

Redescription of *Liolaemus robertmertensi*, Hellmich 1964 (Iguania: Liolaemidae) with description of a new species

M. G. Fernández^{1,2}, Cristian S. Abdala^{3,4}; Mario R. Ruiz -Monachesi¹, Romina V. Semham³, A. Sebastián Quinteros^{1,2}

¹ Instituto de Bio y Geociencias del NOA (IBIGEO) – CONICET – UNSa, Salta, Argentina.

² Cátedra de Sistemática Filogenética, Facultad de Ciencias Naturales, Universidad Nacional de Salta. Salta, Argentina.

³ CONICET- Unidad Ejecutora Lillo Instituto de Herpetología (Fundación Miguel Lillo), Tucumán, Argentina.

⁴ Cátedra de Biología de la Conservación, Facultad de Ciencias Naturales e Instituto Miguel Lillo, Universidad Nacional de Tucumán, Tucumán, Argentina.

Recibido: 04 Mayo 2020

Revisado: 07 Julio 2020

Aceptado: 21 Agosto 2020

Editor Asociado: J. Goldberg

doi: 10.31017/CdH.2020.(2020-090)

lsid:zoobank.org:act:EBA563A7-BF74-4D3C-81E0-2D5F582D2EE5

ABSTRACT

We redescribe *Liolaemus robertmertensi* and describe a new species of *Liolaemus*, the second most speciose lizard genus. These species belong to the *L. robertmertensi* group of the subgenus *Liolaemus sensu stricto*. In recent years, some newly identified populations were assigned to *Liolaemus robertmertensi*. We applied an integrative approach using morphological and phylogenetic evidence to determine the relationships among these populations and found one to belong to a new species described here. We performed statistical analyses to differentiate *L. robertmertensi* and the new species from other species of the *alticolor-bibronii* group. The new species shows a set of character states that allows it to be distinguished from *L. robertmertensi* and from all other species of *Liolaemus*. Despite the description of this new species, the taxonomic status of many populations still remain unknown.

Key Words: Lizards; New species; Argentina; South America.

Introduction

Liolaemus, is one of the world's most species-rich of lizard genera, second only to *Anolis*. Currently, *Liolaemus* includes more than 270 valid species (Abdala *et al.*, 2020, Quinteros *et al.* 2020) that are distributed from the Andes of central Peru to Tierra del Fuego in Argentina. Lizards belonging to this genus inhabit environments of dry climates, especially in the Western Cordilleran sector, and key organisms in these ecosystems (Abdala *et al.*, 2012a; Ávila *et al.*, 2013). Laurent (1983, 1985) divided the genus in two main groups or subgenera: *Liolaemus sensu stricto* (or "Chilean group") and *Eulaemus* (or "Argentine group"). Currently, this proposal is corroborated by several studies such as those by Schulte *et al.* (2000), Espinoza *et al.* (2004), Pyron *et al.* (2013) and Olave *et al.* (2014). At present, there are many cryptic populations that could be new species and those have been not described. While most of these *Liolaemus*

populations are currently assigned to known species, there are considerable variations among these populations, which make it necessary to determine their status. Therefore, taxonomic studies are needed to give identity to these cryptic populations.

An example of these issues occurs in species related to *Liolaemus robertmertensi*, a species belonging traditionally to a like-named species group of the subgenus *Liolaemus*. Previous phylogenies included species such as *L. robertmertensi* as *L. chiliensis*, *L. nitidus*, and *L. sanjuanensis* in this group (Cei, 1993, Lobo, 2001, 2005; Lobo *et al.*, 2010; Abdala and Quinteros, 2014). Quinteros (2013) performed a morphological phylogeny of the *L. alticolor-bibronii* group and recovered the *L. robertmertensi* group nested within the more inclusive group, formed by *L. nitidus*, *L. robertmertensi*, and *L. saxatilis*. More recently, Portelli and Quinteros

(2018) recovered the *L. robertmertensi* group nested inside the *L. alticolor-bibronii* group, including *L. bitaeniatus*, *L. chaltin*, *L. chungara*, *L. pagaburoi*, *L. puna*, *L. ramirezae*, and *L. robertmertensi*, and three populations with uncertain taxonomic status. The most recent phylogeny including representatives of the *L. robertmertensi* group is that of Quinteros *et al.* (2020), which recovers the group within the *L. alticolor-bibronii* group, including the following species in their analyzes: *L. aparicioi*, *L. bitaeniatus*, *L. gracilis*, *L. pagaburoi*, *L. ramirezae*, *L. robertmertensi*, *L. sanjuanensis*, *L. saxatilis*, *L. tandiliensis*, *L. variegatus*, *L. vhagar*, *L. yanalcu*, and five population with uncertain taxonomic status. The *L. robertmertensi* group itself comprises two clades, one including the species distributed from northwestern Argentina to southern-central Bolivia and the other including the species distributed from central-western to southern and central eastern Argentina.

Liolaemus robertmertensi was described from seven specimens by Hellmich (1964), who proposed as type locality the “Mountains around Belén, Catamarca Province”. Numerous specimens have been subsequently collected and identified as *L. robertmertensi*, leading to the extension of the known geographic distribution of the species to other localities in Catamarca and La Rioja (Avila and Lobo, 1999, Avila *et al.*, 2013). Moreover, Portelli and Quinteros (2018) and Quinteros *et al.* (2020) assigned three new populations to *L. robertmertensi* although they exhibit differences in some morphological character states. Considering the above, we found the need to study these populations in a taxonomic and systematic context to thereby elucidate their status, as either as a previously described species or as a new species. Therefore, we redescribed and geographically circumscribed *L. robertmertensi* and then assessed the status of the various populations previously assigned to this species. Based on morphological, molecular, and phylogenetic evidence, we also described a candidate species within the *L. robertmertensi* group from the surroundings of Andalgalá, Catamarca, Argentina and previously found to be phenetically close to *L. robertmertensi* (Portelli and Quinteros, 2018, Quinteros *et al.* 2020).

Materials and methods

We used the general lineage concept of De Queiroz (2007), which defines species as populations of organisms that are evolving independently from

other populations owing to a lack of gene flow. Following this species concept, there have been many integrative taxonomic studies that use a wide range of empirical data to delimit species boundaries (Coyne and Orr, 1998; Knowles and Carstens, 2007; Leaché *et al.*, 2009; Aguilar *et al.*, 2013; Quinteros *et al.*, 2020), rather than relying solely on traditional taxonomic methods. Accordingly, we used molecular phylogenies to infer species boundaries and univariate analysis of variance, multivariate principal component analysis and discriminant analysis of principal components of morphological data to describe those boundaries morphologically.

We analyzed the morphological characters traditionally used in *Liolaemus* taxonomy including those from Laurent (1985), Etheridge (1993, 1995, 2000), Cei (1986, 1993), Lobo (2001, 2005), Abdala (2007) and Quinteros (2012, 2013). Description of color patterns follow those proposed by Lobo and Espinoza (1999) and Quinteros (2012, 2013). Terminology for squamation and neck folds are from literature (Smith, 1946; Frost, 1992). Furthermore, the description of color in life for the new species was based on observations made in the field or from photographs of specimens taken immediately after capture.

Measurements and scale counts were recorded from museum specimens. Body measurements were taken using a digital caliper 0.05 mm (Mitutoyo USA, CD-6”CX, Illinois, USA). When necessary, we used a binocular dissecting microscope (10-40X) to count and characterize scales. Where bilateral, scale counts and measurements data were taken from the right side of the lizards. In total, we examined 682 specimens corresponding to species of the *Liolaemus alticolor-bibronii* group and two populations of uncertain taxonomic status.

Statistical Analyses

We studied a total of 25 characters (7 morphometric and 18 meristic) from 107 adults specimens (see Appendix I) belonging to four described species and one candidate species: *L. gracilis* ($n=19$), *L. robertmertensi* ($n=12$), *L. sanjuanensis* ($n=16$), *L. saxatilis* ($n=22$) and *L. sp.1* ($n=38$).

We measured the following morphometric characters: snout-vent length (SVL; from tip of snout to vent), head length (HL; from tip of snout to posterior edge of auditory meatus), head width (HW; from the temporal regions), head height (HH), trunk length (TrL; between fore and hind limbs),

foot length (FL; from the tip of four toe to ankle) and base of tail width (TW; at the base of tail in the cloacal region).

We counted the following classical meristic characters: scales around body (SAB), dorsal scales (DS; between occiput and thighs region), scales from occiput to rostral, frontal-superciliaries (number of scales between the frontal and superciliaries), superciliaries, left postrostral organs (number of scale organs on the left postrostral scale), temporal scales, neck scales, gular scales, lorilabial scales contacting subocular, supralabials, infralabials, ventral scales, number of lamellae on third finger, number of lamellae on first toe, number of lamellae on second toe, number of lamellae on third toe, number of lamellae on fourth toe.

We performed two complementary multivariate tests using R environment (R Development Core Team, 2020) considering all characters (25): first a principal component analyses (PCA), which resolved for each data set standardized orthogonal linear combinations that together explained the variation in the original variables (Crawley, 2007). This analysis explains differences between individuals, but not between levels of a factor, and these variables must be continuous and strongly correlated (Luo *et al.*, 1999; Harlow, 2005). We used "The Screen Test" and "Proportion of Variance Accounted For" criteria and components that explain a minimum of ~10% of the variation (O'Rourke *et al.*, 2013), to decide how many PCA axes (PC) had to be included for these analyses. To visualize each individual's spatial location, we incorporated a 95%

confidence ellipse around the bay centre (Lê *et al.*, 2008) for each factor level. Secondly, we performed a discriminant-function analysis (DFA) in order to present a visualization of differences and similarities among species (Zar, 2010).

To test differences among taxa in each character, we performed parametric and non-parametric univariate tests for significant differences among the compared groups. We used Analysis of the Covariance (ANCOVA) on the continuous variables with snout-vent length (SVL) as covariate to adjust all size-correlated characters. Variables not influenced by SVL were summarized by an Analysis of Variance (ANOVA). When parametric *P* values were significant ($P \leq 0.05$), multiple post hoc comparisons were performed using Tukey's test. Homoscedasticity and normality assumptions were checked performing the Levene (Zar, 2010) and Shapiro-Wilks tests. When these assumptions were not met, we performed nonparametric Kruskal-Wallis tests.

Results

Statistical analyses

Two multivariate analyses suggest that the candidate species: *Liolaemus* sp.1 has differences from *L. gracilis*, *L. robertmertensi*, *L. sanjuanensis* and *L. saxatilis* (Tables 1 and 2). Principal component analyses indicate that three main components explain 57.09% of the total variance (Fig. 1). The first principal component axis (PC1) accounts for most of the variance (26.58%), composed mainly by eight characters: SVL, HW, TrL, TW, SAB, DS, NS and GS contribu-

Table 1. Summary of statistically significant characters among different *Liolaemus* species studied (N= number of specimens), showing: F-value (F- degree freedom), P-value (*P*) and mean \pm (standard error).

Traits	F _(4,78)	<i>P</i>	<i>L. sp. nov.</i> (38)	<i>L. gracilis</i> (19)	<i>L. robertmertensi</i> (12)	<i>L. sanjuanensis</i> (16)	<i>L. saxatilis</i> (22)
Head height	2.72	0.036	6.04(\pm 0.15)	5.24(\pm 0.14)	5.33(\pm 0.22)	6.44(\pm 0.18)	5.94(\pm 0.17)
Foot length	3.27	0.016	14.92(\pm 0.22)	12.45(\pm 0.31)	13.48(\pm 0.41)	15.33(\pm 0.26)	13.60(\pm 0.24)
Scales around body	6.65	<0.01	31.60(\pm 0.30)	40.15(\pm 0.52)	33.08(\pm 0.50)	49.93(\pm 0.62)	38.22(\pm 0.87)
Dorsal scales	6.27	<0.01	38.13(\pm 0.49)	41.63(\pm 0.69)	40.58(\pm 0.51)	51.00(\pm 1.16)	39.90(\pm 0.58)
Superciliaries	13.52	<0.01	6.81(\pm 0.09)	6.05(\pm 0.05)	6.50(\pm 0.19)	5.62(\pm 0.15)	7.32(\pm 0.10)
Neck scales	9.4	<0.01	14.07(\pm 0.21)	23.47(\pm 0.30)	17.58(\pm 0.67)	33.81(\pm 1.13)	21.82(\pm 0.41)
Lorilabial contacting suboculars	3.8	<0.01	2.42(\pm 0.09)	3.10(\pm 0.07)	2.75(\pm 0.18)	3.56(\pm 0.18)	3.50(\pm 0.17)
Supralabials	4.40	<0.01	5.84(\pm 0.09)	5.31(\pm 0.11)	6.33(\pm 0.18)	6.62(\pm 0.22)	5.22(\pm 0.13)
Ventral scales	2.74	<0.05	63.37(\pm 0.71)	75.37(\pm 1.2)	69.08(\pm 1.28)	76.06(\pm 1.27)	73.68(\pm 1.32)
Lamellae on first toe	4.14	<0.05	10.08(\pm 0.16)	11.42(\pm 0.20)	10.08(\pm 0.19)	9.87(\pm 0.20)	8.63(\pm 0.10)
Lamellae on third toe	3.80	<0.05	18.23(\pm 0.24)	20.10(\pm 0.20)	17.33(\pm 0.25)	17.81(\pm 0.35)	17.32(\pm 0.15)

Table 2. Summary showing posterior analyses among different *Liolaemus* species studied (N= number of specimens). Different letters indicate statistically significant differences ($P \leq 0.05$).

Traits	<i>L. sp. nov.</i> (38)	<i>L. gracilis</i> (19)	<i>L. robertmertensi</i> (12)	<i>L. sanjuanensis</i> (16)	<i>L. saxatilis</i> (22)
Head height	A	B	B	C	A
Foot length	A	C	B	A	B
Scales around body	A	B	A	C	B
Dorsal scales	A	B	AB	C	AB
Superciliaries	A	CD	AC	D	B
Neck scales	A	B	C	D	B
Lorilabial contacting subocular	A	BC	AB	C	C
Supralabials	A	C	AB	B	C
Ventral scales	A	C	B	C	BC
Lamellae on first toe	A	B	A	A	C
Lamellae on third toe	A	B	AC	A	C

ting to this axis. The second principal component axis (PC2) accounts for 18.90%, of the variance (Fig. 1) with a high contribution of four characters: HL, HH, VS and FL. Finally, the third principal component axis (PC3) accounts for 11.60%, of the variance (Fig. 1) with a high contribution of third characters: 1stTLN, 3rdTLN and 4thTLN.

The discriminant-function analysis (DFA) showed differences among the candidate species and the other four species (Table 1; $F_{(100, 311)} = 12.34$; $P < 0.01$; Fig. 2). The first discriminant function accounted for 69 % of the total variance (eivals= 16.88; $\chi^2 = 577.67$; $df = 100$; $P < 0.01$), while the second accounted for 17 % (eivals= 4.0; $\chi^2 = 315.12$; $df = 72$; $P < 0.01$). This function was significantly correlated with eleven characters: head height, foot length, scales around body, dorsal scales, superciliaries, neck scales, lorilabial scales contacting subocular, supralabials, ventral scales, number of lamellae on first toe, number of lamellae on third toe (Table 1). The post hoc analyses for these characters showed statistically significant differences among taxa (Table 2). Our analyses allowed the identification of one new species of *Liolaemus* (Table 3).

Redescription of *Liolaemus robertmertensi* Hellmich, 1964

Holotype. - ZMS 152/1926. Adult male. “Gebirge in der Umgebung von Belén” (mountains around Belén), Catamarca Province, Argentina. Collected by V. Weiser, 28 December 1926.

Paratypes. - ZSM 153/1926 / 1-6, four males, two females, similar data as the holotype.

Additional specimens:

FML 16442. FML 1753-1/3. FML 7710. IBIGEO-R 5086. IBIGEO-R 5087. IBIGEO-R5088. MCN 2180. MCN 2610.

Diagnosis. - *Liolaemus robertmertensi* is a medium-sized lizard (max SVL 56.2 mm) belonging to the *L. robertmertensi* group. Tables 1 and 2 show differences between *L. robertmertensi* and phylogenetically

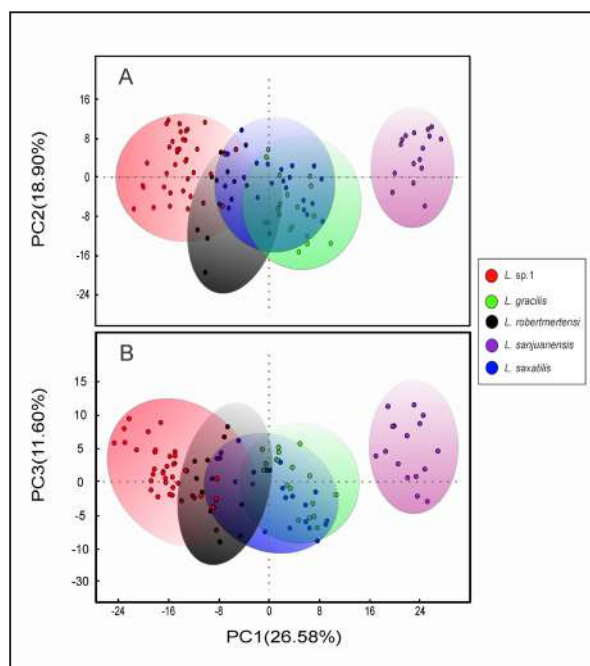


Figure 1. Principal component analyses (PCA), showing correlation between component A-one vs. component two; B-one vs. component third, which account for most of the variance among the characters. The inner circle denotes the 95% of confidence among the species.

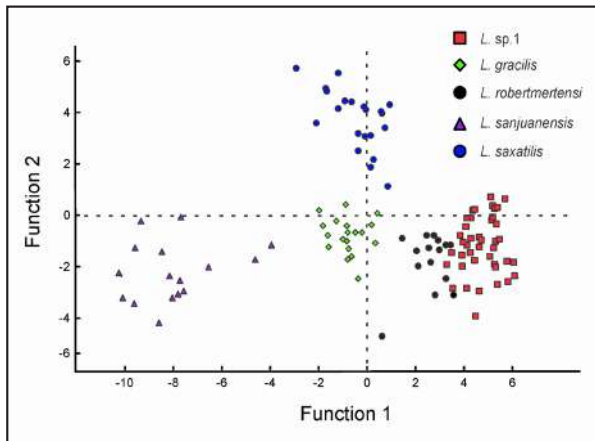


Figure 2. Function 1 and 2 of the discriminant function analysis (DFA) performed on the morphometric and meristic characters among four species of *Liolaemus*, and one candidate species.

close species. Head height is less in *L. robertmertensi* than in *L. sanjuanensis* (Mean= 5.33; SD= 0.22 vs Mean= 5.94; SD= 0.17). Foot length is longer in *L. robertmertensi* (Mean= 5.33; SD= 0.22) than in *L. gracilis* (Mean= 5.24; SD= 0.14), but less than in *L. sanjuanensis* (Mean= 15.33; SD= 0.26). The number of scales around mid-body is lower in *L. robertmertensi* (Mean= 33.08; SD= 0.5) than in *L. gracilis* (Mean= 40.15; SD= 0.52), *L. sanjuanensis* (Mean= 49.93; SD= 0.62), and *L. saxatilis* (Mean= 38.22; SD= 0.87). Number of dorsal scales lower in *L. robertmertensi* (Mean= 40.58; SD= 0.51) than in *L. sanjuanensis* (Mean= 51; SD= 1.16). Number of superciliaries in *L. robertmertensi* (Mean= 6.5; SD= 0.19) is greater than in *L. sanjuanensis* (Mean= 5.62; SD= 0.15), but lower than in *L. saxatilis* (Mean= 7.32; SD= 0.1). Number of neck scales is lower in *L. robertmertensi* (Mean= 17.58; SD= 0.67) than in *L. gracilis* (Mean= 23.47; SD= 0.3), *L. sanjuanensis* (Mean= 33.81; SD= 1.13), and *L. saxatilis* (Mean= 21.84; SD= 0.41). Number of lorilabials is lower in *L. robertmertensi* (Mean= 2.75; SD= 0.18), than in *L. sanjuanensis* (Mean= 3.56; SD= 0.58), and *L. saxatilis* (Mean= 3.5; SD= 0.17). Number of supralabials in

L. robertmertensi (Mean= 6.33; SD= 0.18), is greater than in *L. gracilis* (Mean= 5.31; SD= 0.11), and *L. saxatilis* (Mean= 5.22; SD= 0.13). Number of ventral scales in *L. robertmertensi* (Mean= 69.28; SD= 1.08), is lower than in *L. sanjuanensis* (Mean= 76.06; SD= 1.27) and *L. saxatilis* (Mean= 73.68; SD= 1.23). Number of lamellae on first toe in *L. robertmertensi* (Mean= 10.08; SD= 0.19), is lower than in *L. gracilis* (Mean= 11.42; SD= 0.2), but greater than in *L. saxatilis* (Mean= 8.63; SD= 0.1). Number of lamellae on third toe in *L. robertmertensi* (Mean= 17.33; SD= 0.25) is lower than in *L. gracilis* (Mean= 20.1; SD= 0.2). Also, nasals contact rostral in *L. robertmertensi*, whereas in *L. balerion*, *L. exploratorum*, *L. sanjuanensis*, *L. saxatilis*, *L. vhagar*, and *L. yanalcu* there is no contact. Subocular scale is whitish, lighter than loreal region, in *L. robertmertensi*, differing from *L. gracilis*, *L. vhagar*, *L. meraxes*, *L. incaicus*, *L. paulinae*, *L. puna*, *L. pyriphlogos* and *L. yanalcu*, where subocular scale is same color as loreal region. The dorsal surface of the head is smooth in *L. robertmertensi*, whereas in *L. exploratorum* and *L. pagaburoi* and markedly rugose in *L. bitaeniatus*, *L. lemniscatus*, *L. saxatilis*, *L. tacnae*, and *L. variegatus* it is somewhat rough. Dorsal scales are lanceolate in *L. robertmertensi*, being rhomboidal in *L. bitaeniatus* and *L. variegatus*. Scales of dorsum has a well-developed mucron, in *L. robertmertensi*, differing from *L. tandiliensis*, *L. alticolor*, *L. chavin*, *L. pachacutec*, *L. paulinae*, and *L. tacnae* (without mucron), *L. alticolor*, *L. chavin*, *L. pachacutec*, *L. paulinae*, and *L. tacnae*, *L. vhagar* *L. yalguaraz* (weakly-developed mucron). Temporal scales are slightly keeled in *L. robertmertensi*, being smooth in *L. gracilis*, *L. balerion*, *L. bibronii*, *L. paulinae*, *L. pachacutec*, *L. puna*, *L. tacnae*, and *L. walkeri*; and markedly keeled in *L. alticolor*, *L. aparicioi*, *L. bitaeniatus*, *L. cyaneinotatus*, *L. lemniscatus*, *L. meraxes*, *L. sanjuanensis*, *L. saxatilis*, and *L. variegatus*. The scales of the neck of *L. robertmertensi* present keels, while in *L. gracilis* and

Table 3. Classification results from the prediction of discriminant function. Numbers in parenthesis are percentages of cases where correctly classified (the overall value is 95%).

Traits	Predicted species assignment					
	N	<i>L. sp. nov.</i>	<i>L. gracilis</i>	<i>L. robertmertensi</i>	<i>L. sanjuanensis</i>	<i>L. saxatilis</i>
<i>L. sp.nov.</i>	38	38(100)	0	0	0	0
<i>L. gracilis</i>	19	0	19(100)	0	0	0
<i>L. robertmertensi</i>	12	0	0	12(0100)	0	0
<i>L. sanjuanensis</i>	16	0	0	0	16(100)	0
<i>L. saxatilis</i>	22	0	0	0	0	22(100)

L. vhaagar they are smooth. The females of *Liolaemus robertmertensi* do not present precloacal pores, while the females of *L. aparicioi*, *L. bitaeniatus*, *L. incaicus*, *L. ramirezae*, *L. variegatus* and *L. yanalco* exhibit precloacal pores. Specimens of *L. alticolor*, *L. aparicioi*, *L. chaltin*, *L. pyriphlogos*, *L. puna*, *L. chavin*, *L. pachacutec* and some specimens of *L. wari* have a black line surrounding the interparietal scale, while this line is absent in *L. robertmertensi*. The males of *Liolaemus robertmertensi* present paravertebral spots (rectangular, parallel to the axis of the body forming a continuous line), while those are absent in *L. alticolor*, *L. chungara*, *L. fuscus*, *L. gracilis*, *L. chaltin*, most of males of *L. puna* and *L. walkeri*. Presence of dorsolateral stripes in *L. robertmertensi* differentiates this species from *L. tacnae* and *L. yanalco*. Vertebral line is absent in *L. robertmertensi*, differing from *L. gracilis* (evident and segmented) and from *L. tandiliensis* (evident in some specimens), *L. alticolor*, *L. aparicioi*, *L. balerion*, *L. bibronii*, *L. chavin*, *L. curicencis*, *L. cyaneinotatus*, *L. gracilis*, males of *L. incaicus*, *L. pachacutec*, females of *L. puna*, *L. pyriphlogos*, *L. sanjuanensis*, *L. tacnae*, *L. variegatus*, *L. walkeri*, and *L. wari*, where vertebral line is evident. Throat is immaculate in *L. robertmertensi*, showing spots in *L. alticolor*, *L. chungara*, *L. pagaburoi*, *L. puna*, *L. pyriphlogos*, *L. variegatus*, *L. walkeri*, and *L. yalguaraz*. Males of *L. chavin*, *L. pachacutec*, *L. wari*, and *L. walkeri* exhibit partial or total ventral melanism, which is absent in *L. robertmertensi*.

Redescription of the Holotype

Adult male, SVL 53 mm with 34 scales around the body. Dorsals lanceolate and strongly keeled, with presence of well-developed mucron. The keels, in the anterior region of the dorsum, form a continuous row. Dorsal surface of the head, smooth. Interparietal, pentagonal and small, much smaller than the parietal. Five supraocular scales, of which three are enlarged. Semicircles complete with ten scales. Six scales between rostral scale and frontal scale. Four scales between superciliaries and frontal scales. Six scales contact the interparietal. Thirteen scales in from occiput to rostral. Split frontal scale. A row of scales between subocular and supralabial. Temporary rather large and obviously keeled. Two small auricular scales, a split tympanic scale. Side of the neck with a weak bifurcation to the ear, which bends easily. Granular neck scales, with evident keel. Mental scale in contact with four scales. Four chin shields. Sixty six rounded ventral scales, almost as

wide as dorsals.

Five precloacal pores. Fore limbs length 22 mm. Hind limbs length 30 mm. Tail regenerated. The dorsal scales of the tail are a little smaller than on trunk, granulated, with strong keel. Ventral scales of tail smooth.

Color of the holotype in ethanol- Head dorsally light brown without spots. Dorsum with light brown background color. On temporal zone the spot takes the form of a black bar, starting just before the hind limbs and going off on the flank. These bar-shaped spots are in contact with each other and are interrupted by lighter spots.

No presence of lateral line. Eleven dark paravertebral spots, linear and perpendicular to the axis of the body, without white margin. Lateral field with white margin and black irregular bands, on a light brown background. Anterior and posterior limbs with dark transverse spots. Ventral region immaculate. Dorsal region of tail without spots. Ventral region of the tail, immaculate cream.

Variation. - (Based on five males and seven females) Scales around midbody 31-34 (Mean= 32.4; SD= 1.4). Dorsal scales 38-44 (Mean= 40.9; SD=2.1) between occiput and anterior surface of thighs. These are lanceolate, imbricate and strongly keeled with presence of well-developed mucron. Ventral scales 64-75 (Mean= 70.6; SD=4.1). Number of scales on dorsal head 11-14 (Mean= 12.6; SD= 1.0). Five to six (Mean= 5.56; SD= 0.53) scales between frontal and rostral. Six to seven (Mean= 6.75; SD= 0.46) superciliaries. Four to five (Mean= 4.44; SD= 0.53) scales between frontal and superciliaries. Five to seven (Mean= 6.38; SD= 0.74) scales surround nasal. Nasal always contacts the rostral. One to two (Mean= 1.4; SD= 0.5) scales between nasal and canthal. Seven to eight (Mean= 7.5; SD = 0.5) temporal scales with weakly to strongly keeled scales. Neck scales 15-18 (Mean= 16.5; SD= 1.1), laminar and keeled. Six to seven (Mean= 6.25; SD= 0.46) lorilabials. Two to three (Mean= 2.50; SD= 0.53) lorilabials in contact with the subocular scales. Subocular scale whitish, lighter than the other scales of loreal region. Five to seven (Mean= 6.13; SD= 0.64) supralabials and 4-5 (Mean= 4.25; SD= 0.46) infralabials. Fourth supralabial upturned, but never contacts the subocular. Four to five (Mean= 4.8; SD= 0.4) precloacal pores in males, absent in females.

Snout vent length (SVL) in males 43-53 mm

(Mean= 48.5 mm; SD= 3.3), in females 44- 56.2 mm (Mean= 49.7mm; SD= 4.5). Length of the trunk in males 14.9-29.4 mm (Mean= 21.7 mm; SD= 1.2) and in females 23.4-27.6 mm (Mean= 25.5 mm; SD= 2.96). Head length in males 7.21- 11.3 mm (Mean= 10.3 mm; SD= 1.41) and in females 6.03-8.29 mm (Mean= 7.35 mm; SD= 1.18). Head height 3.22-6.05 mm (Mean= 5.26 mm; SD= 0.95) in males, in females 5.11-5.61 mm (Mean= 5.32 mm; SD= 0.26). Head width 5.40-8.43 mm (Mean= 7.38 mm; SD= 1.00) in males and females 6.03-8.29 mm (Mean= 7.35 mm; SD= 1.18). Humerus length 4.44- 8.96 mm (Mean= 6.38 mm; SD= 1.55) and tibia 5.81-9.82 mm (Mean= 8.09 mm; SD= 1.43). Length of the tail 83.5- 113.6 mm (Mean= 98.4 mm; SD= 10.7). Ratio between tail length and SVL is 2.24 (in males 2.07 and females 2.58).

Color in life. - Fig. 3

Males and females are characterized by their light brown background color. Sexual dichromatism is evident by the presence of paravertebral spots in males, absent in females. The paravertebral spots continue until dorsal region of the tail. Dorsolateral bands are brown, lighter than vertebral region. Ventrolateral zone without spots. This region takes a yellow coloration in females during their reproductive period. The throat is cream-colored immaculate but chest and abdomen is gray. The ventral tail is

immaculate cream.

Distribution

Hellmich (1964) proposed as type locality of *Liolaemus robertmertensi* as the mountains surrounding Belen, Catamarca. However, this species now also known from around the towns of Tinogasta, Fiambalá and Cóndor Huasi, all in Catamarca Province (Fig. 4).

Natural history

Liolaemus robertmertensi live in in the lower areas of the Sierras of Belén and Fiambalá, always associated with shrubs and altitudes of 1600-2000 m a.s.l, where it is sympatry with *L. koslowsky*. Its diet is unknown but it is highly probable that it may be a mostly insectivorous species, as other species of the *L. robertmertensi* group (Espinoza *et al.*, 2004). Reproductive mode is also unknown. However, it is likely to be oviparous in consideration of its restriction to lower altitudes and that all members of the *L. robertmertensi* group with known reproductive mode are oviparous (Schulte *et al.*, 2000; Espinoza *et al.*, 2004).

Description of the new species

Liolaemus brizuelai sp. nov.

urn:lsid:zoobank.org:act:EBA563A7-BF74-4D3C-81E0-2D5F582D2EE5



Figure 3. Picture of *Liolaemus robertmertensi* from Puerta de San José, Condor Huasi.

Liolaemus robertmertensi-Schulte *et al.*, 2000

Liolaemus robertmertensi-Espinoza *et al.*, 2004

Liolaemus robertmertensi-Quinteros, 2012,

in part

Liolaemus robertmertensi-Quinteros, 2013,

in part

Liolaemus sp. 12, Portelli & Quinteros, 2018

Liolaemus sp. 12, Quinteros, Ruiz-Monachesi, and Abdala, 2020

Holotype. - MCN 2611. Adult male. Puesto Río Blanco, Salar de Pipanaco 27°49'43"S; 66°11'44.2"W, 761 m a.s.l. Pomán, Catamarca, Argentina. Collected by C. Abdala, S. Quinteros, and G Scrocchi 19 March 2007

Paratypes. -. FML 1308 / 1-5: Pomán, northern end of Pipanaco - Puesto Río Blanco, 3 km from the salar - 30 km south of Andalgalá, Catamarca Province, Argentina.

FML 1478 / 1-3: Pomán, Salar de Pipanaco - 92 km south of Andalgalá - 18 km west of Ruta Siján - El Pajonal - Ruta Prov. 46, Catamarca Province, Argentina.

FML 1616/2: Pomán, Puesto Río Blanco - 30 KM south of Andalgalá, Catamarca Province, Argentina.

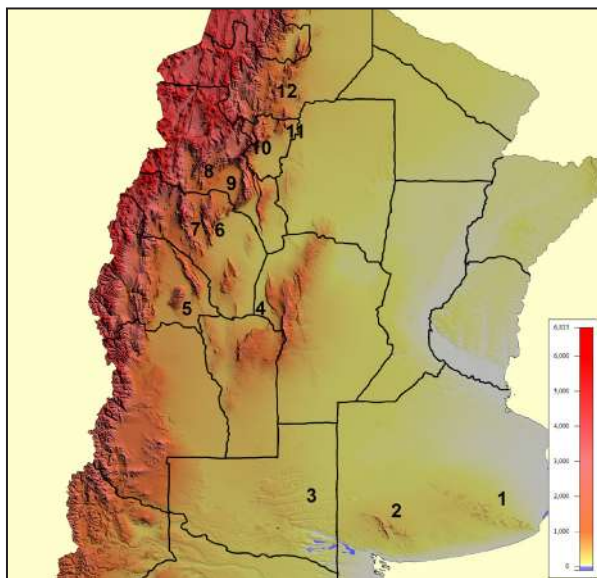


Figure 4. Map showing the distribution of *L. robertmertensi*, *L. brizuelai* and some species close distributed. 1: Sierras de Tandilia (*L. tandiliensis*), Buenos Aires. 2: Sierras de la ventana, Buenos Aires. 3: Mahuidas. La Pampa. 4: Sierra de Comechingones (*L. saxatilis*). Córdoba y San Luis. 5: Sierra de Pie Palo (*L. sanjuanensis*). San Juan. 6: Sierra de Velasco (*L. sp11*). La Rioja. 7: Sierra de Famatina (*L. sp13*). La Rioja. 8: Sierras de Belén y de Fiambalá (*L. robertmertensi*). Catamarca. 9: Salar de Pipanaco (*L. brizuelai*). Catamarca. 10: Nevados del Aconquija (*L. ramirezae*). Tucumán. 11: Sierra de Medina (*L. bitaeniatus*). Tucumán. 12: Sierra de Metán (*L. bitaeniatus*). Salta. Modified from Vega *et al.*, 2008.

FML 1706/3: Andalgalá, Puesto Río Blanco - Ruta Prov.1, Catamarca Province, Argentina.

MCN 1713: Pipanaco Salt Flat. Pomán, Catamarca Province, Argentina. MCN 2571: Road to Mina Capillitas, from Andalgalá. 27°27'0.6''S; 66°23'30.0''W, 2433 m a.s.l. Andalgalá, Catamarca Province, Argentina. MCN 2574: Post Río Blanco, Don Pio Brizuela, 32 Km S of Andalgalá, by Provincial Route 46, Km 96. Arriving at the post. Pipanaco Salt Flat. 27°49'43''S; 66°11'4.2''W, 761 m a.s.l. Pomán, Catamarca Province, Argentina.

Diagnosis. – *Liolaemus brizuelai* sp. nov. belongs to the *Liolaemus robertmertensi* group (Lobo *et al.*, 2010, Abdala and Quinteros, 2014; Portelli and Quinteros, 2018; Quinteros *et al.* 2020). It is a medium sized *Liolaemus*, (max. SVL 57.49 mm), phenetically similar to *L. robertmertensi*. Table 2 shows statistical differences between *Liolaemus brizuelai* sp. nov. and *L. robertmertensi* and other phylogenetically close species. Head height in *L. brizuelai* (Mean= 6.04; SD= 0.15) is greater than in *L. robertmertensi* (Mean= 5.33; SD= 0.22). Foot length in *L. brizuelai* (Mean= 14.92; SD= 0.22) is longer than in *L. robertmertensi* (Mean= 13.48; SD= 0.41). Number of scales of neck in *L. brizuelai* (Mean= 14.07; SD= 0.21) is lower than in *L. robertmertensi* (Mean= 17.58; SD= 0.67). Number of ventrals is lower in *L. brizuelai* (Mean= 63.37; SD= 0.71) than in *L. robertmertensi* (Mean= 69.08; SD= 1.28). A black margin in dorsolateral stripes is present in *L. robertmertensi* but absent in *L. brizuelai*. A line surrounding interparietal scale is always absent in *L. robertmertensi* but is evident in some *L. brizuelai*. Throat is immaculate cream in *L. robertmertensi* but shows stripes or can be gray in *L. brizuelai*. Head of *L. robertmertensi* bears no markings, but head of *L. brizuelai* can show lines or dots.

Tables 1 and 2 show differences between *L. brizuelai* and *L. gracilis*, *L. sanjuanensis*, and *L. saxatilis*, species phylogenetically close to *L. brizuelai*. Head height in *L. brizuelai* (Mean= 6.04; SD= 0.15) is greater than in *L. gracilis* (Mean= 5.24; SD= 0.14), but less than in *L. sanjuanensis* (Mean= 6.44; SD= 0.18). Foot length in *L. brizuelai* (Mean= 14.92; SD= 0.22) is longer than in *L. gracilis* (Mean= 12.45; SD= 0.31) and *L. saxatilis* (Mean= 13.6; SD= 0.24). Number of scales around midbody in *L. brizuelai* (Mean= 31.6; SD= 0.03) is lower than in *L. gracilis* (Mean= 40.15; SD= 0.52), *L. sanjuanensis* (Mean= 49.93; SD= 0.62), and *L. saxatilis* (Mean= 38.22; SD= 0.87). Number of dorsal scales in *L. brizuelai* (Mean= 38.13; SD= 0.49)

is lower than in *L. gracilis* (Mean= 41.63; SD= 0.69) and *L. sanjuanensis* (Mean= 51; SD= 1.16). Number of superciliaries in *L. brizuelai* (Mean= 6.81; SD= 0.09) is greater than in *L. gracilis* (Mean= 6.05; SD= 0.05) and *L. sanjuanensis* (Mean= 5.62; SD= 0.15), and lower than in *L. saxatilis* (Mean= 7.32; SD= 0.1). Number of neck scales in *L. brizuelai* (Mean= 14.07; SD= 0.21) is lower than in *L. gracilis* (Mean= 23.47; SD= 0.3), *L. sanjuanensis* (Mean= 33.81; SD= 0.13), and *L. saxatilis* (Mean= 21.82; SD= 0.41). Number of lorilabials in *L. brizuelai* (Mean= 2.42; SD= 0.09) is lower than in *L. gracilis* (Mean= 3.1; SD= 0.07), *L. sanjuanensis* (Mean= 3.56; SD= 0.18), and *L. saxatilis* (Mean= 3.5; SD= 0.17). Number of supralabials in *L. brizuelai* (Mean= 5.84; SD= 0.09) is greater than in *L. gracilis* (Mean= 5.31; SD= 0.11) and *L. saxatilis* (Mean= 5.22; SD= 0.13), but lower than in *L. sanjuanensis* (Mean= 6.62; SD= 0.22). Number of ventral scales in *L. brizuelai* (Mean= 63.37; SD= 0.71) is lower than in *L. gracilis* (Mean= 75.37; SD= 1.2), *L. sanjuanensis* (Mean= 76.06; SD= 1.27), and *L. saxatilis* (Mean= 73.68; SD= 1.32). Number of lamellae on first toe in *L. brizuelai* (Mean= 10.08; SD= 0.16) is lower than in *L. gracilis* (Mean= 11.42; SD= 0.2), but greater than in *L. saxatilis* (Mean= 8.63; SD= 0.1). Number of lamellae on third toe in *L. brizuelai* (Mean= 18.23; SD= 0.24) is lower than in *L. gracilis* (Mean= 20.1; SD= 0.2), but greater than in *L. saxatilis* (Mean= 17.32; SD= 0.15). In *L. brizuelai*, the nasal scale contacts the rostral, whereas in *L. balerion*, *L. exploratorum*, *L. sanjuanensis*, *L. saxatilis*, *L. vhagar*, and *L. yanalcu*, there is no contact. The dorsal surface of the head is smooth in *L. brizuelai*, being slightly rugose in *L. exploratorum* and *L. pagaburoi* and markedly rugose in *L. bitaeniatus*, *L. lemniscatus*, *L. saxatilis*, *L. tacnae*, and *L. variegatus*. Subocular scale is whitish, lighter than loreal region in *L. brizuelai*, differing from *L. gracilis*, *L. vhagar*, *L. meraxes*, *L. incaicus*, *L. paulinae*, *L. puna*, *L. pyriphlogos* and *L. yanalcu*, where subocular scale is same color as loreal region. The neck scales of *L. brizuelai* have a keel, while in *L. gracilis* and *L. vhagar* they are smooth. Females of *L. brizuelai* do not present precloacal pores, while the females of *L. aparicioi*, *L. bitaeniatus*, *L. incaicus*, *L. ramirezae*, *L. variegatus* and *L. yanalcu* present precloacal pores. Males of *Liolaemus brizuelai* present paravertebral spots, while these are absent in *L. alticolor*, *L. chun-gara*, *L. fuscus*, *L. gracilis*, *L. chaltin*, most of males of *L. puna* and *L. walkeri*. Presence of dorsolateral stripes in *L. brizuelai* differentiates this species from

L. tacnae and *L. yanalcu*. Vertebral line is absent in *L. brizuelai*, differing from *L. gracilis* (evident and segmented) and from *L. tandiliensis* (evident in some specimens), *L. alticolor*, *L. aparicioi*, *L. balerion*, *L. bibronii*, *L. chavin*, *L. curicencis*, *L. cyaneinotatus*, *L. gracilis*, males of *L. incaicus*, *L. pachacutec*, females of *L. puna*, *L. pyriphlogos*, *L. sanjuanensis*, *L. tacnae*, *L. variegatus*, *L. walkeri*, and *L. wari*, where vertebrate line is evident. Males of *L. chavin*, *L. pachacutec*, *L. wari*, and *L. walkeri* exhibit partial or total ventral melanism, which is absent in *L. brizuelai*

Description of the Holotype.-

Snout vent length (SVL) 50.2 mm. Trunk length 25.4 mm. Head longer (12.3 mm) than wide (8.33 mm). Head height 6.58 mm. Interorbital distance 7.24 mm. Orbit-auditory meatus distance 4.34 mm. Auditory meatus height 1.74 mm high, 1.59 mm wide. Distance between nostrils 2.75 mm. Subocular scale length 3.60 mm. Tibia length 10.8 mm, and foot length 16.5 mm. Humerous length 7.28 mm. Tail length 101.9 mm, not autotomized.

Dorsal surface of the head smooth, with 11 scales from occiput to rostral. Rostral wider than taller. Mental larger than rostral, trapezoidal, bordered by four scales. Nasal contact with rostral. Four internasals. Nasal surrounded by seven scales, separated from canthal by one scale. Five scales between frontal and superciliaries. Five scales between frontal and rostral. Frontal divided horizontally into two scales. Interparietal smaller than parietals, in contact with six scales. Orbital semicircles incomplete. Five supraoculars, enlarged. Preocular separated from lorilabial row by one scale. Three scales in the anterior margin of auditory meatus. Seven keeled temporals. Six lorilabials, three of them, in contact with subocular scale. Six supralabials, none in contact with subocular. Five infralabials, first of them enlarged. Four chinshields, the second pair separated by one scale. Thirty scales around midbody. Thirty-eight lanceolate, imbricate, and keeled dorsal scales, from occiput to hind limbs. Flank scales same sized and shaped than dorsals. Sixty-two ventral scales, smaller than dorsals, flat and imbricate. Presence of horizontal and bifurcated folds ("Y" shaped) in the neck. Twenty smooth weakly-imbricate gular scales. Four precloacal pores. Antehumeral scales flat, equal in size than dorsals. Fourth finger with 16 subdigital lamellae; fourth toe with 21. Infracarpals and infratarsals flat and imbricate.

Color of the holotype in ethanol

Head dorsally brown with small black lines without defined pattern. Trunk and tail same color as head. Fore and hind limbs same color as trunk. Without vertebral line. Black and rectangular paravertebral spots without white margins, perpendicular to the axis of the body and uniform arrangement are evident. Lateral field same color as dorsum. Dorsolateral bands present, irregular and with white margin, two scales wide. Paravertebral spots continue on dorsal region of the tail forming a vertebral line. Ventrally, from the mental scale to the cloacal region, gray.

Variation. — (Based on 32 specimens: fifteen males, twelve females, and five young)

Midbody scales 28-34 (Mean=31.3; SD=1.52). Dorsal scales 31-43 (Mean=38.0; SD=2.95) between occiput and anterior border of thighs. Dorsal scales lanceolate, imbricate, strongly keeled, and with mucron. Ventral scales 57-75 (Mean= 63.4; DS= 4.37). Ten to thirteen scales from occiput to rostral (Mean= 11.3; SD= 0.94). Four to eight (Mean= 5.69; SD=0.86) scales between frontal and rostral. Six to eight (Mean= 6.81; SD= 0.54) supraciliary scales. Four to five (Mean= 4.38; SD= 0.49) scales between frontal and superciliaries. Five to eight (Mean= 6.69; SD= 0.64) scales surround nasal and always contacts the rostral scale. Nasal scale in contact with the canthal scale or separated one or two scales (Mean= 1.44; SD= 0.56). Six to nine (Mean= 7.13; SD= 0.61) temporals scales, slightly keeled. Neck scales 12-16 (Mean= 14.1; SD= 1.16), lamellar and keeled. Six to nine (Mean= 6.56; SD =0.72) lorilabials. Two to three (Mean= 2.36; SD= 0.48) lorilabials in contact with the subocular scales. Subocular whitish, lighter than the other scales of loreal region. Four to seven (Mean= 5.88; SD= 0.61) upper labials and four to five (Mean= 4.34; SD= 0.48) lower labials. Fourth upper labial does not contact the subocular in 90% of specimens. Males present three to six (Mean= 4.37; SD= 0.67) precloacal pores. SVL males 39.0-57.5 mm (Mean= 49.3 mm; SD= 6.07), females 39.4-56.1mm (Mean= 49.2 mm; SD= 6.19). Length of the trunk in males 16.3-27.5 mm (Mean= 22.5 mm; SD= 3.03) and in females 20.4-33.4 mm (Mean= 25.0 mm; SD =4.19). Head length in males 9.28-13.1 mm (Mean= 11.4 mm; SD= 1.20) and in females 8.77-11.7 mm (Mean= 10.5 mm; SD= 1.08). Head height 6.34-9.77 mm (Mean= 8.12 mm; SD= 1.04) in males, in females 6.12-9.22 mm (Mean= 7.47 mm; SD= 0.87).

Head width 4.45-7.54 mm (Mean= 6.07 mm; SD= 0.96) in males and females 4.75-6.48mm (Mean= 5.65 mm; SD= 0.65). Humerus length 5.49-8.78 mm (Mean= 6.90 mm; SD= 0.80) and tibia 7.43-10.9 mm (Mean= 9.44mm; SD= 0.94). Length of the tail 73.0-128.1 mm (Mean= 95.1 mm; SD= 18.9). Ratio between tail length and SVL is 1.72 (males 1.49 and females 1.78).

Color in life. - Fig. 5

Liolaemus brizuelai is characterized by its light brown dorsum with black paravertebral spots. These spots always present white margins and are variably shaped (rectangular, dashed line or as stretch line) in specimens. Paravertebral spots continue throughout the dorsal region of the tail. Dorsolateral bands are lighter brown than the vertebral region in females but in males there is no distinction between those regions. The dorsolateral bands may have black or white margins in both sexes. Lateral field with irregular spots on a coppery brown background on all specimens. Ventrolateral zone can exhibit black, white or yellow spots in males. This region takes a yellow coloration in females during the reproductive period but never shows spots. Males show a yellow coloration in the ventral region of the thighs near the cloaca region. Throat, chest, and belly immaculate grey. Ventral region of tail is immaculate cream.

Distribution

Liolaemus brizuelai is known from the Salar de Pipanaco and surroundings in the district of Pomán, as well as from the neighboring town of Andalgala, both in the province of Catamarca, Argentina. The new species inhabits a sandy region where algarrobo (*Prosopis flexuosa*) forest is the predominant vegetation and can be found under fallen trees.

Etymology. - We dedicate this species to Mr. Pío Brizuela, owner of Puesto Río Blanco, type locality of *L. brizuelai*. He has fought for conservation of algarrobo forests in his province and encourages researchers to use his property field for research; as a consequence many new species of vertebrates have their type locality as Puesto Río Blanco.

Discussion

Liolaemus robertmertensi was described by Hellmich (1964) from “mountains around Belén” in Catamarca Province, Argentina. Although its description only was based on 7 specimens, it was useful, given the

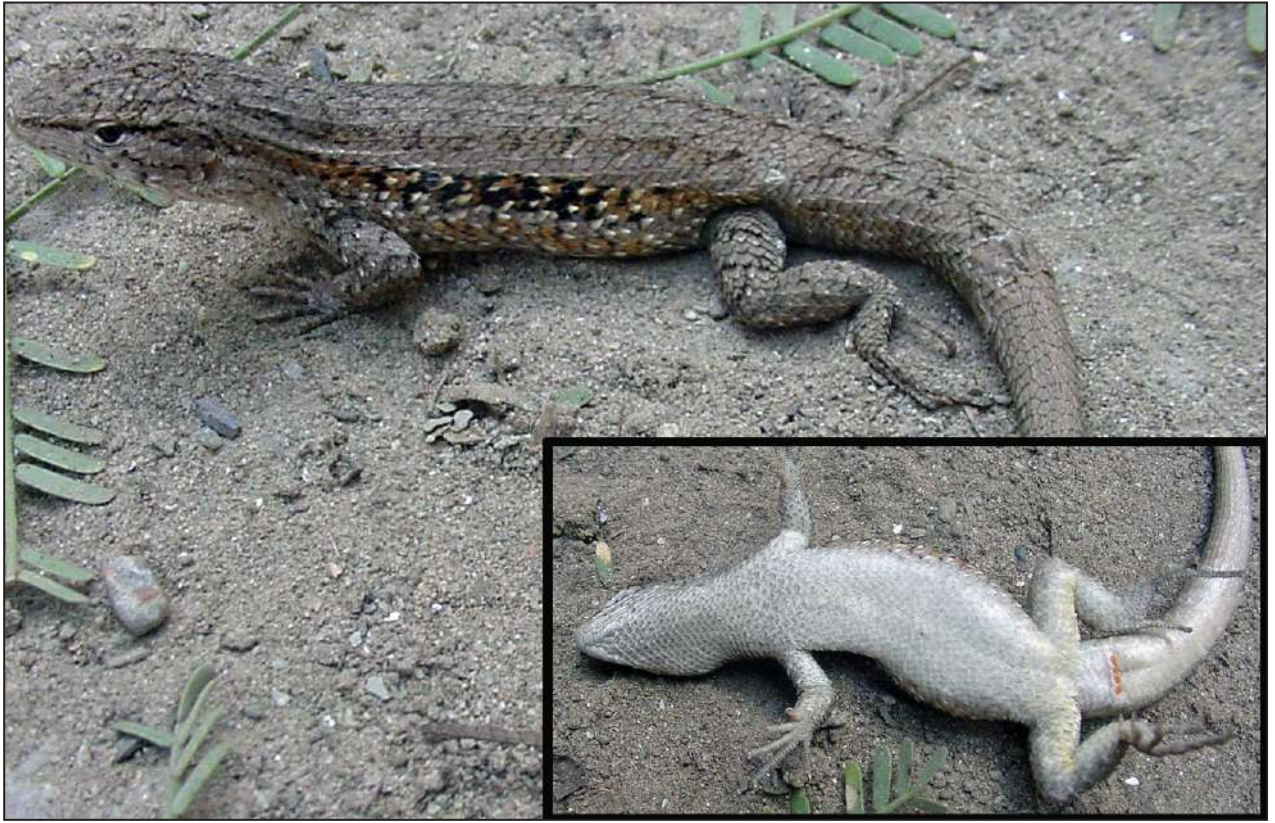


Figure 5. Picture of *Liolaemus brizuelai* from its Type Locality.

taxonomic approach at that time. However, a more detailed description was needed as new populations of similar lizards have been discovered. Molecular and morphological evidence both show that there are still many populations assigned to *L. robertmertensi* but which appear to be new species (Quinteros, 2013; Portelli and Quinteros, 2018, Quinteros *et al.*, 2020). Moreover, other studies have proposed that *L. robertmertensi* might occur over a wider range than that proposed by Hellmich (1964). For example, Avila and Lobo (1999) included localities for *L. robertmertensi* from La Rioja Province and other places in Catamarca. These identifications were followed by other authors (Lobo and Espinoza, 1999; Lobo, 2005; Schulte *et al.* 2000; Espinoza *et al.*, 2004; Quinteros, 2012, 2013; Semhan, 2015, among others). Later, these distributions were confirmed by Avila *et al.* (2013). However, since the contributions of Avila and Lobo (1999) and Avila *et al.* (2013), there had been no further studies to specifically elucidate the taxonomy of the populations assigned to *L. robertmertensi* until this work.

Lobo (2005) first proposed a monophyletic *Liolaemus robertmertensi* group composed of *L. chiliensis*, *L. nitidus*, and *L. robertmertensi*. This group

is recovered in different analyses but its composition has varied to add new species such as *L. curicensis*, *L. gracilis*, *L. saxatilis*, and *L. tandiliensis* (Díaz Gómez and Lobo, 2006), or *L. sanjuanensis* (Lobo, 2010). Later, Abdala and Quinteros (2014) included *L. chiliensis*, *L. nitidus*, *L. robertmertensi*, and *L. sanjuanensis* in this group. The abovementioned studies all recovered and proposed the *L. robertmertensi* group as a clade outside the *L. alticolor-bibronii* group. However, the *L. robertmertensi* was included within the in studies of the *L. alticolor* group (Quinteros, 2013; Portelli and Quinteros, 2018; and Quinteros *et al.*, 2020) or in broader phylogenetic studies (Pyron *et al.*, 2013, Zheng and Wiens, 2015, Esquerré *et al.*, 2019).

The most recent phylogenies that recover the *L. robertmertensi* group, are those of Portelli and Quinteros (2018) and Quinteros *et al.* (2020). Portelli and Quinteros (2018) recovered the *L. robertmertensi* group as sister clade of the *L. bibronii sensu stricto* group, and both groups as members of a more inclusive clade, the *L. gracilis* clade. Similar results were recovered by Quinteros *et al.* (2020). The main differences among these two studies are in the composition of the *L. robertmertensi* group (Table 4)

Table 4. Historical taxonomic composition of the *Liolaemus robertmertensi* group.

Lobo 2005	Díaz Gómez & Lobo, 2006	Lobo <i>et al.</i> , 2010	Abdala & Quinteros, 2014	Portelli & Quinteros, 2018	Quinteros <i>et al.</i> , 2020
<i>L. robertmertensi</i>	<i>L. robertmertensi</i>	<i>L. chiliensis</i>	<i>L. chiliensis</i>	<i>L. sanjuanensis</i>	<i>L. robertmertensi</i>
<i>L. chiliensis</i>	<i>L. chiliensis</i>	<i>L. nitidus</i>	<i>L. nitidus</i>	<i>L. brizuelai</i>	<i>L. yanalcu</i>
<i>L. nitidus</i>	<i>L. nitidus</i>	<i>L. robertmertensi</i>	<i>L. robertmertensi</i>	<i>L. saxatilis</i>	<i>L. ramirezae</i>
	* <i>L. curicencis</i>	<i>L. sanjuanensis</i>	<i>L. sanjuanensis</i>	<i>L. tandiliensis</i>	<i>L. chungara</i>
* <i>L. saxatilis</i>	<i>L. robertmertensi</i>			<i>L. gracilis</i>	<i>L. pagaburoi</i>
* <i>L. sp3</i>	<i>L. chiliensis</i>			<i>L. robertmertensi</i>	<i>L. bitaeniatus</i>
	<i>L. nitidus</i>			<i>L. yanalcu</i>	<i>L. chaltin</i>
	<i>L. saxatilis</i>			<i>L. pagaburoi</i>	<i>L. puna</i>
	<i>L. gracilis</i>			<i>L. bitaeniatus</i>	<i>L. sp1</i>
	<i>L. sp2</i>			<i>L. ramirezae</i>	<i>L. sp2</i>
				<i>L. variegatus</i>	<i>L. sp 11</i>
				<i>L. aparicioi</i>	<i>L. sp13</i>
				<i>L. sp 2</i>	<i>L. sanjuanensis</i>
				<i>L. sp 4</i>	<i>L. brizuelai</i>
				<i>L. sp 5</i>	<i>L. saxatilis</i>
				<i>L. sp 11</i>	<i>L. tandiliensis</i>
				<i>L. sp 15</i>	<i>L. vhagar</i>
				<i>L. robertmertensi</i>	<i>L. gracilis</i>
				<i>L. yanalcu</i>	<i>L. robertmertensi</i>
				<i>L. ramirezae</i>	<i>L. yanalcu</i>
				<i>L. chungara</i>	<i>L. ramirezae</i>
				<i>L. pagaburoi</i>	<i>L. pagaburoi</i>
				<i>L. bitaeniatus</i>	<i>L. bitaeniatus</i>
				<i>L. puna</i>	<i>L. variegatus</i>
				<i>L. chaltin</i>	<i>L. aparicioi</i>
				<i>L. sp1</i>	<i>L. sp2</i>
				<i>L. sp2</i>	<i>L. sp4</i>
				<i>L. sp11</i>	<i>L. sp5</i>
				<i>L. sp3</i>	<i>L. sp11</i>

but neither recovered *L. nitidus* as either a member of the *L. robertmertensi* group or the broader *L. alticolor-bibronii* group. Both studies recovered a *L. robertmertensi* group formed by two clades, one distributed from central-west Argentina to Bolivia and the other distributed from central-west to the south-east of Argentina. *Liolaemus robertmertensi* and *L. brizuelai* sp. nov. are members of the second group (Fig. 6). In that clade, *L. robertmertensi* and *L. brizuelai* are more related to *L. gracilis*, *L. saxatilis*, *L. sanjuanensis*, *L. tandiliensis*, *L. vhagar*, and an unnamed population. *Liolaemus brizuelai* correspond to *L. sp. 12* of Portelli and Quinteros (2018) and Quinteros *et al.* (2020). In both studies, *L. brizuelai* is more related to other species than to *L. robertmertensi*. Hence, the redescription of *L. robertmertensi*, including more character states, and the determination of a more accurate type locality (including more localities) allow us to identify a new taxon. Therefore, we found phylogenetic and morphological evidence which allow us to described the

L. sp 12 (Portelli and Quinteros, 2018, Quinteros *et al.*, 2020) as a new species, *L. brizuelai*. Included in many previous studies, *L. brizuelai* was considering as *L. robertmertensi* (Lobo and Espinoza, 1999; Lobo, 2005; Schulte *et al.* 2000; Espinoza *et al.*, 2004; Quinteros, 2012, 2013 in part). Moreover, it is possible that there are still some terminal taxa included in our study whose taxonomic status remains unknown, as *L. sp11* and *L. sp13* of Portelli and Quinteros (2018) and Quinteros *et al.* (2020).

Liolaemus brizuelai is known only from the Salar of Pipanaco, a small area within the Monte phytogeographic region (Cabrera and Willink, 1980). The habitat of the species corresponds to an algarrobo (*Prosopis flexuosa*) forest that has suffered from extraction and clearing in recent years due to the advance of the agricultural frontier. The Pipanaco region is home to various endemic species, including *Liolaemus salinicola*, Laurent, 1986, *L. pipanaco*, Abdala and Juárez Heredia, 2013, and now *L. brizuelai*, as well as some mammals (*Tympanoctomys aureus*,

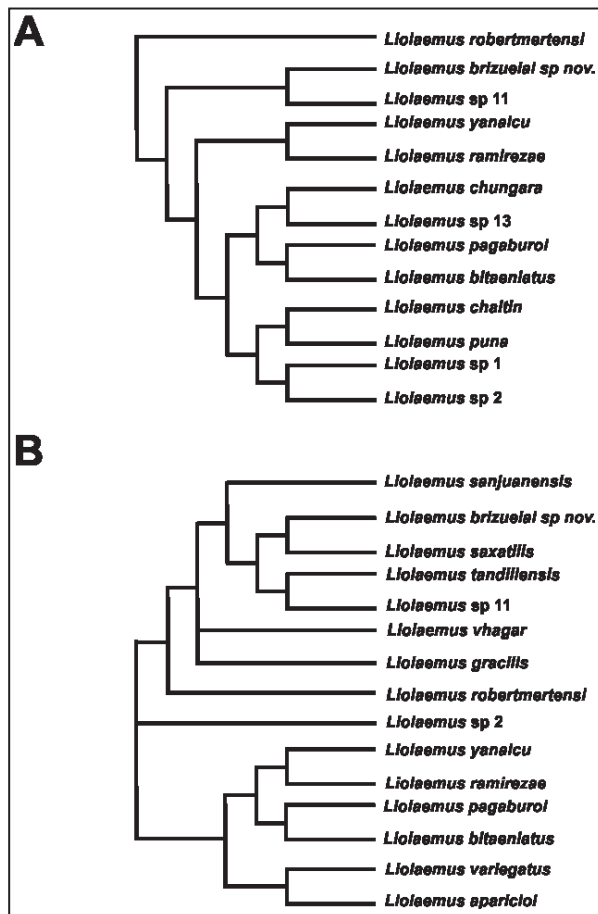


Figure 6. Phylogenetic estimates of the *Liolaemus robertmertensi* group showing the placement of *L. robertmertensi* and *L. brizuelai*. A. Topology recovered under Parsimony. B. Topology recovered under Bayesian Inference. Modified from Quinteros *et al.*, 2020.

Andalgalomys roigi, and *Eligmodontia bolsoniensis*). Some of these species are already recognized as threatened by the IUCN Red List, for example *L. salinicola* is Endangered and *P. aureus* is Critically Endangered. Thus, the conservation of the Bolsón de Pipanaco is priority if we are to protect to only known habitats of these endemic species.

Acknowledgments

We dedicate this work to Mr. Pío Brizuela who allowed us to study *Liolaemus* in his property and always provided us with his assistance. Thanks to Fernando Lobo (IBIGEO), Esteban Lavilla, Sonia Kretschmar (FML); Julian Faivovich and Santiago Nenda (MACN) who facilitated specimens from collections under their care. Thanks to Francisco Zurita for doing the German translation of the original description of *Liolaemus robertmertensi*. Agencia Nacional de Promoción Científica y Tecnológica PICT2015-1398. We also thank R. Langstroth and

an anonymous reviewer whose comments greatly improved the MS.

Literature cited

- Abdala, C.S. 2007. Phylogeny of the *boulengeri* group (Iguania: Liolaemidae, *Liolaemus*) based on morphological and molecular characters. *Zootaxa* 1538: 1–84.
- Abdala, C.S.; Quinteros, A.S.; Semhan, R.V.; Bulacios Arroyo, A.L.; Schulte, J.; Paz, M.; Ruiz-Monachesi, M.R.; Laspiur, A.; Aguilar Kirigin, A.J.; Gutierrez, R.; Valladares, P.; Valdes, J.; Portelli, S.N.; Santa Cruz, R.; Aparicio, J.; Garcia, N. & Langstroth, R. 2020. Unravelling interspecific relationships among highland lizards: first phylogenetic hypothesis using total evidence of the *Liolaemus montanus* group (Iguania: Liolaemidae). *Zoological Journal of the Linnean Society* 189: 349-377.
- Abdala, C.S., & Quinteros, A.S. 2014. Los últimos 30 años de estudios de la familia de lagartijas más diversa de Argentina. Actualización taxonómica y sistemática de Liolaemidae. *Cuadernos de Herpetología* 28: 55-82.
- Aguilar, C.; Wood Jr., P.L.; Cusi, J.C.; Guzman, A.; Huari, F.; Lundberg, M.; Mortensen, E.; Ramirez, C.; Robles, D. & Suárez, J. 2013. Integrative taxonomy and preliminary assessment of species limits in the *Liolaemus walker* complex (Squamata, Liolaemidae) with descriptions of three new species from Peru. *ZooKeys* 364: 47–91.
- Avila, L. & Lobo, F. 1999. New Lizard Records for La Rioja and Catamarca Provinces, Northwestern Argentina. *Herpetological Review* 30: 2.
- Ávila, L.J., Martínez, L.E. & Morando, M. 2013. Checklist of lizards and amphisbaenians of Argentina: an update. *Zootaxa* 3616: 201-238.
- Barraclough, T.G.; Birky Jr., C.W. & Burt, A. 2003. Diversification in sexual and asexual organisms. *Evolution* 57: 2166–2172.
- Cei, J.M. 1986. Reptiles del Centro, Centro-Oeste y Sur de la Argentina. *Herpetofauna de las zonas áridas y semiáridas. Museo Regionale di Scienze Naturali, Torino, Monografie* 4: 1-527.
- Cei, J.M. 1993. Reptiles del noroeste, nordeste y este de la Argentina. *Museo Regionale di Scienze Naturale, Torino, Monografie* 14: 1-949.
- Coyne, J.A. & Orr, H.A. 1998. The evolutionary genetics of speciation. *Philosophical Transactions of the Royal Society of London B: Biological Sciences* 353: 287–305.
- Crawley, M.J. 2007. *The R book*. London: John Wiley & Sons Ltd.
- Crisci-V, J., Freire-E, S., Sancho, G., & Katinas, L. 2001. Historical biogeography of the Asteraceae from Tandilia and Ventania mountain ranges (Buenos Aires, Argentina). *Caldasia* :21-41.
- De Queiroz, K. 2007. Species concepts and species delimitation. *Systematic Biology* 56: 879–886.
- Díaz Gómez, J.M. & Lobo, F. 2006. Historical biogeography of a clade of *Liolaemus* (Iguania: Liolaemidae) based on ancestral areas and dispersal- vicariance analysis (DIVA). *Papéis Avulsos de Zoología* 46: 261-274
- Espinosa, R.E.; Wiens, J.J. & Tracy, C.R. 2004. Recurrent evolution of herbivory in small, cold-climate lizards: breaking the ecophysiological rules of reptilian herbivory. *Proceedings of the National Academy of Sciences, USA* 101: 16819-16824.
- Esquerré, D., Brennan, I.G., Catullo, R.A., Torres-Pérez, F. &

- Keogh, J.S. 2019. How mountains shape biodiversity: The role of the Andes in biogeography, diversification, and reproductive biology in South America's most species-rich lizard radiation (Squamata: Liolaemidae). *Evolution* 73: 214-230.
- Frost, D.R. 1992. Phylogenetic analysis and taxonomy of the *Tropidurus* group of lizards (Iguania, Tropiduridae). *American Museum Novitates* 3033.
- Harlow, L. 2005. The essence of multivariate thinking: basic themes and methods. Mahwah: Lawrence Erlbaum Associates.
- Hellmich, W. 1964. Über eine neue *Liolaemus*-Art aus den Bergen von Catamarca, Argentina. *Senckenbergiana biologica* 45: 505-507
- Knowles, L.L. & Carstens, B.C. 2007. Delimiting species without monophyletic gene trees. *Systematic Biology* 56: 887-895.
- Laurent, R.F. 1983. Contribución al conocimiento de la estructura taxonómica del género *Liolaemus* Wiegmann (Iguanidae). *Boletín de la Asociación Herpetológica Argentina* 1: 15-18.
- Laurent, R.F. 1985. Segunda contribución al conocimiento de la estructura taxonómica del género *Liolaemus* Wiegmann (Iguanidae). *Cuadernos de Herpetología* 1: 1-37.
- Lê, S.; Josse, J. & Husson, F. 2008. FactoMineR: an R package for multivariate analysis. *Journal of Statistical Software* 25: 1-18.
- Leaché, A.D.; Koo, M.S.; Spencer, C.L.; Papenfuss, T.J.; Fisher R.N. & McGuire, J.A. 2009. Quantifying ecological, morphological, and genetic variation to delimit species in the coast horned lizard species complex (*Phrynosoma*). *Proceedings of the National Academy of Sciences* 106: 12418-12423.
- Lobo, F. 2001. A phylogenetic analysis of lizards of the *Liolaemus chiliensis* group (Iguania: Tropiduridae). *Herpetological Journal* 11: 137-150.
- Lobo, F. 2005. Las relaciones filogenéticas en el grupo *chiliensis* de *Liolaemus* (Iguania: Liolaemidae). Sumando nuevos caracteres y taxa. *Acta Zoológica Lilloana* 49: 67-89.
- Lobo, F. & Espinoza, R.E. 1999. Two new cryptic species of *Liolaemus* (Iguania: Tropiduridae) from northwestern Argentina: resolution of the purported reproductive bimodality of *Liolaemus alticolor*. *Copeia* 1999: 122-140.
- Lobo, F. & Espinoza, R.E. 2004. Two new *Liolaemus* from the Puna region of Argentina and Chile: further resolution of purported reproductive bimodality in *Liolaemus alticolor* (Iguania: Liolaemidae). *Copeia* 2004: 850-867.
- Lobo, F.; Espinoza, R.E. & Quinteros, S. 2010b. A critical review and systematic discussion of recent classification proposals for Liolaemid lizards. *Zootaxa* 2549: 1-30.
- Luo, R.; Misra, M.; Himmelblau, D.M. 1999. Sensor fault detection via multiscale analysis and dynamic PCA. *Industrial & Engineering Chemistry Research* 38: 1489-1495.
- Olave, M.; Avila, L.J.; Sites, J.W. & Morando, M. 2014. Multilocus phylogeny of the widely distributed South American lizard clade *Eulaemus* (Liolaemini, Liolaemus). *Zoologica Scripta* 43: 323-337.
- O'Rourke, N.; Psych, R. & Hatcher, L. 2013. A step-by-step approach to using SAS for factor analysis and structural equation modeling. Cary: Sas Institute.
- Portelli, S.N., & Quinteros, A.S. 2018. Phylogeny, time divergence, and historical biogeography of the South American *Liolaemus alticolor-bibronii* group (Iguania: Liolaemidae). *PeerJ* 6: e4404.
- Pyron, R. A.; Burbrink, F. T. & Wiens, J. J. 2013. A phylogeny and revised classification of Squamata, including 4161 species of lizards and snakes. *BMC Evolutionary Biology* 13: 93.
- Quinteros, A.S. 2012. Taxonomy of the *Liolaemus alticolor-bibronii* group (Iguania: Liolaemidae), with descriptions of two new species. *Herpetologica* 68: 100-120.
- Quinteros, A.S. 2013. A morphology-based phylogeny of the *Liolaemus alticolor-bibronii* group (Iguania: Liolaemidae). *Zootaxa* 3670: 1-32.
- Quinteros, A.S., Ruiz-Monachesi, M.R. & Abdala, C.S. 2020. Solving the *Liolaemus bibronii* puzzle, an integrative taxonomy approach: redescription of *L. bibronii* and description of three new species (Iguania: Liolaemidae). *Zoological Journal of the Linnean Society* 189: 315-348.
- R Development Core Team. 2020. R: a language and environment for statistical computing, v. 3.6.0. Vienna: R foundation for statistical computing. Available at: <http://www.R-project.org>. (accessed March 2020).
- Schulte, J.A.; Macey, J.R.; Espinoza, R.E. & Larson, A. 2000. Phylogenetic relationships in the iguanid lizard genus *Liolaemus*: multiple origins of viviparous reproduction and evidence for recurring andean vicariance and dispersal. *Biological Journal of the Linnean Society* 69: 75-102.
- Semhan, R.V. 2015. Análisis comparativo de ensambles de lagartos del género *Liolaemus*: factores ecológicos y limitantes históricos. Tesis de Doctorado en Ciencias Biológicas, Facultad de Ciencias Naturales, Universidad Nacional de Tucumán, Argentina.
- Smith, H. 1946. Handbook of lizards: lizards of the United States and of Canada. Ithaca: Cornell University Press.
- Zar, J.H. 2010. Biostatistical analysis. Upper Saddle River: Prentice-Hall/Pearson.
- Zheng, Y. & Wiens, J.J. 2016. Combining phylogenomic and supermatrix approaches, and a time-calibrated phylogeny for Squamate reptiles (lizards and snakes) based on 52 genes and 4162 species. *Molecular Phylogenetics and Evolution* 94: 537-547.