

NESTING OF THE SCALLOPED WOODCREEPER (*LEPIDOCOLAPTES FALCINELLUS*)

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Resumen. – Nidificación del Chinchero Escamado (*Lepidocolaptes falcinellus*). – Proveemos la primera descripción del nido, tamaño de puesta, pichones, y comportamiento reproductivo para el Chinchero Escamado (*Lepidocolaptes falcinellus*), basándonos en 102 h de observaciones de un nido en la selva Atlántica subtropical en el Parque Provincial Cruce Caballero, provincia de Misiones, Argentina. El nido estaba en una larga grieta vertical a 2,5 m de altura en el tronco de un cedro (*Cedrela fissilis*). Los dos adultos llenaron el fondo del hueco con pedazos de corteza hasta una altura de 11 cm. Se turnaron para incubar los tres huevos con 100% de atención durante 15–16 días, y alimentaron a los pichones con artrópodos, especialmente larvas de lepidópteros. Después de que el macho murió, la hembra crió sola a dos pichones que volaron con dos días de diferencia, 18 y 19 días luego de eclosionar los huevos. Los Chincheros Escamados fueron observados en cuatro ocasiones defendiendo su nido contra potenciales predadores o competidores de huecos (Trepador Garganta Blanca, *Xiphocolaptes albicollis*; Carpintero Arcoiris, *Melanerpes flavifrons*; Tarefero, *Sittasomus griseicapillus*). Nuestras observaciones de la construcción del nido, el período de incubación, desarrollo de los pichones, período de permanencia de los pichones en el nido, y comportamiento parental de los Chincheros Escamados se asemejaron a observaciones publicadas del Trepador Cabecirrayado (*Lepidocolaptes souleyetti*) y el Trepatronco Coronipunteado (*L. affinis*) de Centroamérica tropical; sin embargo, los Chincheros Escamados permanecieron más tiempo cada vez que entraban al nido durante la incubación y pasaban más tiempo dentro del nido, siendo similar en estos aspectos a los Trepadores Oscuros (*Dendrocolaptes platyrostris*) que anidan en el mismo sitio del nordeste de la Argentina.

Abstract. – We provide the first description of the nest of the Scalloped Woodcreeper (*Lepidocolaptes falcinellus*), its clutch size, nestlings, and nesting behavior from prospecting to fledging, based on 102 h of observation at a nest in the subtropical Atlantic forest at Parque Provincial Cruce Caballero, province of Misiones, Argentina. The nest was in a long vertical crack, 2.5 m high in the trunk of a cedar (*Cedrela fissilis*). The two adults filled the bottom of the cavity with bark flakes to a height of 11 cm. They took turns incubating the three eggs with 100% attentiveness for 15–16 days, and fed the two nestlings a diet of arthropods, especially caterpillars. After the male died, the female raised the nestlings alone and they fledged two days apart, 18 and 19 days after hatching. The Scalloped Woodcreepers were observed on four occasions defending their nest against potential predators and cavity competitors (White-throated

Woodcreeper, *Xiphocolaptes albicollis*; Yellow-fronted Woodpecker, *Melanerpes flavifrons*; Olivaceous Woodcreeper, *Sittasomus griseicapillus*). Our observations of nest construction, incubation period, nestling development, nestling period, and parental behavior for Scalloped Woodcreepers were similar to published observations for Streak-headed Woodcreepers (*Lepidocolaptes souleyetii*) and Spot-crowned Woodcreepers (*L. affinis*) of tropical Central America; however, Scalloped Woodcreepers had longer bouts on the nest and higher nest-attentiveness during incubation, and in these characteristics were similar to Planalto Woodcreepers (*Dendrocolaptes platyrostris*) that breed at the same site in northeastern Argentina. Accepted 6 April 2011.

Key words: Scalloped Woodcreeper, *Lepidocolaptes falcinellus*, Atlantic forest, nest defense, nestlings, parental care.

INTRODUCTION

The woodcreepers (Furnariidae: Dendrocolaptinae) are Neotropical forest birds that nest in existing tree cavities. The Scalloped Woodcreeper (*Lepidocolaptes falcinellus*) is endemic to the Atlantic forest of southeastern Brazil, eastern Paraguay, and the province of Misiones in northeastern Argentina, and little is known about its nesting ecology (Narosky *et al.* 1983). Ihering (1902) reports a clutch size of two from Rio Grande do Sul, but the large size of the eggs, lack of observations of an adult, and unusual subterranean nest placement suggest strongly that the clutch was misidentified (C. Marantz *in litt.*). Marantz *et al.* (2003) report a clutch size of three eggs based on the sample size given by Narosky *et al.* (1983) for the egg measurements given by Schönwetter (1979; C. Marantz *in litt.*), but we know of no direct report of clutch size. In Rio Grande do Sul, Brazil, Belton (1984) reported three individuals with active gonads in November and early December, and a bird seen repeatedly carrying “something white” to a longitudinal split about 4 m high in an 8 m snag on 13 December 1979. We provide here the first detailed description of a confirmed nest, nestlings, and breeding behavior, based on observations made throughout the breeding cycle at a nest in Argentina.

METHODS

Our observations were made at a nest in Parque Provincial Cruce Caballero, San Pedro department, Misiones, Argentina (26°31'S, 53°59'W; 600 m a.s.l.), where the Scalloped

Woodcreeper is a common resident of primary and secondary forest (Bodrati *et al.* 2010). The vegetation is mixed Atlantic forest with laurel (Lauraceae), guatambú (*Balfourodendron riedelianum*) and Paraná pine (*Araucaria angustifolia*; Cabrera 1976), and annual rainfall is 1200 to 2400 mm distributed evenly throughout the year. We found the nest on 6 October 2010 when both adults entered. We watched it from a distance of 7–12 m for 102 h 25 min over 47 days, spanning the period from nest construction until the chicks fledged. The adults were very tame and they paid little attention to observers, so we could identify many food items based on previous experience, a field guide (Canals 2003) and expert help from E. Nuñez Bustos. Nest contents were checked at intervals of 1–2 days by direct observation using a ladder and flashlight or by indirect observation using a small video camera mounted on a pole. We were unable to access the nest contents to measure or mark the eggs or nestlings. We recorded adult and nestling vocalizations with a Marantz PMD-222 cassette-recorder and a Sennheiser ME-66 shotgun microphone, and we measured nest characteristics with a measuring tape after the chicks fledged.

RESULTS

Nest site, prospecting and construction. The nest was located 2.53 m above the ground in a large crack in the main trunk of a living 17-m tall cedro (*Cedrela fissilis*, Meliaceae) within the camping area and 14 m from the rangers' house at Parque Provincial Cruce Caballero (Figs 1A–B). It was on a hillside that sloped



FIG. 1. Nest of Scalloped Woodcreepers (*Lepidocolaptes falcinellus*) at Parque Provincial Cruce Caballero, Misiones, Argentina. A) Nest cavity (indicated by white arrow) and surroundings. The photo was taken from our usual observation point, and the park ranger house is visible in the background (A. Bodrati). B) Adult emerging from cavity (K. Cockle). C) Complete clutch of three eggs visible through the cavity entrance (L. Pagano). D) Dead male showing incubation patch (K. Cockle).

down to a small creek located 60 m away. The crack began to form around 2004 (pers. observ.) by a split in the tree at its lowest fork. The split formed a cavity open at the top, but covered with debris and an orchid (*Catasetum fimbriatum*, Orchidaceae) such that the cavity effectively had two opposite facing entrances (northeast and southwest). The birds almost always used the southwest entrance, which faced the forest 9 m away. On this side of the tree, the crack was 68 cm in length and 6 cm wide at the widest point. By sitting directly in front of the southwest entrance, we could see through the tree and out the northeast side. The cavity bottom was approximately 30 x 10

cm. The tree was 64 cm in diameter at the height of the nest cavity, and 58 cm in diameter at breast height (1.3 m). Although located in a clearing, the trunk of the nest tree received direct sunlight only during two hours early in the morning.

Both adults were observed prospecting the cavity on 6 October, and once one entered the empty cavity alone with a butterfly (Nymphalidae). Both adults lined the bottom of the cavity with rectangular pieces of bark that averaged about 2 x 5 cm. We identified these bark strips as mostly cedro, but also laurel (*Ocotea* sp., Lauraceae), grapia (*Apuleia leiocarpa*, Fabaceae), young Paraná pine (*Araucaria*

angustifolia, Araucariaceae), timbó (*Enterolobium contortisiliquum*, Fabaceae), fig (*Ficus luschnathiana*, Moraceae), and cancharana (*Cabralea canjerana*, Meliaceae). Using their bill as a lever, the adult woodcreepers pried the bark from the nest tree and nearby trees (usually within 50 m and always within 100 m of the nest). If the bark was well separated from the tree, the woodcreepers sometimes gripped it directly and pulled it off with their bill. The nest lining also included very few dead leaves. The adults were first seen entering with nest material on 6 October and they continued to bring material until the first egg hatched (Table 1). When the chicks fledged, the bark was piled 11 cm deep on the cavity bottom.

While constructing the nest, the adults spent little time inside the cavity (Table 1). They frequently vocalized with whistles and trills (Figs 2A and 2B), sometimes emitting the notes in rapid succession, but at other times they vocalized only sporadically. When interacting at the nest cavity or its vicinity during construction and throughout the nesting cycle, the adults emitted a very soft and rapid 'kwee kwee kwee kwee kwee', an unusual vocalization that we had not previously heard (Fig. 2C).

Laying and incubation. The three eggs were laid on 12, 14, and 17 October. The adults did not roost in the nest on 16 October, but one adult roosted in the nest on 18 October and we assume incubation began on 17 October when the last egg was laid. The eggs were shiny white (wet-looking) when first laid, but they became dull white within 24 hours (Fig. 1C). Nest attentiveness was low early in the laying period, with no activity during 3 h and 2:40 h on the afternoons of 14 and 16 October, respectively, but it increased rapidly and was 100% during the incubation period (Table 1). The adults vocalized very little during the incubation period, and usually only far from the nest. Occasionally

the adults took nest material from the nest, discarded it nearby, and returned to the nest. Two eggs hatched on 1 and 2 November, after an incubation period of 15–16 days. The adults removed the shells immediately after the chicks hatched. The third egg began to hatch on 2 November but the chick died before emerging from the egg, and an adult discarded it 10 m from the nest on 4 November.

Nestling development. When the nestlings hatched they had pink skin and wet, dark grey down on the head and in a line down the back. The gape flanges were pale yellow. At 1 day old, they lifted their heads, gaped and vocalized very softly when the nest was checked, but we could not hear them from the ground. The nestlings opened their eyes at 5 or 6 days of age. Pin feathers and down covered their bodies, wings and tail by 7 days of age, and the pin feathers broke at 8 days of age. At 9 days the feathers had emerged from the pins, and we could see pink-orange mouth linings. By their 16th day, the nestlings appeared fully-feathered, but with shorter bills and slightly shorter tails than the adults. The first chick fledged on 19 November and the other on 21 November, following a nestling period of 18 days for the first chick and 19 days for the second. We did not observe any parasites on the nestlings, but we would only have been able to detect large parasites such as botfly (*Philornis* spp.) larvae on the head and upperparts.

Nestlings began vocalizing on the day they hatched, but they were initially almost inaudible from outside the cavity. By 8 November, when they were 6 and 7 days of age and the adults left them alone in the nest, the nestlings emitted 3–5 note calls (Fig. 2D). Their calls increased in volume and tempo, becoming almost continuous when the adults arrived or we touched the nest tree (Fig. 2E). On 11 November, the nestlings were 9 and 10

TABLE 1. Behavior of adult Scalloped Woodcreepers (*Lepidocolaptes falcinellus*) at their nest in Parque Provincial Cruce Caballero, Misiones, Argentina, October–November 2010. *The male died on 11 November, so only the female was present from 12 to 20 November.

Nest stage	Time observed (h:min)	Nest attentiveness (% time adult in nest)	Length of on-bouts (min) mean \pm SE (n)	No. of trips with nest material/h	No. of trips with food/h	No. of fecal sacs removed/h
Prospecting (6 Oct)	1:30	not recorded	< 2 (7)	0	-	-
Construction (8 Oct)	1:00	~2%	< 1 (8)	8.0	-	-
Laying						
Early (12–14 Oct)	5:28	4%	14 (1)	0.6	-	-
Late (16 Oct)	6:25	35%	8 \pm 3.1 (14)	2.4	-	-
Hours before last egg laid (17 Oct)	4:53	75%	32 \pm 8.5 (7)	1.6	-	-
Incubation	22:44	100%	54 \pm 3.4 (12)	0.6	-	-
Nestling						
1–5 Nov	17:48	88%	15 \pm 1.7 (55)	-	2.9	0
8–11 Nov	13:35	43%	2 \pm 0.4 (107)	-	8	2.3
12–20 Nov*	31:42	2%	0.1 \pm 0.02 (196)	-	6.2	1.3

days of age, and occasionally when the adult was away from the nest for several minutes, the nestlings began to emit whistles that were similar to the whistles of adults (Fig. 2F). Between 11 and 16 November, we often heard these three types of vocalizations (Figs 2D–F) during the day and until little light remained at dusk. The nestlings became much quieter in the last few days before fledging, calling rarely when alone, and softly when the adult arrived at the cavity.

Parental care. Both parents brought food and brooded the nestlings. The feeding rate increased over the first few days of the nestling period (Table 1), but feedings were sometimes sporadic, with one adult delivering up to three items in c. 1 min sometimes, but up to 1 h elapsing between feedings at other times. Until 2 days after the first nestling hatched, the arriving adult would enter the nest before the brooding adult emerged, or possibly only one adult brought food while the other remained inside the nest. Subsequently, the

changeover was obvious because the arriving adult vocalized softly (Fig. 2C), the brooding adult answered and emerged, and the arriving adult entered. Between 16:00 h on 11 November and 12:00 h on 12 November, when the chicks were 10 and 11 days old, the adult male died inside the cavity, about 15 cm above the chicks. The female continued to enter the nest and feed the nestlings on 12 November, but she vocalized more often, as if calling the male with whistles (Fig. 2A) and trills (Fig. 2B) near the nest and while foraging in the forest. Her vocalizations attracted the attention of another pair from a nearby territory, a pair that had not previously ventured so close to the nest. On the morning of 13 November, we removed the dead male from the nest using a fishing hook. The study skin was prepared by G. Cox and deposited at the Museo de La Plata (La Plata, Buenos Aires, Argentina; MLP 14185). The male weighed 32 g, had enlarged and darkened testes (right: 4 mm, left: 6 mm), a large brood patch (Fig. 1D), and possibly a damaged foot. It was not

molting and had no parasites. Its stomach contained insect parts.

We observed adults bringing food to the nest 357 times, and we could identify the food item concerned on 297 of these occasions. Insects (class Insecta) comprised at least 85% of the items (Lepidoptera: 95 caterpillars, 38 adult moths or butterflies, and 3 pupae; Orthoptera: 34 crickets or grasshoppers; Hymenoptera: 10 ants, 5 wasps, and 4 bees; Coleoptera: 17 adult beetles; Blattaria: 6 cockroaches; Hemiptera: 5 cicadas; Isoptera: 3 termites; Diptera: 1 fly; 32 unidentified insect larvae) with other arthropods accounting for the remainder (Arachnida: 29 spiders and 2 harvestmen; Malacostraca: 4 pill bugs; Chilopoda: 1 centipede; Diplopoda: 1 millipede; and 7 unidentified arthropods). Among the adult Lepidoptera, at least six were of the family Nymphalidae (one *Dynamine postverta*, two *Doxocopa* spp., one *Adelpha* sp., one *Taygetis* sp.) and five Hesperidae. All prey items were equal to or smaller than the adults' bills in the first few days after the nestlings hatched, but they were often 1.5 times the bill length in the last few days before the nestlings fledged. The woodcreepers captured prey from branches and tree trunks by probing under, prying up or pulling off loose bark; pulling off lichens; probing in *Tillandsia* spp. bromeliads; loosening off moss; flushing up moths and catching them in mid-air. They sometimes gleaned ants from around the cavity entrance, including inside the cavity itself. They occasionally beat ants, beetles or other unidentified arthropods against the tree trunk before taking them into the nest. We also saw the adult female catch and eat a ladybug (Coleoptera) and a cicada (Hemiptera).

We did not see the adults remove fecal sacs until the first chick was 7 days of age. Adults removed fecal sacs most often in the early morning. They dropped them from the air before landing on any trees, or they flicked them from the first tree at which they arrived.

Most fecal sacs were discarded 3–40 m from the nest, and usually just inside the forest. Sometimes the adults removed fecal sacs and returned to the nest immediately without food. We did not observe any feces in the nest until the day before the second nestling fledged, when a considerable amount of feces was seen in the nest.

Fledging. The chicks fledged on 19 and 21 November, 18 and 19 days after their respective hatch dates. On 20 November, only one chick remained in the nest (“nestling”), and the adult whistled (Fig. 2A) and trilled (2B) near the nest and at the nest entrance, as if calling the nestling. The nestling now begged very softly and only rarely. The adult occasionally showed prey items to the nestling and then exited the cavity, as if trying to entice the nestling out. The nestling climbed to the cavity entrance behind the adult after four of the feedings, but it did not leave the cavity. The other chick (“fledgling”) remained within about 50 m of the nest most of the day. Twice or more it whistled to the adult (Fig. 2A), in response to which the adult flew toward it. Some time between 16:05 h and 18:50 h the fledgling returned to the nest. At 19:10 h the adult arrived at the cavity entrance with food, the fledgling flew out of the nest, and the adult flew right behind it (seeming to touch it) to the edge of the forest. Adult and fledgling disappeared into the forest and did not return to the nest to sleep; the remaining nestling spent the night alone in the nest cavity. On 21 November we began watching the nest before first light. The adult emitted a trill note (Fig. 2B) and the nestling answered from inside the cavity. When the adult arrived at the cavity entrance with prey for the first time that day, the nestling climbed out the other entrance and hitched up one of the main branches. The adult followed, climbing the other main branch. When the chick flew to the forest, the adult flew with it, and they disappeared into

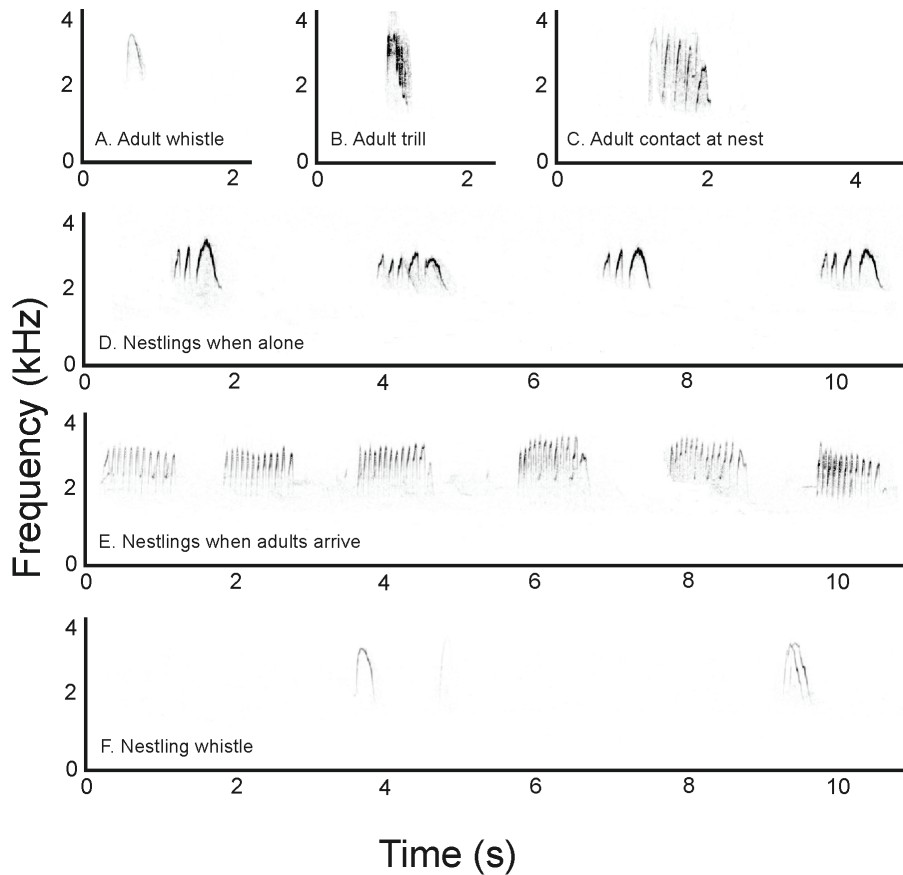


FIG. 2. Vocalizations of Scalloped Woodcreepers (*Lepidocolaptes falcinellus*) at Parque Provincial Cruce Caballero, Misiones, Argentina. A) Adult whistle, 9 November 2010. B) Adult trill, 16 October 2010. C) Contact voice between adults at the nest cavity, 8 November 2010. D) Nestling vocalizations when adult not present, 9 November 2010. E) Nestling begging vocalizations when adult arrives and enters cavity, 13 November 2010. F) Nestling whistle call when adult is away from nest, 13 November 2010 (both nestlings vocalized at 9 s). All recordings by A. Bodrati. Sonograms generated using Adobe Audition 1.5 and Syrinx 2.6h (John Burt, www.syrinxpc.com).

the midstory together. On the following days, we sometimes heard the trills and whistles of three individuals from the forest around the campsite, suggesting that the fledglings survived until at least 6 December when we left the field site.

Adult movements around the nest. Most activity at the nest began about 1 h after first light. The

adults foraged and collected nest material mostly 30–60 m from the nest tree and 10–70 m from the stream. They usually arrived at the nest tree by flying low, and landing a few cm below the cavity entrance. From there, they would hitch up to the entrance, enter sideways and descend tail-first. However, when foraging or collecting nest material from branches of the nest tree, the adults dropped through

the air, almost in a spiral, to the cavity entrance. During incubation, 46 of 47 (98%) inbound trips to the nest and all 49 (100%) outbound trips were to the west (where the forest was closest), compared to only 2% of inbound and 0% of outbound trips to the east. During the nestling period, until the first chick fledged, 228 of 275 (83%) inbound trips and 242 of 297 (81%) outbound trips were to the west. On 10 November, one of the adults flew into the window pane of the park rangers' house (east of the nest). It did not fall to the ground, but instead flew around the house.

Nest defense and interactions with other species. Whenever the Scalloped Woodcreepers displayed aggression toward other species, they lifted their crown feathers and inflated their white throats. The adults defended their nest against potential cavity competitors and nest predators on at least four occasions.

On 24 October, Natalia Sandoval (pers. com.) observed a male Yellow-fronted Woodpecker (*Melanerpes flavifrons*) about 2 m above the woodcreeper nest cavity. We suspect this individual was one of the two males from a group of five Yellow-fronted Woodpeckers that had a nest 50 m to the west. As Sandoval watched, the incubating adult Scalloped Woodcreeper emerged from the cavity and chased the woodpecker 14 m to a tree where a Rufous-bellied Thrush (*Turdus rufiventris*) had a nest. The thrush then attacked the woodcreeper, which in turn attacked the woodpecker. Moments later, we arrived to see the Yellow-fronted Woodpecker fall to the ground from the woodcreepers' nest-tree. It appeared stunned and unable to fly. We gave the woodpecker sugar-water, kept it in a dark box for 30 min, and then banded and released it on a tree trunk 20 m from the woodpecker nest tree. The bird did not fly and was not seen again. During 19 h of observation from 25 October to 26 November at the Yellow-

fronted Woodpecker nest, it became clear that one of the males had disappeared and the remaining male was unbanded. We therefore assume that the injured male woodpecker died.

On 2 November, a White-throated Woodcreeper (*Xiphocolaptes albicollis*) landed on the nest-tree 2.5 m above the cavity opening, and the brooding adult Scalloped Woodcreeper chased it away seconds later. The White-throated Woodcreeper is the largest woodcreeper in our study area, four times as large as the Scalloped Woodcreeper in body mass, and it is a known predator of passerine nestlings (Bodrati 2003). A pair had a nest 70 m from the Scalloped Woodcreepers' nest-tree, and one of the adults had destroyed a nest of Blue-naped Chlorophonia (*Chlorophonia cyanea*) 10 m from the Scalloped Woodcreepers' nest on 28 October, carrying their egg toward its own nest (observed and photographed by Luis Pagano and José Segovia).

On 10 November, a much smaller Olivaceous Woodcreeper (*Sittasomus griseicapillus*) landed 1.5 m from the nest cavity while one of the adult Scalloped Woodcreepers was 10 m away on another tree. The Scalloped Woodcreeper immediately attacked the smaller bird and chased it away into the forest.

On 20 November, an Olivaceous Woodcreeper was on the tree 2 m above the cavity, when the female Scalloped Woodcreeper arrived with food. The Scalloped Woodcreeper flew directly at the smaller bird, again chasing it away from the nest tree.

We observed one other incident of aggression by the nesting woodcreepers. When the second nestling was newly hatched, on 2 November, AB climbed the ladder to check the nest. The brooding adult flew at him, pecking his shoulder rapidly before flying away.

Three additional nest predators were seen near the nesting cavity. On 9 November, D.

Martínez (pers. com.) observed a Red-breasted Toucan (*Ramphastos dicolorus*) inserting its bill into the cavity, but apparently it could not reach the chicks. The Red-breasted Toucan is among the most important nest predators in our study area (pers. observ.). On 14 November, when a Squirrel Cuckoo (*Piaya cayana*) alit on the nest tree just after the female woodcreeper arrived with food, the woodcreeper flew off with the food in her bill, and only returned, with the same food, after the Squirrel Cuckoo had departed. We also observed a Saffron Toucanet (*Pteroglossus bailloni*) alight on a branch 3.5 m above the nest cavity on 16 November, when the male woodcreeper was dead and the female was away from the nest. The toucanet remained for more than 2 min, looking at the cavity and tilting its head to listen to the nestlings vocalizing. We believe it left because of our presence 8 m from the nest.

The Scalloped Woodcreepers appeared tolerant of species that are neither predators nor competitors for nest sites. A pair of Rufous-collared Sparrows (*Zonotrichia capensis*) nested 10 m away, and they sometimes clung to the edge of the woodcreepers' nest cavity without eliciting any reaction from the woodcreepers. A group of Red-rumped Caciques also had a nest colony in palms 13 m from the woodcreeper nest. Twice when foraging in these palms the Scalloped Woodcreepers were chased by the caciques and quickly retreated. However, the woodcreepers did not chase the caciques on the many occasions when they landed in the woodcreepers' nest tree.

DISCUSSION

Our observations at a single nest of the Scalloped Woodcreeper provide the first detailed information about nesting in this species, and they represent one of the most complete studies of nesting behavior in any *Lepidocolaptes*. A second nest of Scalloped Woodcreeper was

recorded on video in early November 2010 at São Mateus do Sul, Paraná, southern Brazil, and posted by Leonardo R. Deconto to the Internet Bird Collection (<http://ibc.lynxeds.com>). Adults were recorded exiting with a fecal sac and they were photographed entering with unidentified food items, at a cavity about 4 m high in a living tree about 30 m from the edge of a fragment of low forest without large trees, where the naturally dense understory had been partly cleared for a plantation of citrus fruits and yerba mate (*Ilex paraguariensis*; L. R. Deconto *in litt.* 2011). These observations generally coincide with our findings that the nest is placed in a relatively low cavity and both adults contribute to nestling care. However, monitoring of additional nests would be needed to determine how well our observations represent the breeding biology of the species. In particular, because the male died at the nest we studied, feeding trips may have been less frequent than usual, and the nestling period longer. Nevertheless, in most respects our observations of the nest, eggs, nestlings, and behavior of these Scalloped Woodcreepers closely resembled published observations of Streak-headed Woodcreepers (*Lepidocolaptes souleyetti*) and Spot-crowned Woodcreepers (*L. affinis*) in Central America (Skutch 1969).

The heights of 2.53 m and 4 m for Scalloped Woodcreeper nests fall within the range reported for other *Lepidocolaptes*: 5–25 m for Streak-headed, 0.6–8 m for Spot-crowned (Skutch 1969), and 0.5–6.5 m for Narrow-billed Woodcreeper (*L. angustirostris*; Narosky *et al.* 1983, Di Giacomo 2005, Luz *et al.* 2007, Kirwan 2009, AB pers. observ.). The three-egg clutch is larger than the two eggs laid by the more tropical Streak-headed and Spot-crowned Woodcreepers (Skutch 1969), but within the range of the Narrow-billed Woodcreeper in southern South America (2–4; Di Giacomo 2005, Luz *et al.* 2007) and the Montane Woodcreeper (*Lepidocolaptes lacrymiger*) in

Colombia (three young; Hilty & Brown 1986). The 15–16 day incubation period is similar to the c. 15 d for Streak-headed Woodcreeper eggs (incubated by a *Dendrocincla*), and the 17 d for Spot-crowned Woodcreeper (Skutch 1969). The 18–19 d nestling period is also identical to that of the Streak-headed Woodcreeper (18 or 19 d), the Spot-crowned Woodcreeper (19 d) and the Narrow-billed Woodcreeper (19 d; Skutch 1969, Luz *et al.* 2007).

Newly hatched Scalloped Woodcreepers were similar in appearance to newly hatched Spot-crowned Woodcreepers, described as having pink skin, grey down, and whitish gape-flanges (Skutch 1969). In both species, feathers began to emerge from pins at 8 days of age, and nestlings were well feathered by two weeks of age (Skutch 1969). However, unlike the Spot-crowned and Streak-headed Woodcreeper nestlings observed by Skutch (1969), and a Narrow-billed Woodcreeper nestling we observed in Buenos Aires, Argentina (pers. observ.), the Scalloped Woodcreeper nestlings never came to the cavity entrance to receive food. Neither were they heavily infested with the parasitic botflies (*Philornis* spp.) that affected a nest of Narrow-billed Woodcreepers in Rio de Janeiro (southeast Brazil) and 97% of Planalto Woodcreeper (*Dendrocolaptes platyrostris*) nestlings in our study area in Misiones (Luz *et al.* 2007, Cockle & Bodrati 2009, Norris *et al.* 2010).

The Scalloped Woodcreepers exhibited biparental nest prospecting, construction, and care of nestlings, like four other species of *Lepidocolaptes*: Spot-crowned, Streak-headed, Narrow-billed and White-striped Woodcreepers (*L. leucogaster*; Skutch 1969, Di Giacomo 2005, Luz *et al.* 2007, Rivera Ortiz *et al.* 2010, AB unpubl. data) and several other genera of woodcreepers (e.g., *Dendrocolaptes* and *Xiphocolaptes*; Marantz *et al.* 2003, Cockle & Bodrati 2009). By contrast, in *Dendrocincla* and *Xiphorhynchus*

only females seem to contribute (Skutch 1969, Willis 1972, Marini *et al.* 2002, Marantz *et al.* 2003, Vega Rivera *et al.* 2003) although *Xiphorhynchus* do appear to form long-term pair bonds, unlike *Dendrocincla* (C. Marantz *in litt.*). During incubation, bouts on the eggs were twice as long as those reported by Skutch (1969) for two species of *Lepidocolaptes* in Costa Rica (with overall means of 29 min for Streak-headed Woodcreeper and 27 min for Spot-crowned Woodcreeper). Nest attentiveness was also considerably higher (100%) for our Scalloped Woodcreepers and a nest of Narrow-billed Woodcreeper at similar subtropical latitude in the Atlantic forest (Luz *et al.* 2007), as compared to both Streak-headed Woodcreeper (60–66%) and Spot-crowned Woodcreeper (82%; Skutch 1969). We also observed long incubation bouts (> 2–3 h) and high nest-attentiveness (93%) for incubating Planalto Woodcreepers in Misiones (Cockle & Bodrati 2009). Like the Scalloped Woodcreepers, Streak-headed and Spot-crowned Woodcreepers lined their nest with stiff pieces of bark brought throughout the incubation period, and they also occasionally removed nest material (Skutch 1969). Their method of pulling bark flakes from the nest tree and neighboring trees is reminiscent of Skutch's (1969) description of Streak-headed Woodcreepers grasping and tugging the bark flakes more firmly attached to the tree. Skutch (1969) also describes Streak-headed Woodcreepers arriving at the nest cavity when bringing bark from the nest tree itself, by dropping down 'like a falling brown leaf to alight on the trunk below the cavity and climb into it' (Skutch 1969), a behavior we also observed for the Scalloped Woodcreepers. Similarly, both Scalloped and Streak-headed Woodcreepers vocalized frequently when building the nest.

The Scalloped Woodcreepers removed the eggshells from their nest immediately after the nestlings hatched, like Spot-crowned

Woodcreepers (Skutch 1969). By contrast, the dead, partially hatched nestling/egg was left in the cavity for 2 days, as if the parents did not immediately realize it was dead. Adults fed their nestlings a diet of arthropods, like Streak-headed, Spot-crowned, and Narrow-billed Woodcreepers, foraging near a creek as did a pair of Streak-headed Woodcreepers, but somewhat closer to the nest (30–60 m) than Narrow-billed (150–180 m; Skutch 1969, Luz *et al.* 2007). Among the *Lepidocolaptes*, only the Narrow-billed Woodcreeper has been reported feeding on vertebrates, although woodcreepers in the genera *Dendrocincla*, *Dendrocolaptes*, *Xiphocolaptes*, *Dendrexetastes*, and *Xiphorhynchus* are known to forage on frogs, lizards, bird eggs, and nestlings, and to feed these items to their nestlings (Skutch 1969, 1981; Willis 1972, Hayes & Escobar Argaña 1990, Bodrati 2003, Cockle & Bodrati 2009, Kirwan 2009). Like the Scalloped Woodcreepers, Spot-crowned Woodcreepers were said to be very tame around their nest, and Streak-headed Woodcreepers flushed when a Squirrel Cuckoo approached (Skutch 1969). As with Streak-headed Woodcreepers and Plain-brown Woodcreepers (*Dendrocincla fuliginosa*), Scalloped Woodcreepers did not remove fecal sacs when the nestlings were young, but they may have eaten the sacs as proposed by Skutch (1969) and Willis (1972). Removal of fecal sacs declined at the end of the nesting period, as reported for Streak-headed, Spot-crowned, and Plain-brown Woodcreepers (Skutch 1969, Willis 1972). The Scalloped Woodcreepers discarded fecal sacs much closer to the nest than White-throated (*Xiphocolaptes albicollis*) and Great Rufous Woodcreeper (*X. major*), which often take them >100 m from the nest, and which may stage on several trees before discarding the sacs (Bodrati 2003, AB pers. observ.). By contrast, Luz *et al.* (2007) did not observe Narrow-billed Woodcreepers removing fecal sacs from a nest in Brazil, although we have seen them

do so in Buenos Aires and Chaco, Argentina (AB pers. observ.).

Although one of the fledglings returned to the nest briefly near dusk on the day after it fledged, it did not remain in the cavity overnight and the fledglings were not seen around the cavity after both had fledged. Skutch (1961, 1969) likewise reports that parents and fledgling Streak-headed Woodcreepers, Spot-crowned Woodcreepers, and other woodcreepers do not return to the nest hole to sleep.

Our study adds to a slowly growing body of information about the breeding biology of woodcreepers. We suggest that woodcreeper nestlings in general hatch with pink skin, grey down, and whitish or yellowish gape-flanges. Parents bring nesting material throughout the incubation period, they quickly remove eggshells from the nest, and they eat or remove fecal sacs until a few days before fledging. We suggest that the *Lepidocolaptes* may be characterized by nests that are lined with hard flakes of bark, biparental care, a nestling diet of arthropods, incubation periods of 15–17 d and nestling periods of 18–19 d. To test these generalizations, and to compare nesting biology across latitudes, habitats, or genera, many more nests will need to be found, inspected, and patiently monitored.

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