ORNITOLOGIA NEOTROPICAL 23: 225–234, 2012

BREEDING BIOLOGY OF WHITE-EARED GROUND-SPARROWS (*MELOZONE LEUCOTIS*), WITH A DESCRIPTION OF A NEW NEST TYPE

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Resumen. – Biología reproductiva del Cuatro-ojos de Cabeza Negra (*Melozone leucotis*), con la descripción de un nuevo tipo de nido. – Proveemos la primera descripción detallada de la biología reproductiva del Cuatro-ojos de Cabeza-negra (*Melozone leucotis*), una especie de paseriforme Neotropical que habita tacotales en Centroamérica muy poco estudiada. Basados en ocho años de datos colectados de varias poblaciones del Valle Central de Costa Rica, describimos el nido, huevos, parasitismo, cuido parental y fenología reproductiva de *M. leucotis*. Los nidos pertenecen a uno de dos tipos; el primer tipo es una estructura gruesa de fibras vegetales en la capa externa rugosa y una interna fina, y el segundo tipo es una estructure más simple y pequeña en forma de plataforma de palitos. El primer tipo de nido se encuentra localizado entre la vegetación cera al suelo, y el segundo directamente sobre el suelo. Esta es la primera descripción del segundo tipo de nido. Los huevos son de color blanco en el fondo con manchas cafés, y la nidada va de dos a tres huevos. El parasitismo por parte de los Piuces (*Molothrus aeneus*) fue severo; cinco de los diez nidos encontrados fueron parasitados, incluyendo dos nidos hiperparasitados con 6 y 7 huevos de *M. aeneus*. Las hembras incuban los huevos y alimentan a los pichones, mientras que el macho asiste localizando el alimento para los jóvenes. Esta especie posee una época reproductiva larga de Marzo (a finales de la época seca) hasta setiembre (durante la época lluviosa). Esta investigación es la primera descripción formal del comportamiento reproductiva de esta especie, para un género de aves donde el comportamiento es poco conocido en los trópicos.

Abstract. – We provide the first detailed description of the breeding biology of White-eared Ground-sparrows (*Melozone leucotis*), a little-studied Neotropical songbird that inhabits thickets in Central America. Based on eight years of data collected from populations in the Central Valley of Costa Rica, we describe White-eared Ground-sparrows' nests, eggs, nest parasitism, parental behavior, and breeding phenology. Nests conformed to one of two general types: (1) a bulky structure of plant fibres with a coarse outer layer and a fine inner layer; and (2) a smaller, simpler structure made up of a platform of thin plant fibres placed on top of rocks. Nest of the former type were located in vegetation near the ground, whereas the latter type were constructed directly on the ground. This is the first description of the second nest type. Eggs had a white background with variable brown spotting. Eggs were laid in clutches of two or three. Parasitism by Bronzed Cowbirds (*Molothrus aeneus*) was severe; five of ten nests were parasitized, including two that were multiply parasitized with 6 and 7 cowbird eggs. Only females were observed incubating the eggs, but both sexes provisioned nestlings; only females were observed provisioning fledglings while males assisted in locating food. This species has a long breeding season, begins in March (late dry season), and continues until September (late rainy season). We provide the first formal description of the breeding behaviour of White-eared Ground-sparrows, from a genus of birds whose behaviour is poorly known in the tropics. *Accepted 11 June 2012.*

Key words: White-eared Ground-sparrow, *Melozone leucotis*, breeding biology, nest architecture, nest type description, thicket habitat.

INTRODUCTION

The breeding biology of many species of tropical birds is poorly described and many species have never been studied in detail (Stutchbury & Morton 1995, Macedo *et al.* 2008). This gap in our knowledge is especially problematic for birds whose populations are declining or whose habitats are being increasingly threatened. Information about breeding biology of these species is valuable in its own right, but may also help to guide management and conservation decisions (Greeney & Rombough 2005, Greeney *et al.* 2008, Sandoval & Gallo 2009).

Tropical *Melozone* species live in thicket habitats (Stiles & Skutch 1989) and these habitats are presently afforded no special conservation attention. Thicket habitats are made up of early successional vegetation that, without management, changes quickly over time. The lack of attention to the biological importance of thicket habitats is expected to result in an overall decrease in this type of habitat, which will have negative conservation implications for bird species that inhabit thickets (Sánchez *et al.* 2009).

White-eared Ground-sparrows (*Melozone leucotis*) are one of three Mesoamerican species in the genus *Melozone* (AOU 1998, DaCosta *et al.* 2009). They are distributed from Chiapas (Mexico) to Costa Rica's Central Valley at elevations of 500–2000 m a.s.l. (Stiles & Skutch 1989, Howell & Webb 1995, AOU 1998, Garrigues & Dean 2007). This ground-sparrow lives year-round in territorial pairs in young successional vegetation stages that vary from secondary forest edges to shade coffee plantations and thickets (Stiles & Skutch 1989, Howell & Webb 1995). Little is known about this species' breeding biology; published knowledge is restricted to anecdotal accounts that include one described nest, the estimated growth rate from a single chick, and the weight and size of two eggs (Winnett-Murray 1985).

In this study, we describe the breeding biology of White-eared Ground-sparrows based on observations collected during eight years of field study including two years of research on a color-banded population in the Central Valley of Costa Rica. We present observations on nests, eggs, brood parasitism, nest location, and parental care. We describe variation in nest architecture and include two accounts of a previously undescribed nest type.

METHODS

We collected data on the breeding biology of White-eared Ground-sparrows from 2003 to 2011 in six locations in Costa Rica, spanning the entire species range in the country. We discovered nests by following adult birds as they delivered nesting material, as they carried food to the nestlings, or when an incubating bird flushed from the nest. When a nest was discovered we recorded its height (m), the substrate on which it was placed, the amount of cover above the nest, and the nest's contents (number of nestlings or eggs). To quantify the nest cover at any height directly above the nest, we used an ordinal scale from 0 (a nest with no vegetation above it) to 5 (nest completely covered with vegetation; Sandoval & Barrantes 2006). We found a total of 10 nests over the eight-year study.

To describe nest architecture, we measured three features: nest height, diameter of the inner cup (an average of two perpendicular measurements), and the depth of the inner cup (measured from the bottom of the center of the nest cup to the rim). We measured length and width at the widest point of eggs to the nearest 0.1 mm using dial callipers. Over eight years, we collected five eggs from three nests. Three of the five eggs were unhatched eggs from normal nests (two from

one nest and one from another nest), whereas the last two eggs came from a parasitized nest. We collected nine nests after breeding was complete. These specimens were deposited in the Museo de Zoología at Universidad de Costa Rica (accession numbers provided below).

We collected data on parental care by observing pairs as they provisioned nestlings or juvenile birds. Over eight years, we gathered observations of 32 different pairs, including 21 pairs where one or more birds were banded. Males and females are monomorphic. We distinguished males from females because females have an incubation patch and shorter tarsi, whereas males lack an incubation patch, have longer tarsi, and develop a cloacal protuberance during the breeding season (LS unpub. data). We characterized the presence of incubation patches based on 21 pairs where at least one member of the pair was banded.

RESULTS

Nests. Over an eight year period of studying White-eared Ground-sparrows in the Central Valley of Costa Rica, we found ten nests. Nests were very difficult to find because this species inhabits the dense vegetation of thickets or shade coffee plantations, and birds are challenging to observe for extended periods. The ten nests were 0 to 2 m in height (Table 1). Four nests were found in coffee plants (*Coffea arabica*) between the main stems; two were on the ground under an overhanging rock; one was among exposed tree roots atop a clay cliff along the edge of a trail; one was below a group of dead cypress branches (*Cupressus luscitanica*); one was placed below an *Araceae* leaf on a dense cluster of grasses; and the last was found between the leaves of a *Dracaena* sp. bush (Dracaenaceae). Six of the ten nests were in shade coffee plantations and four were in unmanaged areas of thicket habitat. Most nests were well concealed with an extensive covering of vegetation; nine of the ten nests had cover scores = 3, whereas the remaining nest was completely uncovered (Table 1).

Eight of the nests matched the existing description of the nest of this species (Winnett-Murray 1985). These nests consisted of a dense cup of loosely woven plant fibres with an inner layer of more tightly-woven plant fibers. Nest size was highly variable, leading to variation in nest measurements: 64.8 ± 16.1 mm in the outside cup height, 36.8 ± 11.4 mm in the inner cup depth, and from 69.3 ± 13.9 mm in the inner cup diameter (Table 1).

We found two active nests with different architecture, which appear to represent a previously undescribed type of nest for this species (Fig. 1). Instead of consisting of a dense cup of dead leaves with a tightly-woven inner nest, these two nests consisted solely of a platform of dead leaf petioles and thin plant fibres. Both nests were placed on the ground in rocky areas. Both nests were found in the same population of birds in Getsemaní, Heredia province (10°02'N, 84°06'W, 1400 m a.s.l). The first nest was located in a hollow area covered by rocks in a secondary forest on the edge of a river (found 16 May 2004). The second nest was located under rocks between a dense young secondary forest growth and a plantation of *Mora* sp. (Moraceae; found 21 April 2011). These nests were markedly different from the other nests and from written descriptions of this species' nest, with a shallower outside cup height 38.7 ± 0.6 mm, inner cup depth 10.8 ± 2.6 mm, and an overall flat structure (Fig. 1, Table 1; values are given as means ± SD here and throughout). These nests also were wider than the previous description, from 76.75 ± 16.0 mm to 86.9 ± 21.2 mm. Nests of both forms were deposited in the Museo de Zoología at Universidad de Costa Rica (accession numbers: UCR1,

TABLE 1. Measurements of ten White-eared Ground-sparrow nests in Costa Rica. Nest type indicates one of two general types: type 1 is a nest with a bulky outer layer of coarse plant material and an inner layer of fine plant material; type 2 is a previously undescribed nest type consisting of a single, smaller layer of plant fibres. Nest cover is a measure of the amount of vegetative cover was scored according to a five point scale (details given in Methods). For one nest (indicated by *) we were unable to collect all nest measurements for one of the nest.

Location	Date	Nest type	Cup height (mm)	Cup diameter (mm)	Cup depth (mm)	Nest heigth (mm)	Nest cover	Nest contents (plus cowbird information)
Getsemaní, Heredia province	25 May 2004	1	47.35	48.3	33.4	2	0	2 eggs
Getsemaní, Heredia province	07 June 2005	1	45.3	73.2	20.5	1	3	2 eggs (plus 1 cowbird hatchling)
Getsemaní, Heredia province	07 May 2006	1	76.25	54.8	36.1	1.3	5	2 eggs (plus 1 cowbird egg)
Getsemaní, Heredia province*	31 August 2008	1	-	-	-	1	5	2 hatchlings and 1 egg
Concepción, Heredia province	18 April 2010	1	88.8	81.4	55.2	1.5	4	2 eggs (plus 6 cowbird eggs)
Concepción, Heredia province	28 April 2010	1	62.5	62.1	30.8	1.6	4	0 eggs (plus 4 cowbird eggs)
Calle Hernandéz, Heredia province	12 May 2011	1	57.75	68.1	33.5	2	5	2 eggs (plus 7 cowbird eggs)
Aserrí, San José province	30 May 2011	1	75.55	72.5	47.8	1	3	0 eggs
Getsemaní, Heredia province	16 March 2004	2	39.15	68.7	12.6	0	5	2 eggs
Getsemaní, Heredia province	21 April 2011	2	38.35	95	9	0	5	2 egg (plus 1 cowbird egg)

UCR20, UCR29, UCR30, UCR40, UCR41 and UCR52-54).

Eggs. We measured nine eggs from five nests, including five eggs that were collected and deposited at the Museo de Zoología at Universidad de Costa Rica. All eggs had a glossy white base with irregular dark brown spots concentrated near the base of the egg (Fig. 2a). Eggs where elliptical in shape. Egg length ranged from 23-27 mm with a mean of 25.6 ± 1.4 mm. Egg width ranged from 17.2–19.9 mm with a mean of 17.8 ± 1.0 mm. The average clutch size of the ground-sparrow at nine nests was 2.2 ± 0.5, ranging from a minimum of two eggs to a maximum of three eggs.

Nest parasitism. We found five nests parasitized by Bronzed Cowbirds (*Molothrus aenneus*). The cowbird eggs were readily distinguished by their white to clear blue color, lack of markings, and more circular shape (Fig. 2b). Two nests were multiply parasitized, with six and seven cowbird eggs in addition to the two ground-sparrow eggs. After we removed cowbird eggs, one of the two host eggs hatched in the first nest and neither of the host eggs hatched in the second nest. The remaining parasitized nests had one or two cowbird

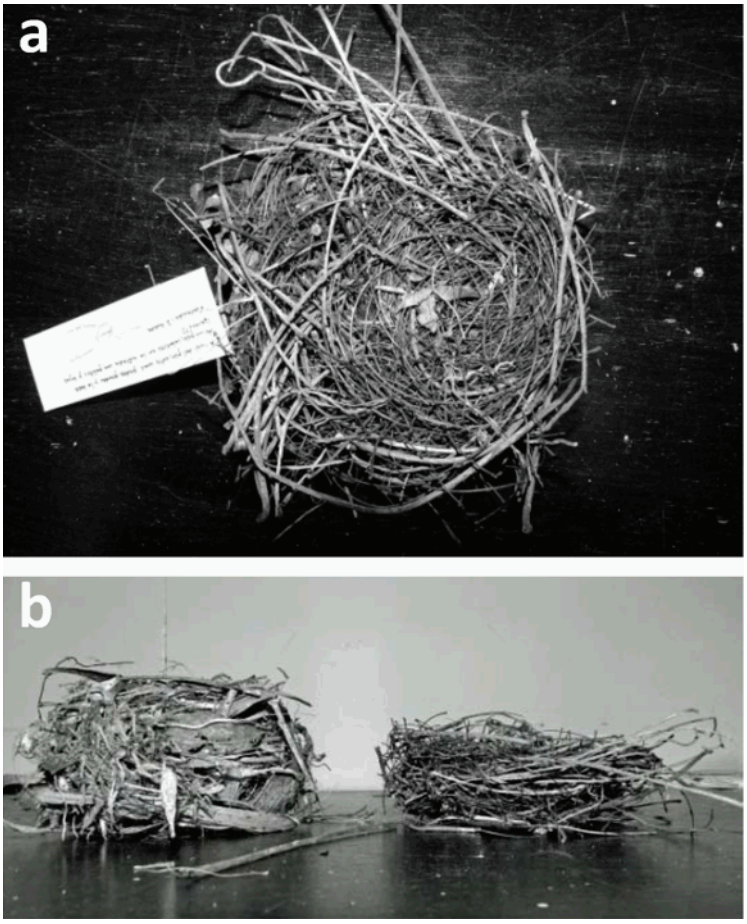

FIG. 1. Photographs of nests of White-eared Ground-sparrows (*Melozone leucotis*) from the Central Valley of Costa Rica. (a) Top view of a nest which lacks the outer layer of loosely woven plant fibres, consisting only of inner layer of more tightly-woven plant fibres (Type 2). (b) Side view comparing the more common nest type (Type 1; left) and the less common, previously undescribed nest type (Type 2; right).

eggs. The mean clutch size for nests that were parasitized by cowbirds was 5.4 ± 2.9 (including both host eggs and cowbird eggs; ranging from 3–9 eggs per nest) (Table 1). In addition, we observed a pair of adult ground-sparrows feeding a fledged cowbird chick (observed on 19 April 2010).

Parental behavior. We banded both parents in 15 pairs and only one of the parents in 6 pairs (N = 38 birds banded over the eight year period). Based on the pairs where both individual were banded only one of the individuals had an incubation patch (the individual without cloacal protuberance), and for three nests where we observed incubation, only the bird with incubation patch (female) was seen to incubate. We observed both parents provision food to the nestlings at three nests observed over approximately 6 h. By contrast, only females provisioned food to young once they had fledged (N = 8 banded pairs and

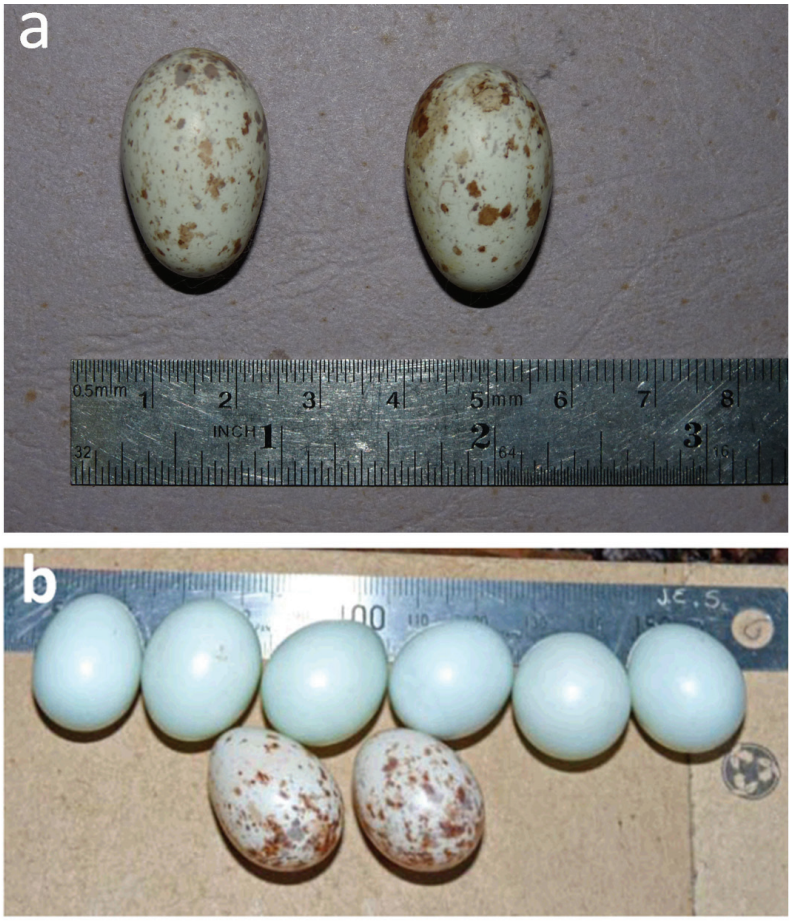

FIG. 2. Photographs of eggs from nests of White-eared Ground-sparrows (*Melozone leucotis*) in the Central Valley of Costa Rica. (a) Eggs had a white base and were marked with variable brown spots. (b) Six eggs of Shiny Cowbirds (*M. aeneus*), and two eggs of White-eared Ground-sparrows from a multiply parasitized nest in Concepción, Heredia province.

approximately 28 h of observations). In these pairs, the male moved far from the female and juveniles, searching for food on the ground or in bushes. Although ongoing playback studies suggest that duets are important in territory defense (LS unpub. data), during the breeding season duets also play a role in revealing the location of food; on multiple occasions, when the male found food, he sang, and the female responded by vocalizing, producing a duet. Females contributed to the duet either from a distance or after flying to perch close to the male. Juveniles often followed the female to the male's position. Females were observed feeding both insects (e.g., moths) and fruits (e.g., *Ficus* sp., *Acnistus arborecens*, and a Melastomataceae berry) to juveniles.

On three occasions while observing a nest, the female was the first to approach the nest or fledglings. Each time, the female

attempted to distract the observer by producing a broken leg display together with harsh noisy calls. During these displays, the male stayed 2 to 10 m from the nest, until the female approached him at which point they duetted and produce solo calls.

Breeding phenology. Our observations suggest that White-eared Ground-sparrows have long breeding seasons. We found nests between March and September, with the maximum number in April and May (N = 3 and 4, respectively). We found only one nest during the other months, except during July when none were found (Table 1). We have observed juvenile birds following adults from March to September. In the Central Valley of Costa Rica, the dry season ends in March or April, and the rainy season lasts from May to September (Sandoval 2011). Therefore, White-eared Ground-sparrows appear to nest from the middle-to-late dry season and throughout the rainy season, with an apparent peak in the early rainy season.

DISCUSSION

This report substantially advances our understanding of the breeding biology of this little-studied Neotropical species. Results of recent molecular studies have revealed seven species in the genus *Melozone* (DaCosta *et al.* 2009, Chesser *et al.* 2010). Four of these species inhabit the Neotropics (*M. albicollis*, *M. kieneri*, *M. biarcuata*, and *M. leucotis*) and three species inhabit the North Temperate Zone (*M. fusca*, *M. crissalis*, and *M. aberti*; AOU 1998). Across the genus, the breeding biology is better known for the temperate species (Tweit & Finch 1994, Johnson & Haight 1996, Benedict *et al.* 2011) than for the Neotropical species (Winnett-Murray 1985, Stiles & Skutch 1989, Howell & Webb 1995).

The nest of the White-eared Ground-sparrow was first described 27 years ago (Winnett-Murray 1985). This description matched most of the nests we observed, which consisted of a bulky outer layer of dead leaves and dry grasses, and an inner layer of tightly woven plant materials (Winnett-Murray 1985). We twice found an alternate form of nest, which lacked the bulky external layer. In both cases the nest was placed on the ground in a rocky area. The rocks surrounding the nest likely provided support to the nest cup that is normally provided by the outer layer of plant material. These two nest forms may be distinct types of nests, or they may form a gradient from a platform of fine thin plant fibres (i.e., the rarer, newly-described nest) to a bulky cup of dead leaves (i.e., the more common, previously-described nest). These alternatives are difficult to distinguish with the sample size (1 nest described by Winnett-Murray, 1985; 10 described in the current study) and we encourage others to collect data about nest substrate and nest type for this species and also for other species in this genus. In any case, this variation in nest architecture may represent an adaptive response to nest microhabitat. The bulkiest nests we measured were placed between branches in coffee plants, where the nest material may provide more support for the eggs and nestlings, or thermal advantages for the developing young. The less substantial form of nest was only found on the ground or on flat substrates, and may be sufficient support for the eggs and nestlings, while minimizing conspicuousness to predators.

Across the genus *Melozone*, all nests share similar characteristics, with somewhat bulky cups of dead leaves and grasses (Baicich & Harrison 2005, Benedict *et al.* 2011). The height at which nests are built appears to be similarly low throughout the genus (Winnett-Murray 1985, Stiles & Skutch 1989, Howell & Webb 1995, Baicich & Harrison 2005). The variable nest types that we describe here for White-eared Ground-sparrows appear to be

unique for the genus (Baicich & Harrison 2005, Stiles & Skutch 1989, Howell & Webb 1995). The egg color and patterning, which consists of a light background with dark brown spotting, is similar to previous anecdotal reports (Winnett-Murray 1985, Stiles & Skutch 1989, Tweit & Finch 1994, Johnson & Haight 1996, Baicich & Harrison 2005, Benedict *et al.* 2011). Clutch size reported here is similar to that found in other tropical species of *Melozone* (Winnett-Murray 1985, Stiles & Skutch 1989, Howell & Webb 1995) but it is smaller than in temperate *Melozone* species, where the average clutch size is four eggs (Tweit & Finch 1994, Johnson & Haight 1996, Benedict *et al.* 2011).

Nest parasitism by the Bronzed Cowbird appears to be high in White-eared Ground-sparrows in Costa Rica, with more that 50% of the nests that we found containing parasitic eggs or chicks. In a previous review paper, based on studies of many different cowbirds hosts in Costa Rica, parasitism by Bronzed Cowbirds was reported for two White-eared Ground-sparrow nests (Sealy *et al.* 1997). We found two nests that were multiply parasitized by Bronzed Cowbirds, with six and seven parasitic eggs. The reproductive success of the host parents was very low in these nests; in the first nest none of the host eggs hatched, whereas in the second nest only one of the two host eggs hatched (in both cases, after we removed the parasitic eggs). The low reproductive success may be the result of inadequate incubation due to the large number of eggs in the nest. This ground-sparrow appears to be unable to distinguish its own eggs from the cowbirds' eggs, as has been reported in other species (Fraga 1985, Sealy *et al.* 1997). Given the high parasitism frequency we record, and the apparent lack of egg recognition, we expect that White-eared Ground-sparrows are heavily negatively affected by cowbird parasitism (Friedmann & Kiff 1985), especially because host and parasite are sympatric throughout their distribution in Costa Rica (Stiles & Skutch 1989, Garrigues & Dean 2007).

Our observations suggest that only female White-eared Ground-sparrows incubate, as was suggested previously from observations of a single nest by Winnett-Murray (1985), and as is common in the temperate *Melozone* species (Tweit & Finch 1994, Johnson & Haight 1996, Benedict *et al.* 2011). We found that both parents provision hatchlings, but after fledging only the female feeds the fledglings while the male searches for food. Interestingly, we found that males reveal the location of food to the female, and subsequently the fledgling birds, through an interesting use of duet song; upon discovering a food source, males sing a song, and the female responds to complete the duet as she moves towards his location. Females defend the nest and the young against potential predators through a distraction display, whereas males do not approach potential predators as closely. The differences between male and female nest defense behaviour may be the result of differences in their investment in reproductive activities, or in security in paternity, as has been proposed in other species with different defense behavior in males and females (Dickinson 2003, Sandoval 2009).

This is the first detailed study on the breeding biology of any Neotropical species in the genus *Melozone*. Information on natural history of this group is critical for understanding the biology of these species and will be important in setting future conservation plans. All of the nests we observed were found in wild thicket habitat (i.e. areas of vegetation left to grow without management) or in managed shade coffee plantations that are similar in structure to thicket habitat. This speaks to the importance of maintaining stands of vegetation that include early successional stages, and the importance of shade

coffee plantations in Neotropical conservation efforts.

ACKNOWLEDGMENTS

We thank Olman Sandoval and Carolina Mendez for help with field research. We thank the Reserva Biologica Monteverde for all of the support they provided to conduct research in the reserve. We thank Lauryn Benedict, Spencer Sealy, and André Weller for comments that improved the manuscript. This research was supported by grants from the Ministerio de Ciencia y Tecnología (MICIT) and the Consejo Nacional para Investigaciones Científicas y Tecnológicas (CONICIT) of Costa Rica, and by the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Government of Ontario, Canada.

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