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Observations on parturition in two *Liolaemus* species of the *archeforus* group (Iguania: Squamata: Liolaemidae)

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Abstract. The viviparous reproductive mode is very common among iguanian lizards of the genus *Liolaemus*, where viviparity occurs in almost half of all species. However, detailed observations about parturition are only available for a few species. The aim of this work is to provide detailed observations of the parturition of three females of *Liolaemus scolaroi* and one female of *L. zullyae* under captivity conditions, and then to compare our observations with the information available for other species of the genus. The viviparous reproductive mode is confirmed for *L. scolaroi* and *L. zullyae*, with births in the end of March and early April, respectively. The litter size recorded for *L. scolaroi* was three neonates and for *L. zullyae* was two neonates. When our results were compared with studies reported in other species of the genus under captivity conditions, differences were found in the litter size and date of birth.

Keywords. Lizards*, Liolaemus scolaroi, Liolaemus zullyae*, reproduction, birth, viviparity, parturition

Introduction

The viviparity in Squamata order has occurred about 150 different times independently (Andrews and Mathies, 2000) and at least three times within the genus *Liolaemus*, with an occurrence for this condition for approximately 50% of its species (Schulte II et al., 2000). This genus is represented by more than 221 species (Avila et al., 2010; Lobo et al., 2010); however, breeding information is scarce or nonexistent for poorly studied species. The species of this genus are found at varying altitudes, latitudes and climates zones and are widely distributed in South America, from southern Perú, Bolivia, Paraguay, Brazil, Argentina, Chile and Uruguay (Cei, 1986; Cei, 1993; Pincheira-Donoso et al., 2008).

Liolaemus scolaroi (Pincheira-Donoso and Núñez, 2005) and *L. zullyae* (Cei and Scolaro, 1996) belong to the *archeforus* species group (Cei and Scolaro, 1996; Pincheira-Donoso et al., 2008), and are considered as basal lineages within the *Liolaemus* clade (Cei and Scolaro, 1996; Scolaro and Cei, 1997; Scolaro et al., 2003; Abdala, 2007; Pincheira-Donoso et al., 2008).

Liolaemus scolaroi (Fig. 1) is a small sized lizard (maximum SVL = 81 mm), with a restricted geographic range in the southern sector of Buenos Aires Lake (named General Carrera in Chile), in the XI Chilean Administrative Region. Apparently, *L. scolaroi* reaches some areas in the Argentinean western slopes of the Buenos Aires plateau along the Jeinimeni River but without clear distribution limits (Pincheira-Donoso and Núñez, 2005; Pincheira-Donoso et al., 2008). It can be found in cold climate environments associated with fallen trees due to landslides and also in association with rocks (Pincheira-Donoso and Núñez, 2005), at elevations ranging between 850 to 920 m (Pincheira-Donoso et al., 2008).

Liolaemus zullyae (Fig. 2) is a medium-size lizard (mean SVL = 70.9 mm for males and SVL = 65.3 mm for females) geographically restricted to the Jeinimeni River Basin. It inhabits a landscape characterized by basaltic rock, with altitudes from 600 to 850 m and among environments related to the basin of Jeinimeni´s River, close to the Chilean–Argentinean border (Cei and Scolaro, 1996).

There is little information available about the biology of these two species, and although they are considered insectivorous and viviparous (Pincheira-Donoso et al., 2008), no records exist about their litter size, breeding season, and behavior associated with parturition. In this paper we report observations made in captivity for birth in three specimens of *Liolaemus scolaroi* and one individual of *L. zullyae*, and compare our observations with those made in captivity for other species of the genus

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Figure 1. Gravid female of *Liolaemus scolaroi*.

(Ibargüengoytía and Cussac, 1998; Ibargüengoytía et al., 2002; Cabrera and Monguillot, 2007; Halloy et al., 2007; Kozykariski et al., 2008).

Materials and Methods

The four pregnant females were captured on March 13th, 2010, near the Reserve Jeinimeni road in the Region of Aysén, XI Chilean Region (46°48'46.3''S, 71°58'41.6''W; 839 m). Individuals were determined taxonomically, transferred to the lab and held in captivity at the Centro Nacional Patagónico (CENPAT - CONICET), until birth was given. For the identification, individuals were assigned to their final collection number LJAMM-CNP vouchers (*Liolaemus scolaroi*: 13137, 13139, 13140; and *Liolaemus zullyae*: 13138). The weight was recorded using a 10 g Pesolas® balance and morphometric measurements were obtained with a Schwyz® digital electronic caliper (0.01 mm).

In order to closely observe the females in the moments associated with parturition, they were placed in individual glass terrariums of 40 x 30 x 30 cm, conditioned with a sand substrate and recording with individual webcams Logitech®, QuickCam®, Communicate STX™ connected to a computer. Lizards were fed with larvae of *Tenebrio sp.* and water was available *ad libitum*. After birth, lizards were euthanized along with their offspring by a pericardic injection of sodium pentothal Abbot®, fixed in 20% formaldehyde and stored in 70% ethanol (following standard herpetological procedures).

Females and their offspring are deposited in the LJAMM-CNP collection, CENPAT - CONICET, Puerto Madryn, Argentina, under the following numbers (corresponding offspring in brackets): LJAMM-CNP 13137 (13154 to 13156); 13138 (13160, 13161); 13139 (13141 to 13143); 13140 (13144 to 13146).

Results

The parturition of three neonates for each female of *Liolaemus scolaroi* was observed, whereas the female of *L. zullyae* delivered two neonates (Table 1). In *L. scolaroi* the births took place on 25th March 2010, 29th March 2010 and on 30th March 2010 for the female LJAMM-CNP 13140, LJAMM-CNP 13139 and LJAMM-CNP 13137 respectively, while for the female of *L. zullyae* the birth took place on 7th April 2010. The SVL of females of *L. scolaroi* was between 63.84 mm to 60.35 mm (n = 3), and the SVL registered for neonates was between 27.28 to 30.47 mm (n = 9); while the SVL of the female *L. zullyae* was 64.4 mm and 27.48 and 28.67 mm (n = 2) for her neonates. The weights of neonates of *L. scolaroi* varied between 0.7 to 1 g (n = 9), and between 0.8 and 0.9 g (n = 2) for *L. zullyae* (Table 1).

Only the parturition of one mother of *Liolaemus scolaroi* (LJAMM-CNP 13137) was fully recorded in detail. The parturition lasted 100 minutes, approximately, while the interval between births was around 34 minutes (between birth of neonate LJAMM-CNP 13154 and the neonate LJAMM-CNP 13155) and around one hour between the neonate LJAMM-CNP 13155 and the neonate LJAMM-CNP 13156. During the parturition, the contraction phase began with lateral movements of the body and the hind limbs. Once the head of neonate appeared, the movements of hind limbs increased their

Figure 2. Pregnant female of *Liolaemus zullyae*.

frequency. All neonates that were observed were born headfirst and they were active immediately after the parturition. None of the females lifted the proximal part of the tail at the beginning of the contraction phase, but this behavior was only observed when the neonate began birthing process.

The birth of two neonates was observed for the female of *Liolaemus zullyae.* The duration of the birth was 38 minutes approximately. The time between the output of neonate LJAMM-CNP 13160 and the beginning of birth in LJAMM-CNP 13161 was 7 minutes approximately. The contraction phase began with lateral movements of the body and increased their frequency after neonates appeared. As it was observed in *L. scolaroi*, the mother only elevated her tail when neonate´s delivery started, but hind limbs movements were registered only at the final part in the birth of neonate 13161. The two neonates were born headfirst and they were active after birth immediately. In both species, the mothers continued with their normal activities after the parturition without showing any behavior associated to parental care.

Discussion

This work confirms the viviparous condition for *Liolaemus scolaroi* and *L. zullyae* with births between late March and early April, respectively. The viviparity as reproductive mode for these southern species agrees with the predictions made for species living at high latitudes and cold areas (Blackburn, 1982; Ibargüengoytía and Cussac, 1998; Andrews and Mathies, 2000; Schulte II et al., 2000; Vidal Maldonado and Labra Lillo, 2008).

According to our results, the litter of *Liolaemus zullyae* and *L. scolaroi* is composed of two-three infants respectively. Previous studies of the parturition in other species of the *archeforus* group, recorded a higher number of specimens born for *L. kingii*, with an offspring between 2 – 5 individuals (n = 3, Ibargüengoytía et al., 2002) and for *L. lineomaculatus* 4 newborns (n = 1, Kozykariski et al., 2008). Other reports of the parturition in these closely related species, document births in late January for *Liolaemus kingii* (Ibargüengoytía et al., 2002) and *L. lineomaculatus* (Kozykariski et al., 2008). Our data for the date of parturition also differs with the date of birth for other *Liolaemus* species outside the *archeforus* group (Cabrera and Monguillot, 2007; Halloy et al., 2007). Despite these differences, a slight lifting of the proximal section of the tail of *L. scolaroi* females, coupled with stretching movements of the hind limbs for all births is consistent with previous records for *L. kingii* (Ibargüengoytía et al., 2002). On the contrary, in *L. zullyae* the movement of the hind limbs was observed only at the final moment of the second birth. Despite these observations, more studies about the breeding behavior of these species would be necessary to determine if there are really differences between them. Females are selected for fewer larger litters with many infants (Angilletta et al. 2006) which do not agree with the results of this study, because the clutch size is smaller than in other closely related species, and females are smaller than males. Future studies focused on the breeding of poorly known *Liolaemus* species, could provide important biological aspects related to the ecological conditions and the evolutionary history of this diverse clade.

Table 1. Snout-vent length (SVL), tail length (TL) and weight of females and their offspring for *Liolaemus scolaroi* and *L. zullyae*. On female's weight, "a" represents weight before birth, "b" represents weight after birth.

Species	Individual	SVL (mm)	TL (mm)	Weight (g)
Liolaemus scolaroi	Female LJAMM-CNP 13140	60.35	62.34	5.2 (a)
	Neonate LJAMM-CNP 13144	27.60	35.77	0.7
	Neonate LJAMM-CNP 13145	29.35	36.15	0.7
	Neonate LJAMM-CNP 13146	29.35	34.92	0.7
	Female LJAMM-CNP 13137	63.84	58.70	8.0 (a)/5.0 (b)
	Neonate LJAMM-CNP 13154	29.45	37.57	0.9
	Neonate LJAMM-CNP 13155	29.02	35.95	0.8
	Neonate LJAMM-CNP 13156	30.47	43.04	1
	Female LJAMM-CNP 13139	61.50	58.97	7.2 (a)/4.5 (b)
	Neonate LJAMM-CNP 13141	28.09	35.86	0.7
	Neonate LJAMM-CNP 13142	27.62	31.55	0.7
	Neonate LJAMM-CNP 13143	27.28	35.97	0.7
Liolaemus zullyae	Female LJAMM-CNP 13138	64.40	70.47	8.5 (a)/6.4 (b)
	Neonate LJAMM-CNP 13160	27.48	34.26	0.8
	Neonate LJAMM-CNP 13161	28.67	36.11	0.9

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