



## OBSERVATIONS ON THE PARENTAL CARE BEHAVIOR OF THE MAROON-CHESTED GROUND DOVE (*PARACLARAVIS MONDETOURA*) IN SOUTHEASTERN ECUADOR

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**Abstract** · We present the first observations of parental care behaviors of the Maroon-chested Ground Dove (*Paraclaravis mondetoura*), using 222.5 hours of recorded observations from a single nest, found on August 2005 in a tropical montane forest in the Tapichalaca Biological Reserve in south-east Ecuador. Recordings began with the onset of incubation and continued through fledging. Observations of male and female attendance at the nest were used to analyze visit frequency and timing, duration, and differences in male and female investment in the reproductive effort. Both adults spent time incubating, brooding, and shared feeding responsibilities and patterns observed reflected those commonly seen in other Neotropical Columbidae. The first descriptions of nestling growth and timing of the development of sex-specific plumage are reported.

### Resumen · Observaciones sobre el comportamiento parental de la tortolita pechimorada (*Paraclaravis mondetoura*) en Ecuador

Presentamos las primeras observaciones sobre los comportamientos de cuidado parental de la tortolita pechimorada (*Paraclaravis mondetoura*). Analizamos 222,5 horas de video, grabado en un nido encontrado en agosto de 2005 en un bosque de montaña subtropical en la Reserva Biológica Tapichalaca, sureste del Ecuador. Nuestras grabaciones comenzaron al inicio de la incubación y continuaron hasta la salida del nido de los pichones. Analizamos la frecuencia y duración de las visitas de los adultos y las diferencias en la inversión de esfuerzo entre el macho y la hembra. Ambos adultos pasaron tiempo incubando y empollando y compartieron las responsabilidades de alimentación. Los patrones observados reflejaron los que se encuentran comúnmente en otros Columbidae Neotropicales. Reportamos las primeras observaciones del crecimiento de los pichones y del desarrollo del plumaje específico de cada sexo.

**Key words:** Breeding biology · Columbidae · Nestling growth · Parental care · Plumage development

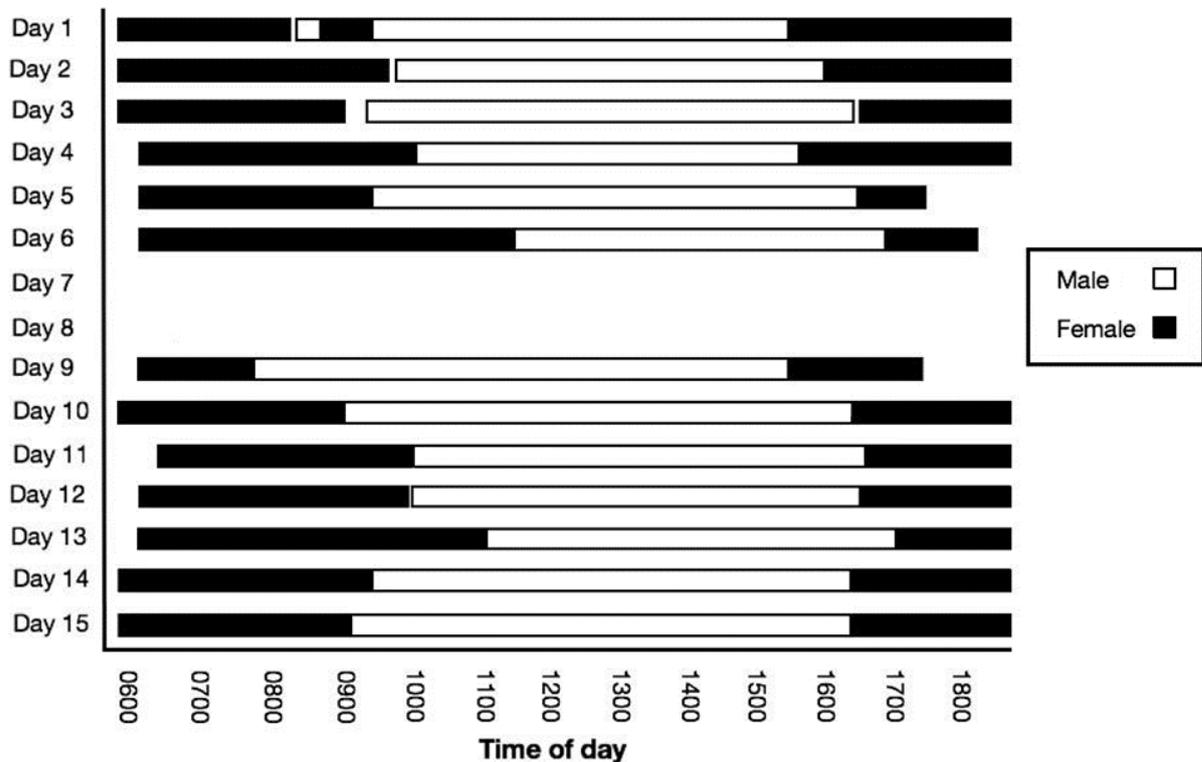
### INTRODUCTION

*Paraclaravis mondetoura* (Maroon-chested Ground Dove) and its congener, the critically endangered *P. geoffroyi* (Purple-winged Ground Dove), comprise a recently affirmed genus (Sweet et al. 2017, Sangster et al. 2018) whose reproductive behavior remains little described (Greeney et al. 2007, Birdlife International 2018, Baptista et al. 2019). Locally uncommon, *P. mondetoura* inhabits heavy undergrowth within montane forests, is highly nomadic (Stiles & Skutch 1989), and strongly associated with the blooming patterns of bamboo, appearing when bamboo is fruiting and disappearing when the seed supply is exhausted (Stiles & Skutch 1989, Howell 1992, Baptista et al. 1997). Greeney et al. (2007) suggested they may nest colonially in association with bamboo flowering, based on observations of a nest and breeding activity in Ecuador. *P. mondetoura* individuals are ground foragers, often searching under a layer of dense vegetation for any seeds or fallen fruit (Baptista et al. 1997). Ranging from southern Mexico, south through the mountains of northern Venezuela, on both slopes of the Andes to Bolivia (Hennessey et al. 2003, Lane 2014), the Maroon-chested Ground Dove is sexually dimorphic. The female is largely colored in variations of browns and grays with cinnamon forehead and face, while male plumage is overall a dark blue-gray with a dark maroon chest (Ridgely & Greenfield 2001). Although some authors treat this wide-spread species as monotypic (Dickinson & Remsen 2013), it is more generally considered to include up to six subspecies (Gibbs et al. 2001, Baptista et al. 2019). The observations presented here refer to the nominate subspecies, and all aspects of reproduction remain undocumented for the remaining populations.

The nest appears as a flat saucer of sticks, leaf petioles, and grass fibers arranged in a somewhat circular pattern (Greeney et al. 2007). Current published data regarding the natural history of this species is limited to the description provided by Greeney et al (2007). They reported egg and nest descriptions, nesting chronology, and confirmed the participation of both

**Table 1.** Percent nest attendance by male and female Maroon-chested Ground Dove (*Paraclaravis mondetoura*) during pre-hatch, post-hatch, and total nest cycle from a single nest near Tapichalaca Biological reserve, Ecuador. Number of visits in parentheses.

	Total % visits	Incubation % visits	Post-hatch % visits
Male	42.3 (55)	39.2 (31)	47.1 (24)
Female	57.7 (75)	60.8 (48)	52.9 (27)

**Figure 1.** Pattern of male and female Maroon-chested Ground Dove *Paraclaravis mondetoura* nest attendance throughout incubation from a single nest near Tapichalaca Biological reserve, Ecuador (N = 130 visits). No observations were made on days 7 and 8.

parents in the care of two nestlings at a single nest. They also suggested the nest may have been a part of a breeding colony within a patch of flowering *Chusquea* bamboo. Beyond this paper, very little has been published about its natural history and parental care behaviors, and research with this species may provide insights into its critically endangered congener, *P. geoffroyi*. Here, using recordings obtained from the nest first described by Greeney et al. (2007), we provide further details on male and female parental care and nestling growth and development of the Maroon-chested Ground Dove in southeastern Ecuador.

## METHODS

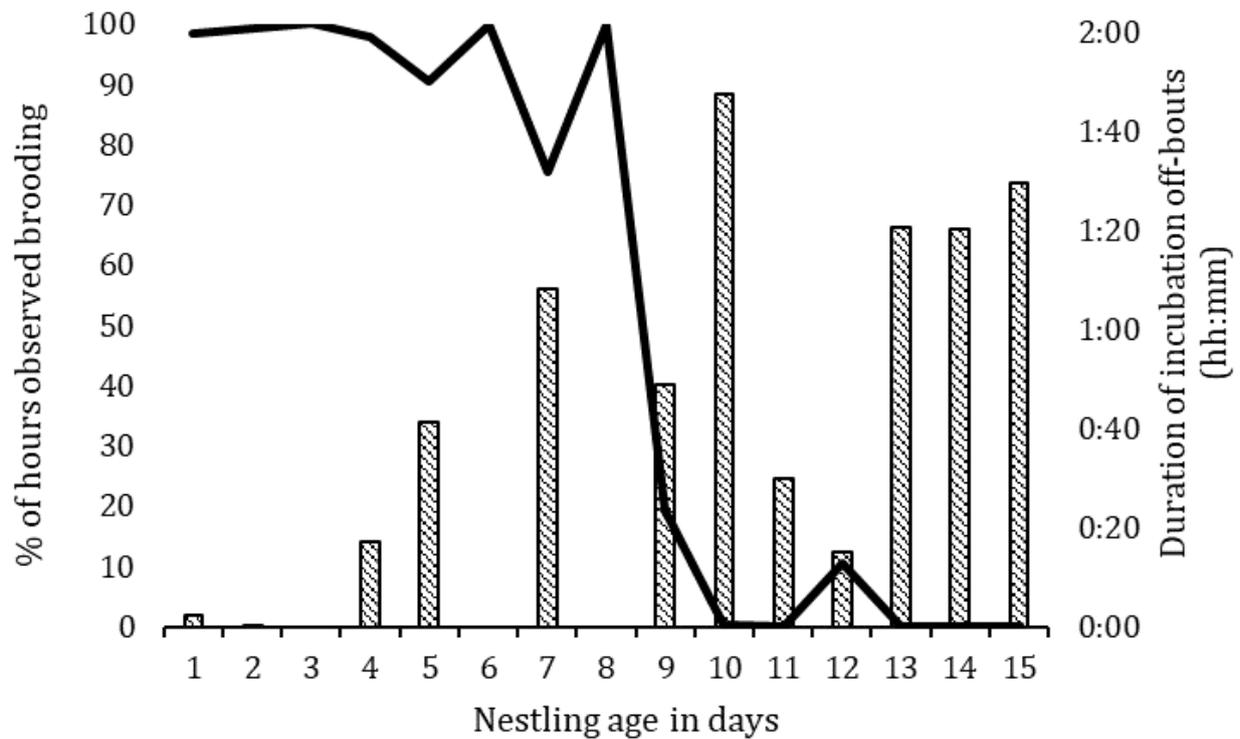
We analyzed the parental care and nestling activity of a single *P. mondetoura* nest at the Tapichalaca Biological Reserve, near south-east Ecuador (04°30'S 79°10'W; 2650 m a.s.l.), found in August 2005 and described by Greeney et al. (2007). The nest was located 2.1 m above the ground on a dense platform of *Chusquea* bamboo stalks, sticks, and leaves (Greeney et al. 2007). Two eggs were laid on consecutive days (13–14 August), with two nestlings hatching after a reported 15-day incubation period. Fledging of two chicks occurred after slightly more than 14 days on 12 September (Greeney et al. 2007). Greeney et al. (2007) reported as many as eight individuals calling in a 10 ha area of flowering bamboo, suggesting nesting activity may have been colonial

and timed to coincide with bamboo flowering in the region. Activity was filmed with a tripod-mounted camera positioned near the ground and 3–5 m from the nest to allow observation of nest contents, and operated continuously during daylight hours (ca. 06:00–18:00). While we could see the nest contents, we were unable to access them due to the dense nature of the *Chusquea* stand in which it was located. Nest activity was recorded, beginning with egg laying, through fledging. All times are presented in decimal minutes. Batteries and recording tape were changed approximately every 4 hours during the day to maintain a nearly continuous record of activity at the nest.

Data transcribed from the videos included number of visits, visit duration and frequency, along with nest activity patterns 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 the nest. 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  $\pm$  standard error (SE).

## RESULTS

Nest activity was recorded between 14 August and 12 September 2005, for a total of 222.5 hours. No footage was rec-



**Figure 2.** Percent brooding and off-bout time by Maroon-chested Ground Dove *Paraclaravis mondetoura* adults during the nestling period from a single nest near Tapichalaca Biological reserve, Ecuador. Line represents percent brooding time by adults and bars represent the off-bout times in h:min each day. Days 6, 8, 11, 12 represented by < 4 hours of video each day. Fledging occurred on day 15.

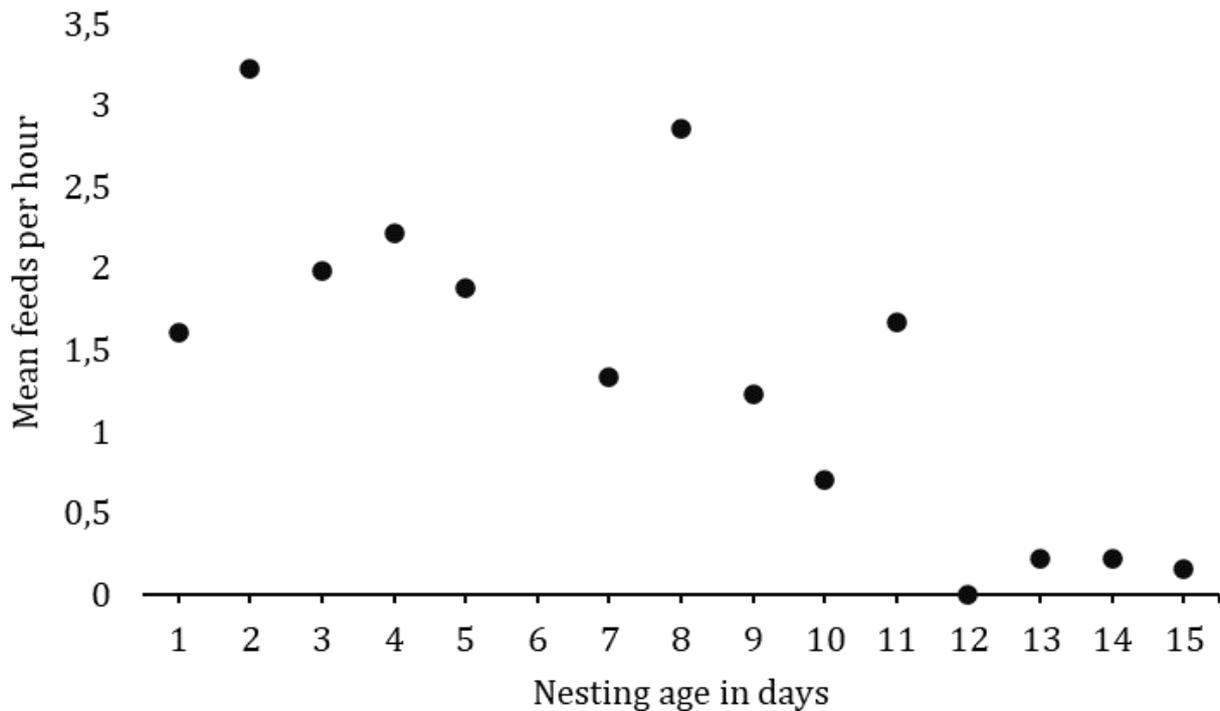
orded on 20 and 21 August and less than 4 hours of observations were made on 3, 5, 8, and 9 September. A total of 130 visits by both male and female were observed, with the female ( $N = 75$ ) visiting slightly more often, but for a shorter duration ( $71.6 \pm 6.5$  min), compared to the male ( $116.6 \pm 12.3$  min;  $N = 55$ ). Average visit duration across the nesting cycle was  $86.6 \pm 7.7$  min ( $N = 130$ ; Table 1). Nestling one hatched overnight on 28 August and the second hatched the morning of 29 August.

**Incubation behavior.** Both parents incubated and eggs were rarely left unattended. Adults made an average of  $0.73 \pm 0.10$  ( $N = 80$ ) visits per hour. Time between adult visits averaged  $4.8 \pm 0.3$  min ( $N = 80$ ) although most frequently (71.5%), the incubating adult would not leave the nest until the other adult walked onto the lip of the nest and was prepared to switch positions. During the incubation period, the eggs were incubated 95.2% of observed hours ( $N = 130.6$  recorded hours) and on-bouts averaged  $95.9 \pm 9.5$  min ( $N = 79$ ) in duration. Adults were typically observed on the nest at the start of filming in the morning and, if still present at dusk, it was assumed they remained on the nest all night. The female was observed on the nest in the evening hours and was present the following dawn, and it was consequently assumed that she had incubated throughout the night, although it remains possible the adults switched during this time. Female visits averaged  $73.6 \pm 7.2$  min ( $N = 48$ ) and the males averaged  $130.4 \pm 15.9$  min ( $N = 31$ ;  $t = 3.6$ ,  $df = 41$ ,  $P < 0.001$ ). The timing of visits by each sex typically differed during incubation. The female was commonly present overnight through mid-morning (06:45–10:30), and the male was more often present between 10:30–16:00 (Figure 1).

**Brooding behavior.** Brooding of the nestlings was nearly

continuous on the day of the hatch, gradually decreasing through day 9 before ceasing nearly entirely ( $N = 92.2$  hours observed, mean = 65%; Figure 2). Prior to day 10, every visit to the nest included some time spent brooding. Beginning with day 10, the adults visited the nestlings for the sole purpose of feeding and did not enter the nest for brooding. Visits for brooding occurred more frequently per hour (mean =  $0.90 \pm 0.18$ ;  $N = 51$ ) and were shorter (mean =  $72.2 \pm 8.9$  min) compared to incubation bouts. Male visits averaged  $77.9 \pm 17.9$  min ( $N = 24$ ), while the female averaged  $67.1 \pm 12.3$  min ( $N = 27$ ). In the first few days following the hatch, adults switched places at the nest, gradually increasing duration of the off-bouts (mean =  $46.4 \pm 2.42$  min;  $N = 50$ ; Figure 2), with switching at the nest occurring less frequently (50.7%) compared to incubation.

**Feeding visits.** Both the male and female were involved in feeding the nestlings, beginning with the hatch. Feeding by crop milk was done periodically throughout the brooding visits. Adults fed an average of  $0.8 \pm 0.1$  per nestling/h ( $N = 151$ ). During brooding, nestlings would peck at the adults' face or neck area until they were fed. Due to the camera angle, when the nestlings were small it was difficult to consistently distinguish whether adults fed both nestlings simultaneously (both nestlings would insert their bills into that of the parent at the same time) or separately during an individual feeding event. However, when clearly observed, the adults often fed both nestlings simultaneously until day 10. After that point, the adults began to feed the nestlings individually. On two occasions, on days 14 and 15, the adult (in one instance, the male; in the other, the female) walked into the nest, regurgitated into its center and departed, leaving the nestlings to eat the contents from the bottom of the nest. While it was impossible to determine contents due to



**Figure 3.** Mean feeding rate of two Maroon-chested Ground Dove *Paraclaravis mondetoura* nestlings from a single nest near Tapichalaca Biological reserve, Ecuador. Day 6 was limited to <1 hour of observation and removed from this analysis. Days 8, 11, 12 represented by < 4 hours of video each day. Fledging occurred on day 15. As is common in Columbidae, individual feeds lasted for several minutes and often involved both nestlings at the same time.

the angle of the camera and large size of the nestlings, it is likely the adult was regurgitating food items, perhaps mixed with some crop milk.

Feeding time was generally brief (mean =  $2.9 \pm 0.1$  min;  $N = 151$ ). The male contributed 63.6% ( $N = 96$ ) of the observed feedings with the remaining 36.4% provided by the female ( $N = 55$ ). The male averaged  $1.0 \pm 0.4$  feedings per nestling/h ( $N = 96$ ), while the female averaged  $0.6 \pm 0.2$  ( $N = 55$ ). Feeding rates peaked on day 2, with 40 feedings between 06:00–18:30, 32 by the male and 8 by the female (Figure 3).

**Nest maintenance and egg removal behaviors.** Both adults were observed conducting periodic nest maintenance by adjusting the position of nest materials. On the day of the hatch, shortly after the second nestling hatched, the male was observed retrieving half the eggshell and flying off with it. He then returned two minutes later and repeated the action with the remainder of the eggshell. By day 10, nestlings were observed moving to the edge of the nest cup to defecate periodically.

On three occasions during incubation, while the female adult was on the nest, the male adult was observed to approach and climb onto the female's back and pass down a twig. The female added the twig to the nest structure, before allowing the male to take her place incubating the eggs, and then the female flew off.

**Nestling growth.** Due to the dense thicket of *Chusquea* bamboo surrounding the nest, we did not approach it after its initial discovery and are only able to provide a general description of nestling development based on views limited by the video camera angle and resolution. At hatching, the nestlings were similar in appearance to most young columbid chicks (Baptista et al. 2019). They had dark skin, were well-

covered in dense tufts of rich, buffy yellow natal down, and had bright whitish markings at the tips of their bills (Figures 4A–B). At six or seven days old, they were still predominantly buffy yellow, but most of the white at their bill tips had been lost (Figures 4C–D). Their flight feathers emerged through the skin within a few days of hatching and grew rapidly (Figure 4C), but their feather sheaths remained unbroken until at least day eight (Figure 4G). Contour feathers most likely began erupting from their sheaths around day seven (Figure 4D), but the color of the emerging feathers was not apparent on the video until day eight (Figures 4E–G). Eight days after hatching, however, the color of the emerging contour feathers of the nestlings provided a clear indication of their respective sexes. Although still well-covered with pale down plumes, one nestling was clearly dusky grey, while the second was showing the development of brown contour feathers similar in color to the upperparts of adult females (Figure 4F). These observed differences in contour feather coloration were not due to variable lighting or nestling position within the nest, as illustrated by Figures 4H and 4I, which show the two young in opposite locations within the nest, with a time-lapse of less than 10 minutes, during which there was no change in light intensity or angle. Only two days after breaking their sheaths, flight feathers were well developed (Figure 4J). The sex-dependent color differences between the nestlings was unmistakable by day 9 or 10, and by day 13 the few remaining plumes of natal down gave the young a somewhat spotted appearance (Figure 4K), and their contour feathers were similar in color to those of their parents, brown on the female nestling and dark grey (though slightly less bluish) on the male nestling (Figures 4K). Although we cannot be certain due to the poor quality of the images, it also appeared that the feathers of the face and lores of the male nestling were already showing white, ap-



**Figure 4.** Development of two Maroon-chested Ground Dove *Paraclaravis mondetoura* nestlings from a single nest near Tapichalaca Biological reserve, Ecuador. Hatch occurred on August 28 and 29 and images show nestlings on day 1 (4A), day 3 (4B), day 6 (4C), day 7 (4D), day 8 (4E-G), day 9 (4H-I), day 10 (4J), and day 13 (4K). For comparison, figure 4L shows the adult male and female on the nest and clearly illustrates the plumage differences between the sexes. See text for specific details on features of nestlings highlighted by arrows.

proximating the patterning of adult males (Figure 4L).

**Nestling behavior and fledging.** Prior to day 10, it was difficult to identify nestling behaviors due to the nearly constant presence of one of the adults. After this point, nestlings were observed preening, stretching, periodically exchanging positions within the nest, as well as defecating around the rim of the nest cup. Fledging occurred at 12:14 on day 15. Both nestlings had been resting on the nest during the morning, with a feeding having taken place at 09:20 that morning. No adults were seen or heard at the nest prior to fledging although based on the observations of the nestling's behavior, it is likely that one of the adults was perched nearby just prior to the young leaving the nest. Over a period of 2 minutes, the young were observed standing, wing flapping, and then walking off the nest and onto the surrounding *Chusquea* platform. For several minutes after, rustling could be heard from off-camera, suggesting the young and perhaps an adult were still in the vicinity. No vocalizations were heard and the young were not seen on the nest again.

## DISCUSSION

Here we report the first detailed observations of the parental care behavior of *P. mondetoura*. Both male and female contributed to incubation, brooding, and feeding of the young. Activity patterns during the incubation and nestling periods were similar to those described for Neotropical Columbidae (e.g. Skutch 1949, 1956; Wiley 1991), although we noted a slightly different feeding pattern than that described by Skutch (1959) for *Claravis pretiosa*. Skutch reported young fed simultaneously after 10 days of age, while we observed young being generally fed singly.

Both the male and female participated in feeding the young, with an overall feeding rate of 1.6 feedings per hour. The male averaged 1.0 feedings per nestling per hour and the female averaged 0.6, although this is complicated by the feeding methods used in Columbidae. Skutch (1959) noted the difficulty of separating out individual feeding events during prolonged stays at the nest by parents and the protracted feeding process involved in regurgitation of the crop se-

cretions. Our observations were comparable to those reported by Skutch (estimated 0.95 feedings per nestling per hour; 1959) in the Blue Ground Dove, although Skutch reported the female feeding more frequently than the male. Similar rates are reported for other Columbidae species (e.g. Nice 1938, 8 feedings per day; Wiley 1991, 0.5 feedings per hour). We also noted 2 feeding events where regurgitation occurred by the parents into the bottom of the nest. While we were unable to confirm the contents, it remains possible some of the contents were *Chusquea* bamboo seeds. Greeney et al. (2007) noted a possible association between nesting of *P. mondetoura* and local fruiting of *Chusquea* stands.

Nearly constant nest attendance during incubation is typical of most columbids for which this aspect of reproduction has been documented (e.g. Skutch 1949, 1959, Johnston 1960, Cintra 1988, Mirarchi & Baskett 1994). Adults often share incubation duties, with the male present in the early morning and afternoon and the female later in the day and overnight (Skutch 1959, Cintra 1988), a pattern observed in *P. mondetoura*. We did observe removal of eggshells by the male shortly after hatch, in contrast to the ingestion of eggshells reported for some species (Anderson & Anderson 1948). Addition of nest material typically involves the male bringing small sticks to the female and handing them down to her while balanced on her back, a behavior noted by Skutch (1959) for the Blue Ground Dove, Anderson & Anderson (1948) in the Inca Dove (*Columbina inca*) and Jackson & Baskett (1964) in the Mourning Dove (*Zenaida macroura*) among others.

Nest attendance decreased with nestling age. By day 10, adult attendance was restricted to feeding visits and this pattern continued until fledging five days later. We observed a nestling period of 14 days, commensurate with that reported for other Neotropical Columbidae (Skutch 1959, Johnston 1960, Cintra 1988, Wiley 1991).

Our observations of nestling growth and development are consistent with those reported for other Columbidae (Baptista et al. 2019). Sexual size dimorphism is common within this family, with plumage dimorphism reportedly less widespread (Baptista et al. 1997). Among Neotropical columbids, *Paraclaravis* is reported to have the strongest plumage dimorphism, making it distinct from other closely related genera (Sweet et al. 2017). We can confirm that nestlings show evidence of plumage color differences as early as day eight.

While these observations represent a single nest, our findings suggest the parental care behaviors of *P. mondetoura* are similar to those reported for other Columbidae, including its sister taxa. With so little still known about the basic natural history of this and other closely related species, including some that are critically endangered, we encourage others to contribute observational studies, particularly among these Neotropical genera.

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