon D, R Prys-Jones, PC Rasmussen & PGP Ericson (2012) The phylogenetic relationships and generic limits of finches (Fringillidae). *Molecular Phylogenetics and Evolution* 62: 581–596.