INCUBATION BEHAVIOR OF THE MASKED GNATCATCHER (*POLIOPTILA DUMICOLA*) IN CENTRAL ARGENTINA

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Abstract.- We described parental behaviors at one nest during the incubation period of the Masked Gnatcatcher (*Polioptila dumicola*). The nest contained three eggs and both parents shared incubation duties for 14-15 days. The use of remote sensors allowed us to determine that adults spent 668.83 ± 40.86 min per day incubating, which resulted in approximately 80% of daylight hours to nest attentiveness. Lapses of incubation were on average 86.30 ± 51.67 min. We did not find significant differences in the duration or amount of incubation lapses or off-bouts among periods of the day (morning, midday, and afternoon).

Keywords: *Chaco forest, incubation, Neotropical birds, parental care, reproductive biology.*

Resumen.- COMPORTAMIENTO DE INCUBACIÓN DE LA TACUARITA AZUL (*POLIOPTILA DUMICOLA*) EN EL CENTRO DE ARGENTINA. Describimos el comportamiento de los parentales durante el período de incubación en un nido de Tacuarita Azul (*Polioptila dumicola*). El nido contenía tres huevos y ambos parentales compartieron tareas de incubación durante 14-15 días. El uso de sensores remotos nos permitió determinar que los adultos destinaron 668.83 ± 40.86 min por día a la incubación, lo que resultó en aproximadamente un 80% de atención al nido durante la incubación diurna. Los intervalos de incubación fueron en promedio 86.30 ± 51.67 min. No encontramos diferencias significativas en la duración, cantidad de períodos de incubación y recesos entre las diferentes horas del día (mañana, mediodía y tarde).

Palabras clave: *aves Neotropicales, biología reproductiva, bosque chaqueño, cuidado parental, incubación.*

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The Polioptilidae family comprises approximately 15 small avian species distributed over an extensive region of America, from southern Canada to central Argentina (Smith et al. 2018). *Polioptila* is the most diverse genus (approximately 12 species) and can be found all across America (Atwood and Lerman 2006, Smith et al. 2018). The Masked Gnatcatcher (*Polioptila dumicola*) is distributed from central Brazil and northern Bolivia to central Argentina, also including Paraguay and Uruguay (Ridgely and Tudor 1997, Atwood and Lerman 2006). This is a very common species, particularly in different ecoregions of Argentina, and it can be found in semi-open forests, grasslands, and savannahs from Chaco, Espinal, Pampa, and some areas of the Monte Desert, as well as in gallery forests in northwestern Argentina (Narosky and Yzurieta 2010, Fraga and Salvador 2013).

This species builds small open-cup nests (external diameter up to 6 cm, height up to 6.5 cm and depth up to 4 cm), composed of vegetal fibers and externally covered with lichens, where both adults incubate the same clutch (de la Peña 2005, Fraga and Salvador 2013). Some specific aspects of its breeding biology such as clutch size, incubation period, nestling characteristics, and some parental care behaviors have already been described (Pautasso 2002, de la Peña 2005, Di Giacomo 2005, Fraga and Salvador 2013). However, other aspects of this species' breeding biology are still unknown. In this paper, we describe parental care behaviors during the incubation of the Masked Gnatcatcher in central Argentina.

We conducted the study in mountain Chaco woodland habitat (Ribichich 2002), located at 650 masl, 15 km east of Río Ceballos (31°10′ S, 64°15′ W), Córdoba, central Argentina. The climate is seasonal, temperate and semiarid, with a mean annual temperature of 18.9 °C (18–39 °C during the breeding season), and a precipitation of 650 mm/year (concentrated in the summer). The study site is dominated by tree species such as *Lithraea molleoides*, *Celtis enherbergiana,* and *Zanthoxylum coco* (Ribichich 2002, Gavier and Bucher 2004).

Upon the finding of a nest of Masked Gnatcatcher containing three eggs on 7 December 2013, we used a temperature sensor (HOBO Temp, RH, 2x External (C) 1999; Onset Computer Corp., Pocasset, MA) to record parental care activities during incubation. The sensors provide an indirect measure of nest parental activity by means of contrasting changes in nest temperature with ambient temperature (see details in Schaaf et al. 2016). The nest was located in a Roman Cassie (*Vachellia caven*) tree at approximately 3 meters above ground (Fig. 1). We placed the sensor on the nest on 8 December 2013 and collected data for 12 consecutive days. Hence, we recorded parental care activity between days 2 and 13 of incubation (dates estimated backward from the day of chicks hatching, and based on the knowledge that incubation in this species lasts 14-15 days, de la Peña 2005). A probe of the sensor was interwoven within the inner cup of the nest in order to register the temperature at which eggs were exposed, whereas another probe was located close to the nest to record ambient temperature. The temperature was recorded every 2 min (Weidinger 2006). We interpreted abrupt changes of nest temperature as changes in incubating attentiveness by parents (i.e. sharp drops of nest temperature implied that an adult had just left the nest and abrupt increases in nest temperature were interpreted as an adult resuming incubation). We validated the method comparing direct observations of nest parental activity with activity patterns recorded from the sensor. For further methodological details, see Vergara-Tabares and Peluc (2013) and Schaaf et al. (2016).

At the monitored nest, we registered the average amount and duration of incubation lapses, average amount and duration of off-bouts, and the total duration of daylight and nighttime incubation. With these data, we calculated the daily nest attentiveness as the proportion of daylight time at which the eggs were incubated (considering daylight length of approximately 14 hours, between 06:00 h and 20:00 h) (Martin 2002). Additionally, we compared the duration and number of incubation lapses and off-bouts among three different time intervals: morning (from the first departure of the bird from the nest until 11:00 h), midday (from 11:00 h to 16:00 h), and afternoon (from 16:00 h until the last entry of the bird to the nest, at approximately 20:00 h). Also, for each of these periods, we calculated mean ambient temperature and mean temperature inside the nest.

To compare the average daily incubation and patterns of incubation behavior among the periods of the day (morning, midday and afternoon), we used

Figure 1. Nest and eggs of Masked Gnatcatcher found in the locality of Río Ceballos, Córdoba Province, Argentina.

Table 1. Variables of incubation behavior (mean ± SD) and range measured at the nest of Masked Gnatcatcher (*Polioptila dumicola*) corresponding to three daytime periods, in the locality of Río Ceballos, Córdoba Province, Argentina. The values of the Kruskal-Wallis test are detailed, using a significance level of 0.05. Nest mean temperatures and range for each period are shown.

Variables	Morning	Mid-day	Afternoon	Kruskal Wallis test	
				H	p
Duration (min) of daytime incubation lapses (range)	77.42 ± 53.36 (10.00 - 202.00)	98.28 ± 57.36 (16.00 - 234.00)	73.05 ± 46.01 (20.00 - 168.00)	3.07	0.214
Nest mean temperature (range)	27.89 ± 4.82 (25.54 - 29.50)	33.09 ± 2.62 (31.52 - 35.27)	33.78 ± 3.42 (30.57 - 35.07)		
Duration (min) of off-bouts (range)	13.87 ± 5.17 (6.00 - 26.00)	14.80 ± 5.78 (8.00 - 28.00)	17.73 ± 13.97 (6.00 - 72.00)	0.68	0.706
Nest mean temperature (range)	18.94 ± 3.19 (11.77 - 28.71)	30.72 ± 0.74 (29.10 - 31.93)	28.92 ± 1.25 (27.10 - 30.65)		
Ambiental mean temperature (range)	17.25 ± 1.82 (16.00 - 21.23)	26.71 ± 3.62 (19.42 -33.17)	25.89 ± 3.47 (18.81 - 34.07)		
Amount of off-bouts	2.22 ± 0.44 (2 - 3)	2.56 ± 1.01 (1 - 4)	2.56 ± 1.01 (1 - 4)	0.60	0.694

a non-parametric Kruskal-Wallis (H) test. Both graphics and analyses were done using INFOSTAT software (Di Rienzo et al. 2002).

We observed that, during incubation, adults invested a mean (± SD) of 668.83 ± 40.86 min (ranging between 524-743 min) of daylight hours, resulting in approximately 80% of daily nest attentiveness. The average ambient temperature at night registered during the study was 15.55 ± 2.06 °C (ranging between 11.38-22.48 °C), and the temperature registered inside the nest was 29.15 ± 1.06 °C (ranging between 26.36-32.34 °C). First off-bouts of the day were registered between 06:00 h and 07:00 h (sunrise: 05:25-06:00 h), whereas the last entries of adults to the nest were registered between 19:00 h and 20:00 h (sunset: 20:00-20:35 h). The mean duration of incubation lapses was 86.30 ± 51.67 min (ranging between 15-234 min), and on average, off-bouts had a duration of 15.27 ± 8.79 min (ranging between 6-72 min) (n=12 days).

We did not find significant differences when comparing the mean duration of daylight incubation lapses among the total of sampled days (H = 4.02, P = 0.97, n = 12 days; Fig. 2). Moreover, when considering periods of the day (morning, midday, and afternoon) we did not find significant differences in the duration of daylight incubation lapses, amount of incubation events, or duration of off-bouts (Table 1). Additionally, although we could not reckon the proportional contribution of each adult to incubation tasks, direct observations at the nest allowed us to confirm the participation of both adults, as we witnessed the parents exchanging the incubation duties at the nest.

In this study, we provide a detailed record of the Masked Gnatcatcher's incubation behavior in central Argentina, focusing on nest attentiveness and on patterns of time investment in incubation, which had not yet been described for the species. Although we acknowledge the limitations of our results, as we report observations of only one nest and one reproductive couple, we believe that the detailed information provided here is useful for future research on this species. Furthermore, this study allows us to confirm the biparental incubation in the Masked Gnatcatcher.

Long incubation lapses and scarce and brief off-bouts throughout the day were maintained during the 12 days of observation. Such an incubation pattern could only be explained by a constant relay of the adults on the nest, which we could witness several times. Other passerine species in the area, with uniparental care during incubation, tend to endure much shorter incubation bouts due to their need to replenish energy during off-bouts (Vergara-Tabares and Peluc 2013, Schaaf et al. 2016). The Masked Gnatcatcher is a little passerine that weighs around 9 g; therefore, if it were a uniparental incubator we would expect much shorter incubation bouts given its relatively high metabolism. On the other hand, such extenuating incubation pattern could be maintained with the provision of food by the other adult. However, we were unable to record adult feeding on the nest during this study. Incubation activities in other *Polioptila* species, although shared between sexes, resemble more those of uniparental incubators. In the Tropical Gnatcatcher (*Polioptila plumbea*) for example, the female spends the nights on the nest and the male performs the majority of the incubation duties during daylight hours, with much shorter incubation bouts (~35 min; Hannelly and Greeney 2004). A similar incubation behavior was observed for the California Gnatcatcher (*P. californica;* Sockman 1998). However, for the reproductive couple of Masked Gnatcatcher that we monitored, we observed high nest attentiveness (80%) during the incubation period, which could be explained by the shared participation of both members of the couple on incubation activities and protection of the eggs. Considering the fact that heat loss and gain is faster in relatively small organisms, the high nest attentiveness observed here may serve as a way to avoid temperature fluctuations, which may affect the normal development of embryos (Conway and Martin 2000, Martin et al. 2000, Simmonds et al. 2017).

Little is known about the relative investment of male and female Masked Gnatcatcher in incubation. However, the incubation pattern observed here for one reproductive couple suggests that this would be an interesting study species to further explore variability in avian parental division of labor during different stages of the nesting cycle, as well as to address questions related to sexual reproductive conflicts, parental care behaviors, and nest architecture (Rytkönen et al. 1995).

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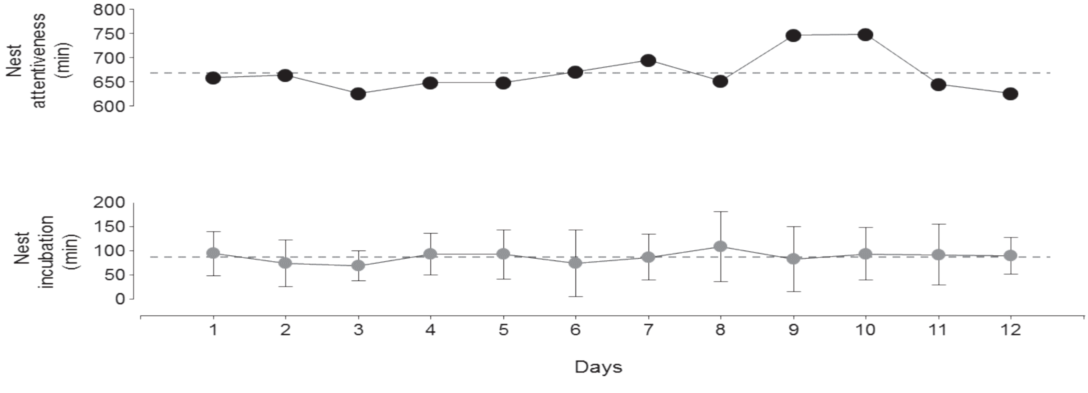

Figure 2. Total time nest attentiveness (upper chart) and mean ± SD of duration of nest incubation lapses during daily hours for the Masked Gnatcatcher's nest (*Polioptila dumicola*) found in the locality of Río Ceballos, Córdoba Province, Argentina. Dotted lines: mean attentiveness at the nest and mean duration of incubation lapses during 12 days.

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