BREEDING BIOLOGY OF THE WREN-LIKE RUSHBIRD (*PHLEOCRYPTES MELANOPS*) AT THE SOUTHEAST PAMPAS OF ARGENTINA

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ABSTRACT.—Between 2013–2015, we conducted a study on the breeding biology of the Wren-like Rushbird (*Phleocryptes melanops*) in wetlands of the Pampas region, Argentina. The search for rushbird nests was conducted by several researchers walking into the wetlands, in three ways, by observing adults carrying material, through singing adults next to the nest or from the active search for nests in the vegetation. Nests were visited at intervals of 3–5 days. Of the 245 nests that we encountered (153 nests in 2013–2014 and 92 nests in 2014–2015), we found eggs in 97. The egg-laying period lasted almost 3 months (late Sept–late Dec). The mean clutch size was 2.7 ± 0.5 eggs (mean $\pm$ SD) (range $= 1$–3; $n = 63$), and the total nesting period was 34 ± 2.5 days (mean $\pm$ SD), with incubation and chick-rearing periods of 18 ± 1.63 days and 16 ± 0.50 days, respectively. From the total number of nests found, 43% of them were abandoned during building, 38% of nests were depredated, 14% of nests ($n = 33$) were successful, while 5% of nests were destroyed. Nest predation was higher during the incubation (80%) than during chick-rearing period (20%). The nesting success was on average of 23% (25% for the 2013–14 and 21% for the 2014–2015) for the entire nesting period. We also observed relatively higher plasticity than previously reported in relationship to vegetation used to fix nests (80% rushes, 20% other plants). Finally, we observed an abrupt termination of the reproductive period after desiccation of the wetlands; 90% of active nests failed (75% depredated and 25% abandoned) when the wetland was dried. *Received 1 September 2015. Accepted 19 May 2016.*

Key words: breeding success, furnariid, nest structure, reproductive phenology, rushes, wetlands.

The Wren-like Rushbird (*Phleocryptes melanops*; hereafter rushbird) is a furnariid widely distributed in southern South America (Peru, Bolivia, Paraguay, Uruguay, Brazil, Chile, and Argentina; Remsen 2003), mainly inhabiting wetlands dominated by rushes (*Schoenoplectus californicus*) and cattails (*Typha* spp.; Nores and Yzurieta 1980, Fjeldså and Krabbe 1990, Remsen 2003). The rushbird has the particularity to build an elaborate enclosed nest attached exclusively to emergent aquatic vegetation (Narosky et al. 1983, Remsen 2003), and is the only furnariid species that uses the mud-daubing technique to build the nest interior (i.e., strips of macerated plant material coated with mud that hardens upon drying are woven into the nest wall; Zyskowski and Prum 1999).

There is little known about the breeding biology of the rushbird. General and anecdotal descriptions have been made by Hudson (1920), MacDonagh (1933), Narosky et al. (1983), Belton (1984), Mason (1985), and de la Peña (2013). As far as we know, the most complete description of the breeding biology of the rushbird was made by Lara et al. (2011) in southern Chile.

Rushbirds are the most abundant and frequent bird species found in the vegetated portion of Pampas wetlands (Josens et al. 2012), nonetheless, there are no studies comprehensively addressing its reproductive biology. This work is part of a larger scale study about the biology of this species, in this first step we describe the breeding biology of nesting rushbirds in the flooding Pampas, specifically describing the nest structure, breeding parameters, nesting phenology, and nesting success.

STUDY AREA

The study was carried out in wetlands in the southeast of the flooding Pampas (Soriano et al. 1992) specifically at the Mar Chiquita County, Buenos Aires Province, Argentina. In this area, three wetlands were selected: a 10 ha interdune wetland dominated by rushes *S. californicus* within the Mar Chiquita Biosphere Reserve (37° 42′ S–57° 23′ W); and the other two in the private ranch Nahuel Rucá (37° 37′ S–57° 25′ W), which has a 320-ha shallow lake featuring a coastal zone with aquatic vegetation dominated by rushes and a center zone of open waters; and a 39-ha shallow lake with rushes

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spread in a patchy way but mixed with *Solanum malacoxylon* in the center zone.

Wetlands are widely distributed ecosystems of the flooding Pampas within the Pampas region (after Soriano et al. 1992) and are represented by a large number of shallow lakes, swamps, streams, and artificial wetlands. Wetlands in this region are characterized by the variable dominance of *S. californicus*, *Typha* spp. and *Zizaniopsis* spp. at their edges and by submerged macrophytes (Vervoorst 1967, Federman 2003). Despite being recognized for their importance in sustaining biodiversity (Martínez 1993, Josens et al. 2012), the wetlands are increasingly affected by different disturbances including drainage to replacement by croplands (Booman et al. 2012, Brandolin et al. 2013).

MATERIALS AND METHODS

We periodically searched for nests from mid-September to early January (austral spring–summer), during two breeding periods (2013–2014 and 2014–2015). The search was conducted by several researchers always walking without optical device assistance. Nests were located in 3 ways, by observing adults carrying material, through singing adults next to the nest, or from active search for nests in the vegetation. Any way, the size and location of the nests and characteristics of vegetation make nests conspicuous within the wetland. The possibility of not detecting them in the area was negligible. Once we found a nest, we recorded its location with a global positioning device (GPS) and marked it with plastic tape near the nest point to facilitate subsequent monitoring. Nests were visited at intervals of 3–5 days following standard procedures to avoid attracting predators to nests (minimal disturbance on the vegetation, nest was only visited by one researcher at a time, and time at the nest was minimized; Martin and Geupel 1993). We measured the following nest morphology variables: nest height and width, entrance height and width, and height of the nest chamber, by using a tape measure to the nearest 1 mm. Eggs were measured and weighed (width and height) by using a digital caliper (nearest $\pm$ 0.1 mm) and a digital balance (nearest to the $\pm$ 0.1 g), respectively. We also recorded the number of stems that sustained the nest, reuse of

nests (i.e., if nests were reused from previous seasons), and the water depth in cm under each nest. At each visit, we recorded number of eggs and nestlings and occurrence of abandonment or predation. We inferred predation when eggs or nestlings were damaged or disappeared between visits. We considered a nest successful if one or more young fledged.

Based on all collected information, we estimated the clutch size, hatching success, fledging success, and lengths of incubation and nestling period (Bart and Robson 1982, Martin and Geupel 1993). To avoid underestimation of clutch size, we only considered nests found during building or egg-laying periods. We assumed that egg-laying occurs every 2–3 days, because this is the egg-laying pattern reported for this species (see Lara et al. 2011). The incubation period was defined as the interval from the day that the last egg was laid until the first egg hatched (Lara Vergara 2009), and the nestling period encompassed the time frame from the day that the first egg hatched to the first day that the young fledged (Martin et al. 1997).

We documented the reproductive success as number of young fledged/number of eggs laid. In addition, we calculate nesting success across the reproductive period. At each visit, we noted egg or chick loss and the presence of adults near the nest. The permanence of eggs following the estimated date of hatching and/or the absence of parents were the criteria used to consider a nest abandoned.

Nesting success was estimated using the Mayfield method (Mayfield 1975), which is based on all nest losses occurring over the entire period of field observation. Total exposure days were calculated as the interval from first egg-laying date or (when egg laying was already initiated) from the day when the nest was found until the day when the young fledged or half way between two subsequent visits between which a nest failed. When the interval between visits to the nest was <2 days, it was assumed that nest loss occurred in the middle of the interval, but since nests were visited every 3–5 days, we assumed that nest loss occurred at 40% of the interval length to avoid overestimation of nest survival (see Johnson 1979). Daily survival rate (DSR) of nests was estimated in the two breeding periods studied (2013–2014 and 2014–2015). The overall survival rate was calculated by raising daily nest survival rate to a power equal to the mean duration of the

TABLE 1.   Morphometric and additional measurements of nests of *Phleocryptes melanops* in different studies.

	Present study		Lara et al. (2011)		de la Peña (2013)	
	Mean	Range	Mean	Range	Mean	Range
Nest height (cm)	12.04	8–20	18	8–39		12–15
Nest width (cm)	7.53	4–12	11.7	8–12		9–11
Height entrance (cm)	2.4	0.9–4.1	2.9	1.5–5.5		3–4
Width entrance (cm)	3.15	2.3–4.1	3.3	2–6		3–4
Number of stems sustaining nest	10	4–12	12	3–23		4–7
Nest chamber height (cm)	6.4	3.8–10.3	8.9	2–20		
Presence of overhang (%)	64		100			

nesting period. Mean duration of these nesting stages was calculated using information from the monitored population in the area.

Correlations between daily rainfall (obtained from Mar del Plata aerodrome weather station; www.tutiempo.net) and average water depth under nests, and between water depth and the number of active nests were developed by using Pearson correlation analyses. We examined whether there were differences between the DSR for the two breeding periods through a Chi-square test using CONTRAST software (Hines and Sauer 1989). Statistical analyses were conducted in R 2.13.0 (R Core Team 2011).

RESULTS

We found 245 nests of rushbirds during two breeding periods (153 nests in 2013–2014 and 92 nests in 2014–2015) of which 179 nests (73%) were found during building, 17 nests (7%) during egg-laying period, 38 nests (16%) during incuba-
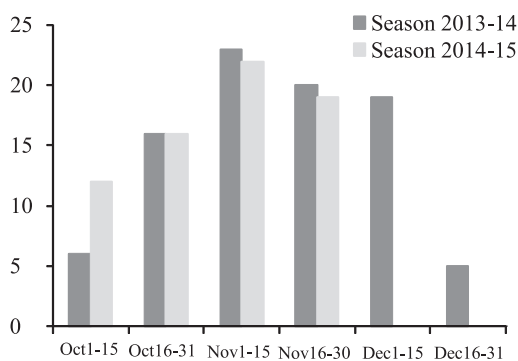

FIG. 1.   Egg-laying period of *Phleocryptes melanops* in two breeding seasons (2013–14 and 2014–15) in wetlands of the southeast Pampas region of Argentina.

tion period, and 11 nests (4%) with nestlings. Only one nest was reused, whilst in 12 nests (5%, $n = 245$) old nesting material was used for building new nests.

The building time of the nests was less than a week (mean $\pm$ SD = 4.5 $\pm$ 1.5, range = 3–6 days; $n = 9$). Nests had a domed shape (mean height $\pm$ SD = 12.0 $\pm$ 2.72 cm, mean width = 7.53 $\pm$ 1.51 cm, $n = 25$), with a small semicircular opening (mean height $\pm$ SD = 2.4 $\pm$ 0.98 cm, mean width = 3.14 $\pm$ 0.45 cm; $n = 24$). The nest chamber height had a mean of 6.4 cm (SD = 1.62 cm, $n = 24$). Eighty percent of nests were attached to rushes ($n = 142$), 4% to *S. malacoxylon* ($n = 7$), 3.5% to *Zizaniopsis* spp. ($n = 6$), and 12.5% to a combination of several plant species ($n = 21$). Nests in the rushes were attached to a set of several stems (main $\pm$ SD = 10 $\pm$ 3.26 stems, $n = 84$). Sixty-four percent ($n = 53$) of the nests had an overhang above the entrance (Table 1).

The egg-laying period extended from late September–late December, with the peak of reproductive activity during early November (Fig. 1). We found a positive relationship between the water depth in the wetland and the rainfall ($R = 0.88$, $n = 6$, $P = 0.019$) (Fig. 2), but the number of active nests was not correlated with the water depth of the wetland ($R = 0.59$, $n = 6$, $P = 0.218$; Fig. 3). However, when the vegetated portion of the wetland was dried (i.e., water depth = 0 cm), we did not record any new nests, and only 10% of active nests were successful while the remaining 90% failed (75% depredated and 25% abandoned).

The mean egg-laying period was 4.26 $\pm$ 0.75 days (mean $\pm$ SD, range = 3–5; $n = 7$). The mean clutch size was 2.7 $\pm$ 0.5 eggs (range = 1–3; $n = 63$), and the mode clutch size was three eggs
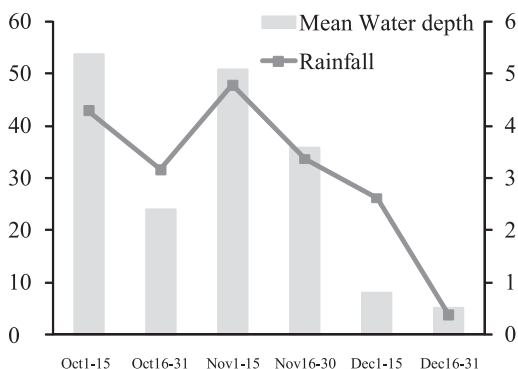
FIG. 2. Relationship between water depth in the wetland and daily rainfall, for breeding season 2014–15 in wetlands of the southeast Pampas region of Argentina.

(68%). Eggs were oval reaching a mean width of 15.7 ± 0.46 mm (mean ± SD; range = 14.8–16.8 mm) and a mean height of 20.5 ± 0.88 mm (range = 19.3–23.3 mm; $n = 31$). The mean weight of eggs was 2.7 ± 0.33 g (range = 2–3.2 g; $n = 31$).

From the total number of nests found, 43% of them ($n = 103$) were abandoned during building, 38% of nests ($n = 93$) were depredated, 14% of nests ($n = 33$) were successful, while 5% of nests ($n = 11$) were destroyed as part of nest construction by other waterbirds (Brown-hooded Gull [*Chroicocephalus maculipennis*], White-faced Ibis [*Plegadis chihi*], Cocoi Heron [*Ardea cocoa*]), or by beds of Coypu [*Myocastor coypus*]), and 1% of nests ($n = 2$) were lost by flooding. Predation was greater during the incubation period (80%) than during the nestling period (20%). Predators left different types of
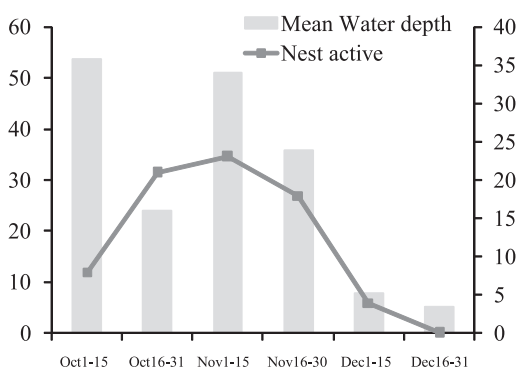

FIG. 3. Relationship between active nests of *Phleocryptes melanops* and water depth, in wetlands of the southeast Pampas region of Argentina.

TABLE 2. Nest failures of *Phleocryptes melanops* for breeding seasons 2013–2014 and 2014–2015. Reproductive stage and observations were recorded in nests after they were depredated in wetlands in the southeast Pampas region of Argentina.

	No marking	Entrance broken	Broken below	Fall-off	Broken side
N total	38	28	17	9	1
% total	41	30	18	10	1
Eggs	32	20	9	2	1
Nestlings	6	8	8	7	
% eggs	84	71	52	22	100

evidence (see Table 2) but these could not be attributed to a particular species.

The hatching success was 50% of the 97 nests with eggs recorded, and 36% of them ($n = 37$ nests) fledged. The average number of fledgings per successful nest was 1.97 ± 0.6 (mean ± SD; range = 1–3; $n = 37$). Reproductive success was 29% [i.e., (total young fledged (69) / total eggs (235) × 100)].

The total nesting cycle spanned 34 ± 2.51 days (mean ± SD), with an egg-laying and incubation period of 18 ± 1.63 days, and 16 ± 0.5 days for the nestling period. The daily nest survival rate (DSR) for the 2013–2014 breeding season was 0.960 ± 0.006 ($n = 65$), with a nesting success of 25% for the entire nesting cycle. During the breeding season from 2014–2015, the daily nest survival rate was 0.956 ± 0.007 ($n = 46$), while for the entire nesting cycle it was 21%. The daily survival was similar between seasons ($\chi^2 = 0.23$, df = 1, $P = 0.62$).

DISCUSSION

The nesting of the rushbird in our study was considerably more frequent than other sympatric species of birds breeding in marsh-like habitats (Cardoni et al. 2012, Pretelli and Isacch 2013). However, we recorded a high rate of nest abandonment and a low reproductive success. Nest abandonment during early stages of the nest building period could be mainly related to breeding display behavior. We observed repeatedly single birds singing above nest platforms, and we suspect they were males displaying to females (NMC, pers. obs.). The low success was mainly because of the high predation rate during the

incubation period. The high rate of egg predation was unexpected, because the nests of the rushbird are well closed, and are located over flooded sites. Although we did not observe direct events of predation in the field, we assume that there are many potential predators, such as Chimango Caracara (*Milvago chimango*), Cocoi Heron, Great Egret (*Ardea alba*), Stripe-backed Bittern (*Ixobrychus involucris*), Snowy Egret (*Egretta thula*), Maguari Stork (*Ciconia maguari*)*,* Brown-hooded Gull, and Brown-and-yellow Marshbird (*Pseudoleistes virescens*) — all common inhabitants of the studied wetlands (Josens et al. 2012; NMC, pers. obs.). In addition, terrestrial mammals can also depredate waterbirds, such as Pampas Fox (*Lycalopex gymnocercus*) and Geoffroy's Cat (*Leopardus geoffroyi*; Canepuccia et al. 2008).

The breeding period extension of the rushbird in our study was similar to that observed previously by Narosky et al. (1983) and Mason (1985) in Argentina. However, in other localities of South America, the breeding period can extend for almost 5 months. Belton (1984) found that in Rio Grande do Sul, Brazil, the breeding period extended from early-October to mid-February. Lara et al. (2011) reported that in central Chile the breeding period extends from early-September to late-January. Possibly, environmental factors influence the breeding period extension. The end date of the breeding period in our study area coincided with a dry period which led to the desiccation of wetlands (mid-Dec–early-Jan; Fig. 2). This could have increased exposition of nests to ground predators. We recorded footprints of the Pampas fox around two depredated nests with signs of having been broken from the ground.

The negative relationships between the water level and nest predation rate have been also observed elsewhere (Cain et al. 2003, Fletcher and Koford 2004, Hoover 2006). In temperate and cold regions, duration of breeding season is frequently determined by weather factors, mainly temperature (Gullett et al. 2015). The dependence of rushbirds by flooded wetlands for successfully completing the breeding cycle shows the vulnerability of this species to hydrological changes, either by human impact (i.e., drainage) or by changing rainfall regimes (Canepuccia et al. 2008).

Morphology of the nest of rushbirds shows variability in size and structure (e.g., amount of sustaining stems, entrance diameter; Table 1). In

the particular case of the overhang above the entrance, 36% of nests did not have it. In the Furnariidae family the overhang structure is present only in nests of the Curve-billed Reedhaunter (*Limnornis curvirostris*; Vaurie 1980, Narosky et al. 1983, Olson et al. 2005).

Previous studies mention that nest of rushbirds were only attached to rushes (Hudson 1920, MacDonagh 1933, Narosky et al. 1983, Remsen 2003, Lara et al. 2011, de la Peña 2013). In the present study, we also observed that this species uses mostly rushes (80%) to attach their nests, although it can also use a variety of other plant species as support for nests. The high variability of nest size and morphology and plants used to attach nests suggest that trushbirds have certain plasticity in nesting habits.

The clutch size (mean = 2.7 eggs) was in agreement with previous reports for the species (Hudson 1920, Mason 1985, Haene et al. 2003, Lara et al. 2011, de la Peña 2013). However, Rottmann (1995) reports that the clutch size could reach up to four eggs.

In this study, nest predation was the main cause of nest failure, in accordance with what happens in most bird species (Ricklefs 1969, Martin 1996). Predation may have been influenced by several factors (Table 2). Because of the shape and location of rushbird nests (i.e., closed nest and fixed relatively high on stems above the water), one would expect a high nest survival rate; however, low reproductive success was observed (29%) when compared to other studies of this species (46% for Chile; Lara et al. 2011). The relatively low nesting success compared to what was found in Chile (Lara et al. 2011) could be explained by different factors of nest loss in both sites. In our study system, we recorded many nests lost after nest construction by larger waterbirds, which use the same rushes as in nests for rushbirds, and by desiccation of the wetlands.

The DSR was 0.960 for the season 2013–2014 and 0.956 for season 2014–2015, making the survival rate for the total reproductive period 25% and 21%, respectively. Mason (1985) finds a DSR of 0.967 and 31% for the total reproductive period of the rushbird in Magdalena (province of Buenos Aires, Argentina). Reproductive success of other passerine bird species nesting in grasslands near wetlands in the same region of this study were 24% for the Spectacled Tyrant (*Hymenops perspi-*

cillatus; Pretelli and Isacch 2013) and 51% for the Bay-capped Wren-Spinetail (*Spartonoica maluroides*; Llambías et al. 2009, Cardoni et al. 2012). For other furnariids nesting in trees, the nesting success was 71% for the Rufous Hornero (*Furnarius rufus*), 33% for the Firewood-gatherer (*Anumbius annumbi*) and 26% for the Tufted Tit-Spinetail (*Leptasthenura platensis*; Mason 1985). The variability of reproductive success in rushbird nesting in different wetlands and the variability recorded in other species of the same region and for other furnariids from other habitats and regions would indicate that it would be determined by site-specific factors (e.g., food availability, predator assembly, rainfall patterns).

Summarizing, reproductive performance of the rushbird in the SE pampas shows relative low values of success, as expected by habitat and type of nest. We also observed a relatively higher plasticity to the previously reported relationship to vegetation used to fix nests and nest morphology. Finally, the association between the completions of the reproductive period with wetland desiccation indicates the potential vulnerability of the species to hydrological changes whether by rain regimes or man-made changes. The high dependency of the rushbird on wetlands with emerging vegetation turns it into a potentially vulnerable species, since the degradation or the replacement of this kind of habitat could involve the loss of its populations (Remsen 2003).

ACKNOWLEDGMENTS

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