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DETAILED DESCRIPTION OF THE NEST, EGGS, AND NESTING HABITAT OF THE MICRO-ENDEMIC, NEAR THREATENED ROSE-BELLIED BUNTING (*PASSERINA ROSITAE*)

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Resumen. – Descripción detallada del nido, huevos y hábitat de anidación del colorín azul rosa (*Passerina rositae*), una especie micro-endémica y amenazada. – El colorín azul rosa (*Passerina rositae*) es una especie amenazada y endémica a una microregión del sureste mexicano. Aunque existe un creciente número de registros de la especie, poco conocemos sobre su historia natural, con sólo un trabajo publicado en los 1960s. En este trabajo describimos detalladamente el nido, los huevos y los sitios de anidación del colorín azul rosa basados en 15 nidos. Todos los nidos fueron encontrados en cañadas de bosque tropical sub-perennifolio con condiciones más cálidas que los bosques tropicales secos adyacentes. Los nidos fueron localizados en alturas de 0,3–2,5 m y estaban constituidos por corteza de árboles, ramas pequeñas y telarañas. Las dimensiones promedio de los nidos medidos son: diámetro exterior 120 × 130 mm, altura exterior 124 mm, profundidad interior 48,5 mm y diámetro interior 53,5 mm. El número de huevos que encontramos por nido osciló entre dos y cuatro. En general, los huevos eran blancos con manchas café-rojizas, mayormente concentradas en la porción más ancha. El tamaño de los huevos medidos varió entre 18,8 mm × 13,6 mm y 20,1 mm × 15,3 mm. Las dimensiones de los nidos y los huevos del colorín azul rosa fueron similares a los de especies hermanas del mismo género. Sin embargo, la apariencia general de los nidos fue más similar en relación con la de especies no tan cercanamente emparentadas. Nuestras observaciones nos permitieron registrar el uso de diferentes hábitats por parte del colorín azul rosa, con grandes parvadas alimentándose en campos de cultivo en la época no reproductiva, mientras que los nidos se encontraban concentrados en cañadas inmersas en bosques nativos. Con base en nuestras observaciones recomendamos que los planes y esfuerzos de conservación enfocados a esta especie incluyan áreas montañosas con orografía accidentada y vegetación conservada en cañadas.

Abstract. – The near-threatened Rose-bellied Bunting (*Passerina rositae*) is micro-endemic to the Isthmus of Tehuantepec, Mexico. Little is known on the natural history and habitat use of the Rose-bellied Bunting, with only one account of two nests from the 1960s. Here, we describe the nest, eggs, and nesting habitat of the Rose-bellied Bunting in 15 nesting locations. All nests were found in tropical dry semi-deciduous forest along ravines with warmer conditions that adjacent tropical dry deciduous forests. Nests were located at a height of 0.3–2.5 m from the ground, and were mainly constructed of tree bark, thin twigs, and spider webs. Average dimensions of the measured nests were: external diameter 120 × 130 mm, external height 124 mm, internal depth 48.5 mm, and internal diameter 53.5 mm. The number of eggs we found per nest oscillated from two to four. In general, eggs were plain white with reddish-brown spots, mostly concentrated at the large end. The size of the measured eggs varied from 18.8 mm × 13.6 mm to 20.1 mm × 15.3 mm. Nest dimensions and egg characteristics of the Rose-bellied Bunting were similar to those of sister species of the *Passerina* genus. However, the appearance of the nests we found resembles that of species that are not that closely related. Our observations allowed us to record the use of different habitats by the Rose-bellied Bunting, with large numbers feeding in croplands throughout the non-breeding season, and nests concentrated along ravines immerse in native forests. Although Rose-

bellied Buntings seem to take advantage of human-disturbed landscapes, forest habitats have been transformed dramatically in the region due to human activities. Based on our observations, we suggest that conservation plans and efforts focused on this species should include hilly areas of rough terrain and well-preserved ravines. *Accepted 25 October 2011*.

Key words: Rose-bellied Bunting, *Passerina rositae*, conservation, Mexico, natural history, Oaxaca, ravine.

INTRODUCTION

The Rose-bellied Bunting *Passerina rositae* (Lawrence 1874) is a medium-sized landbird from the Cardinalidae family (AOU 1998, Chesser *et al.* 2010) with important conservation concerns (IUCN 2010, SEMARNAT 2010). It is endemic to a micro-region of southeastern Mexico (~ 7401 km^2 *sensu* Ridgely *et al.* 2007), specifically to the southern part of the Isthmus of Tehuantepec, including southwest Chiapas and the Sierra Tolistoque (16°36'23"N, 94°52'42"W), Oaxaca (Howell & Webb 1995). Although its distribution is very restricted, it is locally abundant within its geographic range in arid to semiarid thorn forests, semihumid deciduous gallery woodlands and edge, in hilly areas (Howell & Webb 1995, Morales-Pérez 2002, Palomera-García *et al.* 1994). Currently, there is a rising number of museum and sight-records of this species (n = 759; Arizmendi Arriaga 2006); however, little is known about its natural history.

Nearly 50 years ago, Crossin & Petit (1962) published a short note with the first description of the nest and eggs of the Rose-bellied Bunting. In their publication, Crossin & Petit reported two active nests with 3–4 eggs located 5–12 ft (1.5–3.7 m) from the ground in tree saplings (no plant species were reported). These nests were made out of dead leaves, shredded bark, and fine weed stems, with the interior made of fine weed stems. The dimensions of the nests collected by Crossin & Petit were: external diameter 100–120 mm, external height 60–72 mm, internal depth 40–50 mm, and internal diameter 50–55 mm. The eggs of the Rose-bellied Bunting had dimensions ranging 19.0–21 mm × 14–15 mm and were described as "plane white to light blueish ground color, spotted and blotched with reddish brown lavender, chiefly around the large end" (Crossin & Petit 1962: 58).

Here, we provide a detailed description of the nest, eggs, and nesting habitat of the Rose-bellied Bunting based on 15 nesting locations along the central section of its distribution (*sensu* Howell & Webb 1995). We also compare our findings with those of Crossin & Petit (1962), the nest and eggs of other species of the genus *Passerina*, and report the array of plants and habitat conditions of the nesting sites within a human-disturbed landscape in which we found nests. Finally, we discuss important environmental issues that could aid in the conservation of this threatened micro-endemic landbird.

METHODS

Study area. We conducted nest searches in the central part of the distribution of the Rose-bellied Bunting, particularly in the Sierra de Tolistoque (altitudinal range 150–800 m a.s.l.; Fig. 1). This region is characterized by a warm sub-humid climate, with average annual temperature of 27.4°C, average rainfall of 1394 mm (principally occurring during summer) and a severe long drought period (García 1988). The area was originally covered by tropical dry deciduous forests and semi-deciduous forest along effluents and alluvial plains. Tropical dry deciduous forests are present along hills and have an average

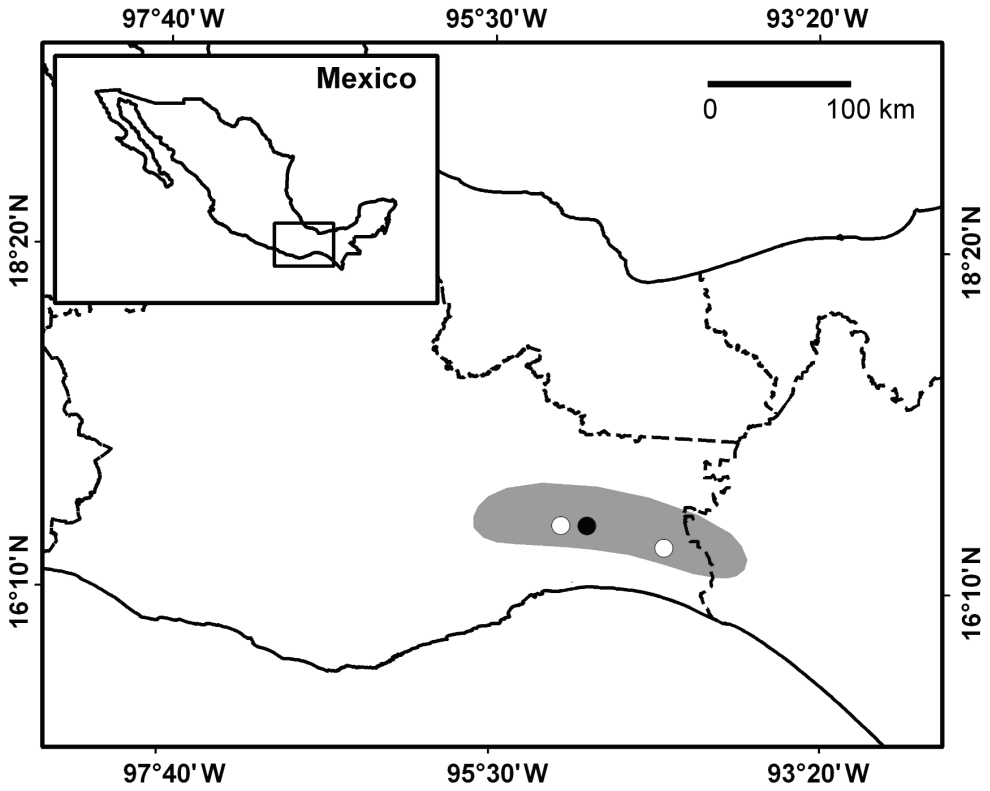

FIG. 1. Map of study area depicting our survey location (black circle) and the sites where Crossin & Petit (1962) collected Rose-bellied Bunting nests (white circles). The gray area represents the distribution of the Rose-bellied Bunting (*sensu* Ridgely *et al.* 2007), and segmented lines state limits.

canopy height of 7 m, of which the majority of trees drop their leaves for 5–8 months of the year (Rzedowski 2006). By comparison, tropical dry semi-deciduous forests exist in lower proportion and retain their leaves longer throughout the year (Rzedowski 2006). Original habitats are being regionally transformed into cattle pastures, croplands, orchards, human settlements, and wind farms (Flores-Mondragón 2007). As a result, they have been dramatically fragmented and are currently endangered at the national scale (Trejo & Dirzo 2002).

Nest searches. As part of a study focused on the reproductive biology of the Rose-bellied Bunting, we recorded the behavior of every sight-recorded individual from March to June 2011 in the studied landscape, including plains, hills, and ravines. When a nests was found, we remained hidden at a minimum distance of 20 m to minimize the effect of our presence on the adults and/or the chicks. We approached the nests when the adults were absent only to take pictures and to check whether the nest was active or inactive, always checking that no potential predators were present in the area. Nests revisions were made as quick as possible.

Nest, egg, and habitat measurements. Every time we found a nest, we recorded if it was active

or inactive and collected plant samples of nearby individuals of the same species. When nests were active, we did not measure them. For nest measurements in the field, we recorded all materials used for its construction and four values using a metric tape: external diameter, external height, internal depth, and internal diameter. We also measured the height of the plant on which the nests were constructed, the distance from the upper part of the nest to the ground, and the distance between nearest nests. We collected one inactive nest, which was measured in the laboratory using the same metric tape. We did not collect, nor manipulated, any eggs of the Rose-bellied Bunting due to its conservation status. Instead, we used calibrated photographs, taken parallel to the eggs, to measure their size and describe their coloration and marks. Photograph calibrations were made in relation to the internal diameter of the nests, for which we used the average value of the measured nests (53.5 mm). We only measured eggs in horizontal position to avoid perspective biases. We also measured humidity and temperature values at eight locations where we found Rose-bellied Bunting nests along ravines. We also measured humidity and temperature values at eight sites located in tropical dry deciduous forests located 50 m away from the ravine sites. All humidity and temperature measurements were taken during the hottest period of the day (12:00–16:00 h).

Statistical analyses. We performed t-tests to contrast humidity and temperature values in tropical dry deciduous and semi-deciduous forests.

RESULTS

After searching for almost two months, we found the first Rose-bellied Bunting nest on 6 May 2011. The nest was constructed in a ravine, on a branch bifurcation of a scratchbush sapling (*Urera baccifera*, Urticaceae). The nest was located at 1.20 m from the ground, and sheltered by a dense assemblage of leaves upon it. The main vegetation type along the ravine was semi-deciduous forest, with similar humidity conditions ($t = -0.3823$, $P = 0.7136$), but warmer than the adjacent tropical dry deciduous forest ($t = 2.8403$, $P = 0.02$). The nest had four eggs, which clutched successfully 22 days later (Fig. 2).

After the first nest, we found 14 additional nests, all under very similar conditions. We found the nests within a wide range of heights from the ground (0.3–2.5 m), and located at distances of 10–60 m among each other. One of the major differences between nesting sites were the plants on which nests were constructed, ranging from small shrubs (30 cm tall), to large trees (15 m tall). We identified seven plant species on which the Rose-bellied Bunting nests were constructed: two nests on a scratchbushes, two on broomticks (*Trichilia hirta*, Meliaceae), three on crotons (*Croton reflexifolius*, Euphorbiaceae), two on jacquinias (*Jacquinia macrocarpa*, Theophrastaceae), two on templetrees (*Plumeria rubra*, Apocynaceae), two on ratapples (*Morisonia americana*, Capparaceae), and three on capers (*Capparis verrucosa*, Capparaceae). We collected samples of all plant species on which nests were constructed. After their identification, we deposited them at the herbarium of the Instituto de Ecología, A.C., Xalapa (XAL).

In order to describe nest characteristics in detail, we collected one of the inactive nests (which was recorded active previously). Prior to its removal, we checked for parental activity for three days. When we collected the nest, we discovered a small piece of eggshell in the bottom of the nest, which in addition to the absence of feathers and/or fledgling excretes in the border of the nest suggest that it was depredated before we collected it. Although the internal part of the nest represented an almost perfect circumference, its external part

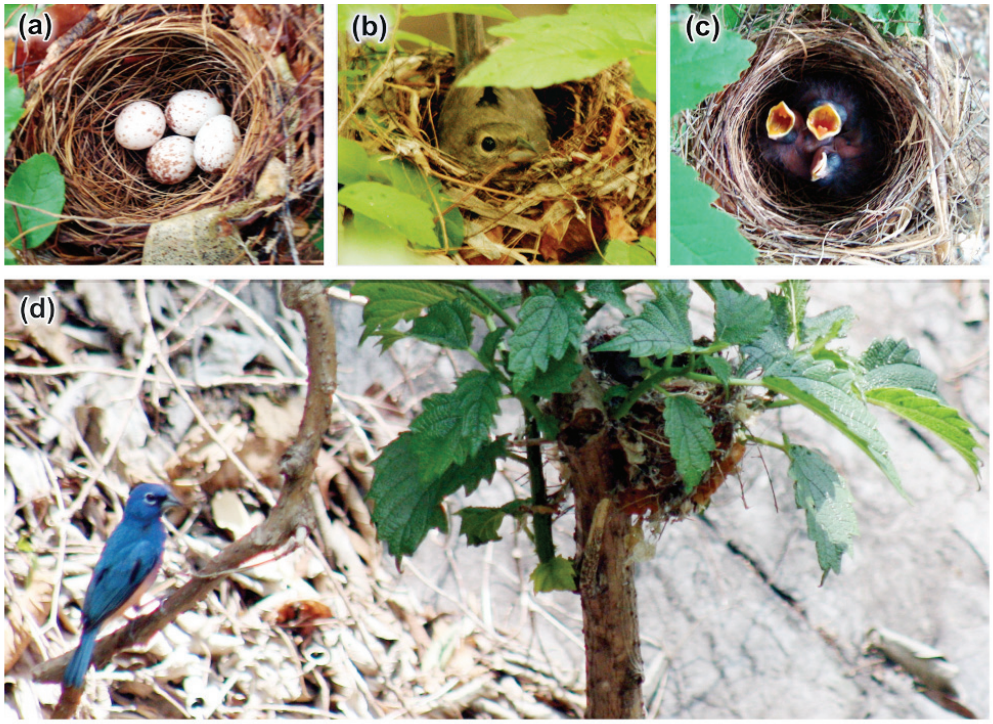

FIG. 2. Nest and nest site of the Rose-bellied Bunting at a ravine of Sierra Tolistoque with: (a) eggs, (b) female incubating, (c) chicks, and (d) male. Photographs: C. E. Sánchez-Perez (a), W. Vásquez (b–d).

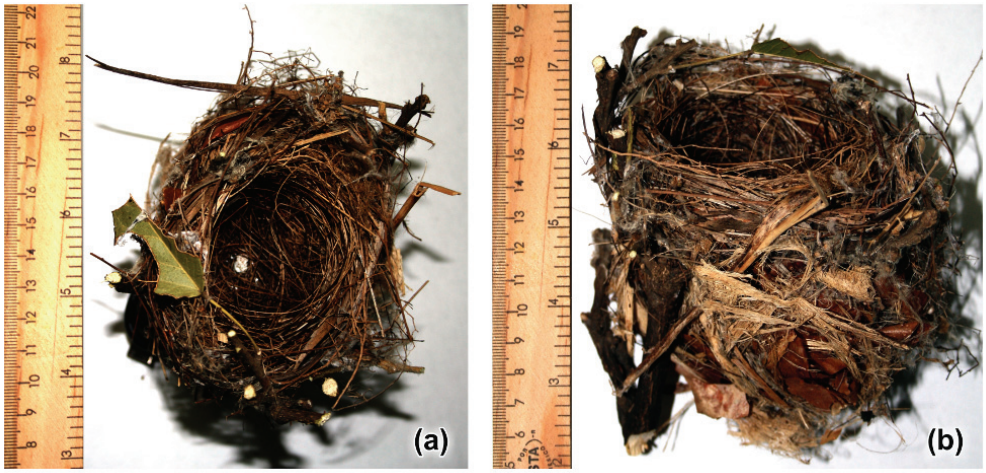

FIG. 3. Collected nest of the Rose-bellied Bunting (MZFC 24280) in upper (a) and lateral (b) view (photographs: I. MacGregor-Fors).

resembled an ellipse. The dimensions of the collected nest were: external diameter 120 × 135 mm, external height 128 mm, internal depth 47 mm, and internal diameter 57 mm.

The main material of the external part of the nest was tree bark of some species of *Bursera* (Burseraceae), among other non-identified trees. The external part was also comprised by different types of thin twigs and spider webs, which in some cases attached the nest to the plant on which it was constructed. The internal part of the nest was only comprised by very thin twigs interlaced among them forming a circular pattern (Fig. 3). After the nest was examined, we deposited it in the Museo de Zoología "Alfonso L. Herrera", at the Universidad Nacional Autónoma de México (MZFC 24280).

We also measured the dimensions of one inactive nest in the field (external diameter 120 × 125 mm, external height 120 mm, internal depth 50 mm, and internal diameter 50 mm). This nest had excretes in its border, and we found eggshell remains on the ground nearby the nest. After checking the nest for two days, we did not record any activity, nor evidence of predation, and thus, we assumed it was successful. Although the rest of the nests were similar to the one we collected, we found two extra materials used by the Rose-bellied Bunting to build the external part of other nests: (1) snake skin, and (2) feathers. The number of eggs we found per nest oscillated from two to four. In general, eggs were plain white with reddish-brown spots, mostly concentrated at the large end. The size of the measured eggs ranged from 18.8 mm × 13.6 mm to 20.1 mm × 15.3 mm.

DISCUSSION

Comparisons with previous studies. When we compared the dimensions of the nests reported by Crossin & Petit (1962) with those from our measurements, we found that the internal parts were fairly similar. However, the dimensions of the external parts reported by Crossin & Petit (1962) differed from our measurements. On average, the external diameter they reported is 16% smaller than the external diameter of the nests we measured, while the external height is 88% smaller than that from our measured nests. The sizes of the eggs we measured were also similar to those reported by Crossin & Petit (1962), with only slight differences in their length (average difference = 0.55 mm). Another important difference was the height at which Rose-bellied Buntings construct their nests. Crossin & Petit (1962) found the collected nests at 1.5–3.7 m, while the 15 nests we found were located 0.30–2.5 m from the ground.

Comparisons with other species of the Passerina *genus.* When we compared the nature and dimensions of the recorded nests and eggs with those of other species of the genus *Passerina*, we found that the Rose-bellied Bunting constructs nests with larger external diameter and height than all other congeners. The internal diameter of the Rose-bellied Bunting's nest was similar to the rest of the species of the genus, excepting the Blue Grosbeak (*P. caerulea*), which is on average larger-sized (ca. 14% in length; Poole 2011), and the Lazuli Bunting (*P. amoena*), for which a wide range of values has been reported (40–70 mm; Poole 2011). The internal depth of the Rose-bellied Bunting's nest is larger than that of the nests of the Painted Bunting (*P. ciris*) and the Varied Bunting (*P. versicolor*), but it is similar to the internal depth of nests of all other species of the genus. The dimension of the Rose-bellied Bunting eggs is similar to the eggs of the rest of the species of the genus, with exception of the eggs of the largest species of the genus (*P. caerulea*). The only species of this genus with marked eggs that we know of (other than the Rose-bellied Bunting), is the Painted Bunting (Poole 2011). However, we found no information about the nature of the nest and eggs of the Orange-breasted Bunting (*P. leclancherii*), and therefore we were unable to compare our findings with this spe-

cies. Although the biogeographic origin of the species pertaining to the *Passerina* genus are different, we found nest similarities (i.e., internal depth, and spotted eggs) among the Rose-bellied Bunting and its three nearest sister species (i.e., Painted, Varied, and Orange-breasted Bunting; Klicka *et al.* 2001). However, the physical aspect of the Rose-bellied Bunting's nest resembles that of two species that are not that closely related to it (i.e., Lazuli and Indigo Bunting *P. cyanea*; Poole 2011).

Conservation issues related to P. rositae. Our observations suggest that the Rose-bellied Bunting is mostly using ravines as nesting sites. These sites have warmer conditions that those found outside the ravines, although the humidity of the surrounding areas is similar. The fact that we only found nests along ravines represents an important threat for this species in context of human modified landscapes. Habitat transformation could have positive effects on this species - e.g., large numbers of the Rose-bellied Bunting feed along croplands in our study area throughout the non-breeding season (pers. observ.). However, forest habitats have been transformed in the region dramatically (Trejo & Dirzo 2002, Flores-Mondragón 2007). Although no targeted conservation actions are known for this species (BirdLife International 2011), some areas have been declared as sites with conservation purposes, comprising 8% (601.6 km^2) of the species' distribution (*sensu* Ridgely *et al.* 2007) (i.e., Cerro del Chilar Área de Uso Común, El Bejucal y la Chichihua, San Isidro Lachiguxe y Peña Blanca Lachiguxe, Zona 1 y 2 del Área de Uso Común, Zona de Preservación Ecológica Cerro de Las Flores, Zona de Preservación Ecológica Cerro de Las Flores-Chayotepec, Zona de Uso Común en Cerro Bandera de la Sierra Tolistoque, Zona de Uso Común en Ojo de Agua del Cerro Tolistoque, Zona de Uso Común en Rio Verde del Cerro de Tolistoque, La Sepultura, CONANP 2011). Thus, based on our observations, we suggest conservation efforts and plans in the area to consider hilly areas with rough terrain, including well-preserved ravines. However, as ravines are somehow less affected by human land-use change, Rose-bellied Buntings could be nesting in ravines as they represent some of the most preserved forested sites in the area. Thus, future studies on the natural history of this species are needed, basically focused on habitat use and behavioral aspects, as they could shed some light in the generation of specific management and strategies for the conservation of the Rose-bellied Bunting.

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