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First Description of the Breeding Chronology of the White-collared Swift (*Streptoprocne zonaris*) in Argentina

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ABSTRACT.—Nesting activity of the White-collared Swift (*Streptoprocne zonaris*) was monitored from October 2001 to March 2002 to describe the breeding chronology of this species. Data were obtained from the colony 'La Cueva de los Pajaritos', near Mallín, Córdoba, Argentina. These are the first descriptions of the nesting chronology of this species in Argentina. The breeding season lasted 81 days from egg laying in early November to fledging in middle to late January. Clutch size ranged from one to two eggs which were incubated for an average of 22 days. Nestlings remained in nests for an average of 44 days and fledglings remained at the site for ~5 additional days. These observations provide new information on nesting sites used by *S. zonaris* in Argentina, and provide the first documentation of the length of the breeding phases for the species in South America. The 'apparently shortened' length of incubation and nestling periods may be a geographical effect, due to this being the most southeastern known breeding colony for *S. zonaris*. *Received 6 July 2010. Accepted 7 February 2011.*

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Swifts (Apodidae) are difficult to observe and identify in the field. Access to nesting sites is usually complicated, and large gaps exist in our knowledge about the biology of many species (Whitacre 1989, Marín and Stiles 1992). The White-collared Swift (*Streptoprocne zonaris*) is in the subfamily Cypseloidinae that comprises 13 species of tropical swifts (Lack 1956, Sibley and Monroe 1990, Chantler and Driessens 1995, Chantler 1999, Marín 1999). This species occurs in Mexico, Central America, South America, and the Caribbean (Beebe 1949, Rowley and Orr 1965, Whitacre 1989).

Neotropical swifts breed early in the rainy season, coinciding with the peak of flying insects

(Snow 1962, Rowley and Orr 1965, Collins 1968, Ayarzaguena 1984, Marín and Stiles 1992, Marín 1999). Species of Cypseloidinae typically nest in caves and caverns, often on cliffs or vertical surfaces in close proximity to, or behind waterfalls (Lack 1956, Knorr 1961, Rowley and Orr 1965, Collins 1968, Whitacre 1989, Marín and Stiles 1992, Marín and Carrion 1994, Marín 1997a). Rowley and Orr (1965) first described the nesting pattern of *S. zonaris* in Mexico, and most of comprehensive reproductive studies for this species are from Central America (Whitacre 1989, Marín and Stiles 1992). Relevant available studies in South America describe the global aspects of its reproductive biology (Nehrkorn 1899, von Ihering 1900, Ruschi 1979, Marín 1993).

There is a lack of information about *S. zonaris* particularly in Argentina. Most published records are distributional notes and nest descriptions (De la Peña 1982, De Lucca 1989, Biancucci 1995, Miatello et al. 1999). This species has been well documented in northern and western Argentina (Dabbene 1918, Olrog 1979, De Lucca 1989), and is known to occur in central and eastern Argentina (Narosky and Yzurieta 1987). *S. zonaris* is best documented in the Province of Córdoba (Pergolani 1944, De la Peña 1982, Narosky and Yzurieta 1987, Yzurieta 1995, Miatello et al. 1999) at the 'La Cueva de los Pajaritos' colony, where many swifts occur (Narosky and Yzurieta 1987, Yzurieta 1995). No current long-term study has been conducted on the reproduction of *S. zonaris*. The objectives of my study were to: (1) contribute to the general knowledge of the reproductive biology of swifts, and (2) delineate the breeding chronology of the White-collared Swift in Argentina.

METHODS

Study Area.—The Province of Córdoba occupies much of central Argentina at the confluence of many areas with different physiognomy and taxonomic lineages (Bucher and Abalos 1979). This region is in the Distrito Serrano Chaqueño (Chaco Province) with a semiarid climate influenced mainly by the Sierras Grandes (Cabrera (1976). These conditions relate to the rugged topography, insulation, and humidity, as well as the type of substrate and vegetation (Miatello et al. 1999). Low temperatures and northerly winds occur from June to late August, often associated with drought. Rain occurs mainly in summer ranging from 800 to 900 mm between October and April (Miatello et al. 1999). The study site is known as 'La Cueva de los Pajaritos' and is at 31° 18′ S, 64° 34′ W, 869 m asl.

Field Work and Data Analysis.—The study site was subdivided into four different areas along natural limits of the relief configurations: 'Garganta del Diablo', 'Cabeza del Indio', 'Cueva de los Pajaritos', and 'Lluvia del Amor'. Field work was conducted for 6 consecutive months from October 2001 to March 2002. I made 18 visits, each 2 days in duration, three times each month, at ~8-day intervals.

Nest searching was conducted during each visit considering the variability of the encounter rate throughout the reproductive period (Ralph et al. 1996). Date, location, and place of settlement were recorded for each nest. Nests are recorded in the order in which they were found and were monitored at 0630–0930 and 1700–2000 hrs. The number of adults, eggs, and/or chicks present in or near the nest was recorded, and data on the physical appearance of nests were collected. I measured timing and duration of egg-laying, incubation, hatching, nestling, and fledging periods and, when necessary, these dates were calculated as averages between visits. The reproductive period of *S. zonaris* was calculated from first egg-laying until last fledging, considering the activity of all nests (Marín 1999). Length of incubation and nestling stages was estimated following Foerster (1987).

RESULTS

Nests.—Six nests of *S. zonaris* were found in three of the four subareas of the site, all in close proximity to water (Table 1) Nests were placed on horizontal or slightly inclined surfaces on the vertical walls of the cliffs. All sites were relatively inaccessible with three in small cracks of the walls and three on extended prominence platforms. Most nests had a well-defined shape, typically a 'circular plate' with a central depression. The exceptions were semicircular nest S5 and nest S6 that did not show evident material and which were too small to have a specific shape. Total or partial absence of nesting material was also recorded in nests ($n = 2$) inside 'La Cueva de los Pajaritos'.

Nesting material was principally semi-wet mud mixed with varying amounts of living plants (mosses, pteridophytes), and roots of macrophytes. Nesting material was drier in nests ($n = 3$) in 'Cabeza del Indio' and 'La Cueva de los

TABLE 1. Nests of White-collared Swifts in Mallín, Córdoba, Argentina, October 2001–March 2002.

Location	# of nests	Nest code	Date found	Distance from water (m)	
				Waterfall	Creek
'Garganta del Diablo'	3	S1	30 Sep 2001	1	5
		S2	30 Sep 2001	4	5
		S5	27 Dec 2001	10	4
'Cabeza del Indio'	1	S6	06 Jan 2002	3	4
'Cueva de los Pajaritos'	2	S3	30 Sep 2001	15	4, 5
		S4	13 Oct 2001	17	3
'Lluvia del Amor'	0				

Pajaritos' where they also included some leaves of angiosperms.

Breeding Chronology.—The reproductive period of *S. zonaris* coincided with the rainy season. Egg-laying started with arrival of the first moderate rains (Oct and Nov). More intense rain occurred in January when fledglings were leaving nesting areas. Peak precipitation was recorded when the breeding season had ended in mid January.

Four active nests with 1–2 adults were found between late September and mid-October. Two other nests were found between December and January, each with two nestlings (Table 1). Nest S4 was not successful. The reproductive period of *S. zonaris* lasted 81 days from early November until mid to late January (Fig. 1).

Egg Laying.—The duration of this phase was estimated based on active nests ($n = 5$), although only two eggs were observed. These eggs were white in color and sub-elliptical in shape, and were deposited in the center of the nest. Egg laying occurred over 21 days from 1 to 21 November (Fig. 1); clutch size was one ($n = 2$) to two ($n = 3$) eggs.

Incubation.—Incubating adults were found during 41 days from early November to mid-December (Fig. 1). Eggs were incubated for an average of 22 days (range = 20–25 days) and were exposed on few occasions.

Hatching.—Hatching date was ascertained for nests S1 and S2, and estimated for nest S3. The remaining two nests were found in the nestling stage. Eggs in nest S1 hatched on the afternoon of

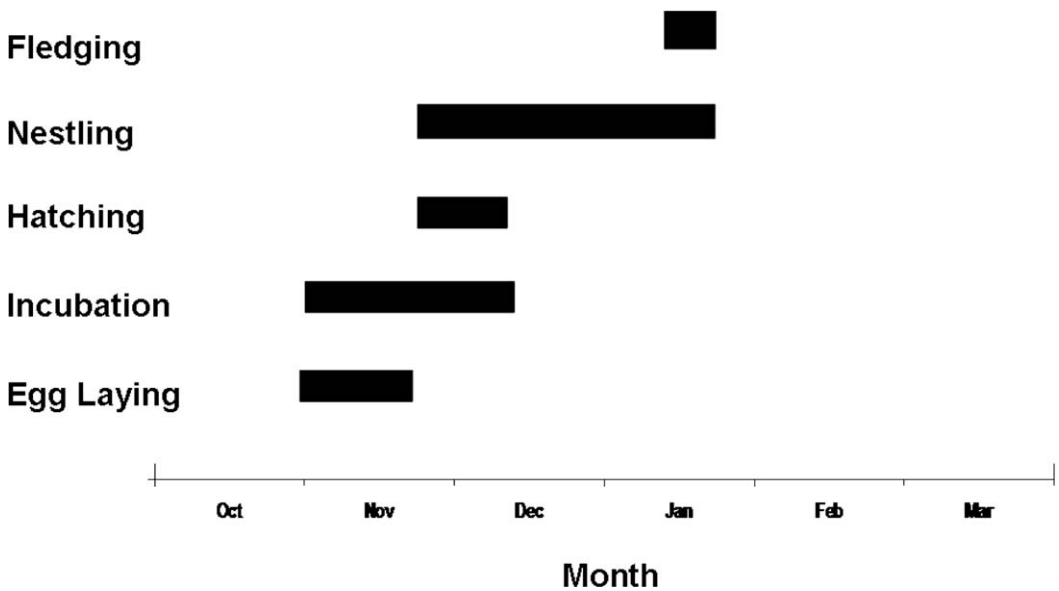

FIG. 1. Breeding chronology of the White-collared Swift in Córdoba, Argentina, 2001–2002.

TABLE 2. Breeding chronology and timing of reproductive stages of *Streptoprocne* spp. swifts. I = early in month, M = middle of month, F = end of month, (-) = no available data, and (**) = calculated from date of hatch.

	S. zonaris[a]				S. biscutata[a]	S. semicollaris[a]	S. rutila[a]	
	1	2 and 4	3	9	6	5	1	7 and 8
Latitude (Country)	10° N (Costa Rica)	16° N (México)	31° S (Argentina)	31° S (Argentina)	25° S (Brazil)	18° N (Mexico)	10° N (Costa Rica)	10° N (Trinidad and Tobago)
Egg laying	F, Apr	F, Apr; I, May	-	I, Nov	I, Nov	F, May	F, May; M, Jun	I, Jun
Hatching	-	F, May	F, Nov (Prob.)	F, Nov	F, Nov	M, Jun (Prob.)	M, Jul	F, Jun
Fledging	M, Jul	-	-	I, Jan	I, Jan	-	F, Aug Approx.	I, Aug Approx.
Incubation	30–35 days (est)	23–25 days Approx.	-	20–25 days	24 days (Average)	-	24–26 days	22–23 days
Age of nestlings at fledging (**)	45–55 days	-	-	40–48 days	40–48 days	-	40–42 days	37–43 days

[a] Sources: 1 = Marín and Stiles 1992, 2 = Whitacre 1989, 3 = De la Peña 1982, 4 = Rowley and Orr 1965, 5 = Rowley and Orr 1962, 6 = Pichorím 2002, 7 =

24 November and in nest S3 on ~11 December, a period of 18 days (Fig. 1). At least one adult remained at nests S1 and S2 during hatching. Nestlings were naked with eyes closed and a pale pink body.

Nestling.—Nests were occupied by nestlings during 58 days from late November to mid-January (Fig. 1). Nestlings remained in nests for an average of 44 days (range = 40–48 days). The shortest period was recorded for the single chick in nest S3, while the longest was for the two chicks in nest S1.

Fledging.—Nestlings fledged in January over a time interval of 15 days (Fig. 1). First departure was at age 25–33 days. This was a temporary event and, after 2 hrs, fledglings reoccupied the nests. Fledglings were quiet and stayed close to the nests while they were outside. Adults were also observed inside or near the nests. Definitive departure occurred at age 35–43 days, although fledglings stayed near nests until leaving the breeding site at age 40–48 days. Contrary to first departure, fledglings were active outside the nests flapping their wings rhythmically and clinging to the wall without taking flight. Intense vocalizations were also recorded. No adults were observed inside or near the nests during these displays. Fledging asynchrony was recorded in nest S6 with a difference of 5 days between nestlings. Some adults and juveniles were observed at the study site during February and March. On these occasions, adults reoccupied nests, but juveniles did not.

DISCUSSION

The breeding chronology of the White-collared Swift was recorded in five nests, which is a considerable number, given the ecological complexity of swifts. Reproduction lasted ~2½ months, from egg laying in November to fledging in late January, and was similar to other *Streptoprocne* swifts (Table 2).

Breeding occurred with seasonal rains as for other neotropical swifts (Snow 1962, Rowley and Orr 1965, Collins 1968, Ayarzaguena 1984, Marín and Stiles 1992). This could be interpreted as an adaptive behavior to take advantage of the maximum abundance of food (Marín and Stiles 1992). It has been suggested that reproduction by *Streptoprocne* species with large body size would begin before the rainy season because, unlike other swifts, these species depend mainly on moisture to build and adhesion their nests (Rowley and Orr 1965, Collins 1968, Foerster 1987, Marín and Stiles 1992, Pichorím 2002).

Eggs were similar to those reported in previous studies (Rowley and Orr 1965, Stockton de Dod 1979, De la Peña 1982, Marín and Stiles 1992,

Marín and Carrion 1994). Marín and Stiles (1992) mentioned that a clutch size of two eggs seems to be characteristic in this genus, having been cited for *S. zonaris* (Rowley and Orr 1965, Stockton de Dod 1979, De la Peña 1982, Whitacre 1989, Marín and Carrion 1994, this study), *S. biscutata* (Andrade and Freitas 1987), *S. rutila* (Belcher and Smooker 1936, Collins 1968), and *S. phelpsi* (Marín and Stiles 1992). However, single egg clutches have also been observed for all species of this genus.

The incubation period was 22 days for *S. zonaris* and apparently is the shortest within the genus (Table 2) and possibly for the Cypseloidinae. Hatching at the end of November coincides with that reported by De la Peña (1982) in Córdoba; this author found eggs in advanced state of incubation at the end of November. Development of nestlings was slow compared with other swifts, probably due to the wet and cold microclimates they select (Collins 1968, Marín and Stiles 1992, Marín 1997b). The age of fledglings leaving the nest within *Streptoprocne* species is usually not less than 40 days (Table 2). All nestlings in my study fledged in early to mid-January displaying the same behavior as *S. biscutata* (Pichorím 2002) and *S. rutila* (Marín and Stiles 1992). Departure may be based on acquisition of a given body mass and wing length (Marín and Stiles 1992, Marín 1997b, Pichorím 2002).

This study provides new information about the breeding biology of *S. zonaris* in Argentina, and the first reports of the incubation and nestling periods for the species in South America.

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