DESCRIPTION OF A NEW SPECIES OF THE 
LIOLAEMUS ELONGATUS GROUP FROM THE ANDES OF CENTRAL CHILE (IGUANIA: LIOLAEMIDAE)

DESCRIPCIÓN DE UNA NUEVA ESPECIE DEL GRUPO DE LIOLAEMUS ELONGATUS DE LOS ANDES DE CHILE CENTRAL (IGUANIA: LIOLAEMIDAE)

Jaime Troncoso-Palacios* & Diego Ramírez-Álvarez

1Programa de Fisiología y Biofísica, Facultad de Medicina, Universidad de Chile, Independencia 1027, Santiago, Chile.
2Servicio Agrícola y Ganadero de Chile, Dirección Regional O’Higgins, Rancagua, Chile.
*Correspondence: jtroncosopalacios@gmail.com
Received: 2020-07-20. Accepted: 2021-01-13.

Resumen.— Los lagartos Liolaemus habitan en el sur de Sudamérica, y son uno de los géneros de vertebrados terrestres más diversos del mundo. En este género, las especies del grupo de L. elongatus habitan en la cordillera andina de Chile y Argentina, y en los afloramientos rocosos de la Patagonia Argentina. Aquí, revisamos la identidad taxonómica de una población de los Andes de la Región de O’Higgins, Chile, previamente confundida con L. cristiani y probablemente también con L. ubaghsi. Nosotros encontramos que este taxón no es asignable a ninguno de los Liolaemus actualmente descritos y proveemos una descripción para este. Preliminarmente incluimos a esta nueva especie en el grupo de L. elongatus, probablemente una de las especies del grupo distribuidas más al norte.

Palabras clave.— Endemismo, Liolaemus cristiani, Liolaemus ubaghsi, Lagarto, Región de O’Higgins, poros precloacales.

Abstract.— Liolaemus lizards inhabit southern South America, and are one of the most diverse terrestrial vertebrate genera in the world. In this genus, species of the L. elongatus group inhabit the Chilean and the Argentine Andean mountain range, and the Argentine Patagonian rocky outcrops. Here, we review the taxonomic identity of one population from the Andean O’Higgins Region, Chile, previously confused with L. cristiani and probably also with L. ubaghsi. We found that this taxon is not assignable to any of the Liolaemus currently described and provide a description for it. We preliminary include this new species in the L. elongatus group, likely one of the northernmost distributed species of this group.

Keywords.— Endemism, Liolaemus cristiani, Liolaemus ubaghsi, Lizard, O’Higgins Region, precloacal pores.

INTRODUCTION

The genus Liolaemus Wiegmann, 1834, is an extraordinarily diverse group of lizards distributed in Southern South America, mainly in Argentina and Chile, but also in Bolivia, Brasil, Peru, Paraguay and Uruguay. The genus reached 257 described species in the last review (Abdala & Quinteros, 2014). However, since several species are described each year, the diversity of the genus is estimated to be approximately 265 species at current (Ruiz et al., 2019a) and according to Núñez et al. (2018), 98 species of Liolaemus occurs in Chile. Liolaemus has been split into two subgenera, Liolaemus (sensu stricto) and Eulaemus, supported by both morphology (Etheridge, 1995; Laurent, 1985) and molecular evidence (Espinoza et al., 2004; Schulte et al., 2000), with each subgenus split into several groups (e.g. Avila et al., 2020). The L. elongatus group belongs to the subgenus Liolaemus (sensu stricto) (Morando et al., 2003) and comprises medium to large Liolaemus (with maximum snout vent length of approximately 100 millimeters), with long tail (approximately 1.5 of the SVL), absent or reduced sexual dichromatism, both presence of lateral
dark stripe and light dots on the dorsum in almost all species, viviparous, insectivorous, mainly saxicolous, and in almost all species high amount of midbody, ventral and dorsal scales (Abdala et al., 2010; Avila et al., 2015; Troncoso-Palacios et al., 2018). These species inhabit in the western and eastern slopes of the Andes mountain range, from the south of the Claro River (Chile) and the Mendoza River (Argentina), to the volcanic hills of the Patagonia in the Chubut Province (Argentina) and in the Araucania Region (Chile) (Medina et al., 2017, 2018; Ramírez-Álvarez et al., 2017; Troncoso-Palacios et al., 2018). Esquerré et al. (2019) recovered the L. elongatus group as the sister group of the L. leopardinus clade.

In general, it is accepted that the L. elongatus group currently comprises the following species (Medina et al., 2018; Ruiz et al., 2019a; Troncoso-Palacios et al., 2018, 2019): L. antontietae Troncoso-Palacios, Esquerré, Urra, Díaz, Castro-Pastene & Ruiz, 2018; L. antumlalguen Avila, Morando, Pérez & Sites, 2010; L. burmeisteri Avila, Fulvio Pérez, Medina, Sites & Morando, 2012; L. carlosgarini Esquerré, Núñez & Scolaro, 2013; L. crandalli Avila, Medina, Fulvio Pérez, Sites & Morando, 2015; L. curis Núñez & Labra, 1995; L. elongatus Koslowsky, 1896; L. janequeae Troncoso-Palacios, Díaz, Puas, Riveros-Ríffo, & Elorza, 2016; L. quinterosi Ruiz, Quipildor, Bulacios, Chafrafr & Abdala, 2019; L. scorialis Troncoso-Palacios, Díaz, Esquerré & Urra, 2015, and L. smaug Abdala, Quinteros, Scrocchi & Stazzonelli, 2010. Additionally, the status of L. choique Abdala, Quinteros, Scrocchi & Stazzonelli, 2010, is disputed because it was found as parapatric in a DNA phylogenetic study by Medina et al. (2017), stating that results “does not support” to L. choique as valid species, because “individuals (from the type locality) are genetically related to L. antumlalguen and L. smaug”; but later, Ruiz et al. (2019b) revalidated L. choique through a morphologic statistical study, which compared L. choique and L. smaug (without comparisons in regards to L. antumlalguen).

Nine species of the 12 species of the L. elongatus group have been described in the last ten years (Abdala et al., 2010; Avila et al., 2010, 2012, 2015; Esquerré et al., 2013; Troncoso-Palacios et al., 2015, 2016, 2018; Ruiz et al., 2019a) and it has been proposed that the diversity inside the group is underestimated (Morando et al., 2003), especially in Chile (Troncoso-Palacios et al., 2016). In 2015, one of us (DRA) found a large Liolaemus sp. in the Andean mountain range of the O’Higgins Region of Chile and later used it to represent to L. cristiani Navarro, Núñez & Loyola, 1991 in a field guide (Ramirez-Álvarez, 2018). This misidentification occurred because both Liolaemus sp. nov. and L. cristiani, have a dark lateral stripe and slender aspect, they are closely distributed, the identification was based mainly on photographs and field observations (only one female specimen collected), and at the time there was no published scientific study on the lizards of this zone. Here, we review the taxonomic status of this population of lizards.

**MATERIALS AND METHODS**

Specimens of Liolaemus sp nov. were collected in the field by hand or lasso. We examined previously collected specimens of all Chilean species of the L. elongatus group. For L. carlosgarini, we directly examined specimens and also, we used the data of the holotype and the paratypes from Esquerré et al. (2013, n = 8). For L. elongatus, we directly examined specimens, but since this species is widely distributed, data was complemented with Avila et al. (2010, n = 99). Data for Argentine species of the L. elongatus group were taken from literature (Abdala et al., 2010; Avila et al., 2010, 2012, 2015; Ruiz et al., 2019a), but we examined some specimens of L. antumlalguen. We also examined specimens of all similarly sized Liolaemus found near the type locality of Liolaemus sp. nov. (Alto Huemul), and that do not belong to the L. elongatus group. Table 1 summarizes the composition of the species groups following Esquerré et al. (2019), Medina et al. (2019) and Troncoso-Palacios et al. (2018), and the diagnosis of these species groups is included in the Diagnosis section.

We examined specimens of L. ubaghsi Esquerré, Troncoso-Palacios, Garín & Núñez, 2014, and L. normae Esquerré, Ramírez-Álvarez, Pavón-Vásquez, Troncoso-Palacios, Garín, Keogh & Leaché, 2019, both species of the L. leopardinus group, which is the sister group of the L. elongatus group (Esquerré et al., 2019). In the case of L. ubaghsi, we add data from nine more specimens from Esquerré et al. (2014). We examined specimens of L. buergeri Werner, 1907, a species of the L. kriegi group (Morando et al., 2003). We also examined specimens of L. cristiani, a species of the L. chillanensis group (Troncoso-Palacios et al., 2018), because Liolaemus sp. has been previously misidentified with it. In this case, we add data of five type specimens from Núñez et al. (1993). We examined specimens of L. riogamas Esquerré, Núñez & Scolaro, 2013, a species closely related to L. cristiani (Esquerré et al., 2013). For L. riogamas, we add data of ten type specimens from Esquerré et al. (2013). All directly examined specimens (n = 84) are listed in the Appendix I.

For species delimitation, we consider the “species category” as a geographically constrained lineage, characterized through character analysis and geographical research (Frost & Hillis, 1990). In particular, we used morphological characters comparisons between Liolaemus sp. nov. and other species, through Principal Component Analysis (PCA) of the morphometric variables, a statistical test of meristic variables, and qualitative character
Troncoso-Palacios & Ramírez-Álvarez – New species of Liolaemus

Comparisons (colour pattern, scales shape and presence of precloacal pores), following several recent species descriptions of the L. elongatus group (Abdala et al., 2010; Troncoso-Palacios et al., 2015; Ruiz et al., 2019).

Morphological characters were examined according to Abdala et al. (2010), Avila et al. (2010, 2012, 2015), Ruiz et al. (2019a) and Troncoso-Palacios et al. (2018). Body measurements were taken using a digital Vernier calliper (0.02 mm precision) and are provided as mean ± standard deviation.

As a visualization and exploratory analysis, we performed a two PCA on the morphometric variables with the R package FactoMineR (Lê et al., 2008). One PCA was performed to compare between species of the L. elongatus group, using data of examined specimens or published data sets, including: L. antonietae, L. antumalguen, L. carlosgarini, L. curis, L. elongatus, L. janequeoae, L. scorialis and Liolaemus sp. nov. Another PCA was performed to compare between Liolaemus sp. nov. and species outside of the L. elongatus group with similar size and geographical proximity to Liolaemus sp. nov.: L. buergeri, L. cristiani, L. normae, L. riodamas and L. ubaghsi. These analyses were performed in the R statistical environment version 3.2.3 (RDCT, 2016). We used the residuals of a regression between the snout-vent length (SVL) and the following six variables: head length (distance between anterior edge of auditory meatus and tip of the snout), head width, head height, axilla-groin distance, arm length and foot length. Missing data from some measurements of some individuals were imputed using the imputePCA function from the MissMDA R package (Josse & Husson, 2012).

We performed a normality test (Shapiro-Wilk) on the meristic variables and an One Way ANOVA followed by a Holm-Sidak post hoc to compare between species (Zar, 2010) of the following variables: midbody scales, dorsal scales (counted between the occiput and the level of the anterior border of the hind limbs), ventral scales, supralabial scales, infralabial scales and fourth toe lamellae; using data from all species listed before for the PCAs analyses methodology.

Table 1. Species groups of Andean Liolaemus used for comparisons. The new species is assigned to the L. elongatus group, but some species of other groups were included in the diagnosis due to its geographical proximity. The groups of the L. elongatus-kriegi complex that inhabit far away from the type locality of the new species are not shown. Species marked with asterisks were not included in the diagnosis due to geographical remoteness (excluding the species of the L. elongatus group). Taxonomy follows Esquerré et al. (2019), Medina et al. (2019) and Troncoso-Palacios et al. (2018). Liolaemus riodamas is placed in the L. chillanensis group due to its close relationship with L. cristiani (fide Esquerré et al., 2013).
For species without a published dataset we performed a comparison based on scale count and SVL ranges following the diagnosis previously published for the description of species of the *L. elongatus* group (Abdala et al., 2010; Avila et al., 2010, 2012, 2015; Esquerré et al., 2013; Ruiz et al., 2019a). Color pattern features were used as qualitative features of comparison for all species.

**RESULTS**

PCA analyses between species of the *L. elongatus* group: The first three Principal Components (PCs) cumulatively account for 76.9% of the total variation (Table 2). PC1 is mainly explained by variation in head length, head width and axilla-groin distance. PC2 mostly represents variation in arm length, head height and head width. PC3 mostly represents variation in foot length, AGD and head height. The PCA plots (Fig. 1) have 95% confidence ellipses around the centroid of the species and illustrate the morphometric differences between the species included in the analysis. In the PC1 vs PC2 graph, *Liolaemus* sp nov. mostly overlaps with *L. scorialis*, whereas marginal overlap is observed with *L. antonietae*, *L. curis* and *L. elongatus*. There is no overlap with *L. antumalguen*, *L. carlosgarini* and *L. janequeoae*. In the PC1 vs PC3 graph, *Liolaemus* sp. nov. mostly overlaps with *L. antumalguen* and *L. curis*, whereas marginal overlap is observed with *L. carlosgarini*, *L. elongatus* and *L. scorialis*. There is no overlap with *L. antumalguen* and *L. janequeoae*. Thus, none of the species of the *L. elongatus* group shows a great overlap with *Liolaemus* sp. nov. in both graphs (PC1 vs PC2 and PC1 vs PC3).

PCA analyses between *Liolaemus* sp. nov. and *Liolaemus* spp. with similar size found near the type locality of *Liolaemus* sp. nov.: The first three Principal Components (PCs) cumulatively account for 77.9% of the total variation (Table 3). PC1 is mainly explained by variation in foot length, head length and head width. PC2 mostly represents variation in axilla-groin distance, arm length and head height. PC3 mostly represents variation in head height, head width and axilla-groin distance.

In the PC1 vs PC2 graph (Fig. 2), *Liolaemus* sp. nov. does not show great overlap with any species, but shows marginal overlap with *L. normae* and *L. ubaghsi*. There is no overlap with *L. buergeri*, *L. cristiani* and *L. riodamas*. In the PC1 vs PC3 graph, *Liolaemus* sp. nov. mostly overlaps with *L. ubaghsi* and *L. riodamas*, whereas marginal overlap is observed with *L. cristiani* and *L. normae*. There is no overlap with *L. buergeri*. Thus, none of the similarly sized species that are geographically proximate to *Liolaemus* sp. nov. shows a great overlap with *Liolaemus* sp. in both graphs (PC1 vs

---

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>PC1</th>
<th>PC2</th>
<th>PC3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eigenvalue per Component</td>
<td>2.57</td>
<td>1.13</td>
<td>0.91</td>
</tr>
<tr>
<td>% of var.</td>
<td>42.77</td>
<td>18.92</td>
<td>15.23</td>
</tr>
<tr>
<td>Cum. % of var.</td>
<td>42.77</td>
<td>61.69</td>
<td>76.92</td>
</tr>
<tr>
<td>Eigenvectors</td>
<td>PC1</td>
<td>PC2</td>
<td>PC3</td>
</tr>
<tr>
<td>Head Length (HL)</td>
<td>0.884</td>
<td>-0.290</td>
<td>-0.018</td>
</tr>
<tr>
<td>Head Height (HH)</td>
<td>0.641</td>
<td>0.463</td>
<td>-0.258</td>
</tr>
<tr>
<td>Head Width (HW)</td>
<td>0.781</td>
<td>-0.316</td>
<td>0.099</td>
</tr>
<tr>
<td>Axilla-Groin Distance (AGD)</td>
<td>-0.656</td>
<td>0.281</td>
<td>0.387</td>
</tr>
<tr>
<td>Foot Length (FL)</td>
<td>0.468</td>
<td>0.114</td>
<td>0.826</td>
</tr>
<tr>
<td>Arm Length (AL)</td>
<td>0.408</td>
<td>0.804</td>
<td>-0.072</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>PC1</th>
<th>PC2</th>
<th>PC3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eigenvalue per Component</td>
<td>2.21</td>
<td>1.38</td>
<td>1.09</td>
</tr>
<tr>
<td>% of var.</td>
<td>36.81</td>
<td>22.98</td>
<td>18.14</td>
</tr>
<tr>
<td>Cum. % of var.</td>
<td>36.81</td>
<td>58.80</td>
<td>77.94</td>
</tr>
<tr>
<td>Eigenvectors</td>
<td>PC1</td>
<td>PC2</td>
<td>PC3</td>
</tr>
<tr>
<td>Head Length (HL)</td>
<td>0.772</td>
<td>-0.285</td>
<td>-0.024</td>
</tr>
<tr>
<td>Head Height (HH)</td>
<td>-0.074</td>
<td>0.471</td>
<td>0.827</td>
</tr>
<tr>
<td>Head Width (HW)</td>
<td>0.749</td>
<td>0.229</td>
<td>0.384</td>
</tr>
<tr>
<td>Axilla-Groin Distance (AGD)</td>
<td>-0.304</td>
<td>0.782</td>
<td>-0.356</td>
</tr>
<tr>
<td>Foot Length (FL)</td>
<td>0.820</td>
<td>-0.009</td>
<td>-0.186</td>
</tr>
<tr>
<td>Arm Length (AL)</td>
<td>0.530</td>
<td>0.649</td>
<td>-0.308</td>
</tr>
</tbody>
</table>
A One-Way ANOVA test on the meristic variables revealed significant differences in four of the six variables analysed: scales around midbody, dorsal scales, ventral scales and supralabial scales (Table 4). The results show statistical differences in at least one meristic character between *Liolaemus* sp. and all species that show a major overlap with it in one of the PCA graphs.

Based on the absence of significant overlap with other species in the PCA analyses, the presence of precloacal pores in the males, and differences in coloration versus other species, we propose that the *Liolaemus* that we analyzed from Alto Huemul should be recognized as a distinct species and we here provide a description for it as:

**Liolaemus pikunche** sp. nov. (Fig. 3a,b)

2014 *Liolaemus* sp.(?) Esquerre, Troncoso-Palacios, Garín & Núñez. Zootaxa, 3815: 522.


**Material examined**
Holotype: SSUC Re 781, adult male (Fig. 3a,b). Alto Huemul  

---

**Figure 1.** Principal Component Analysis (PCA) plots of the species of the *L. elongatus* group (including *Liolaemus* sp. nov.). On the left panels, the individuals are colored according to their species as shown on the legend on the top right corner. Ellipses represent the 95% confidence interval around the centroid for each species. On each axis, the PC is labelled according to its number and the percentage of the total variance that PC explains. On the right, the variables graphs, which illustrate the contribution of each variable to the construction of the axes.
Troncoso-Palacios & Ramírez-Álvarez – New species of Liolaemus

Troncoso-Palacios & Ramírez-Álvarez – New species of Liolaemus (34°56'S, 70°38'W, 1790 m asl), O’Higgins Region, Chile. Collected by D. Ramírez-Álvarez and J. Troncoso-Palacios. January 29, 2020. Paratypes: SSUC Re 782–784 (adult males), SSUC Re 785 (adult female), SSUC Re 786 (juvenile) (Fig. 3). Same locality and data as the holotype. SSUC Re 780 (adult female). Collected by D. Ramírez-Álvarez. February 22, 2015. Same locality as the holotype.

Diagnosis

We include this lizard in the L. elongatus group because it shows all the morphological features that characterized this group: L. pikunche is a large (maximum SVL = 91.3 mm) saxicolous Liolaemus with a relatively long tail (1.6–1.8 of the SVL), no sexual dichromatism, presence of lateral dark stripe, light dots on the dorsum, and high counts of midbody, ventral, and dorsal scales (82–90, 119–127 and 71–76, respectively). Additionally, L. pikunche is distributed within the geographical latitudinal range of the L. elongatus group, but it is allopatric in regards to all known species of this group.

Liolaemus pikunche differs from L. antonietae, which is smaller (maximum SVL = 77.6 mm) than L. pikunche (maximum SVL = 91.3 mm) and with head lighter than body and few dispersed dark brown spots (head markedly darker than the body and covered by several dark brown spots in L. pikunche).

Liolaemus pikunche differs from L. antumalguen, which is larger (maximum SVL = 107.8 mm) than L. pikunche (maximum SVL = 91.3 mm) and has inconspicuous or no tail rings, no dorsal stripes, and has ventral melanism (marked tail rings, light dorsal...
Troncoso-Palacios & Ramírez-Álvarez – New species of Liolaemus

Figure 3. Liolaemus pikunche sp. nov. A) Dorsal view of the male holotype (SSUC Re 781). B) Ventral view of the holotype. C) Dorsal view of one female paratype (SSUC Re 780). D) Close-up to the precloacal pores of the SSUC Re 782 specimen. E) Not collected individual. F) Dorsal view of one male paratype (SSUC Re 784).
Liolemaus pikunche differs from L. burmeisteri which lacks a dorsal pattern, whereas L. pikunche has occipital stripe and fragmented vertebral line. Moreover, the head is not darker than the body in L. burmeisteri, but is darker than the body in L. pikunche. Additionally, L. pikunche has more midbody scales (82–90) than L. burmeisteri (70–81), fewer dorsal scales (71–76) than L. burmeisteri (76–85) and more ventral scales (119–127) than L. burmeisteri (99–110).

Liolemaus pikunche is larger (maximum SVL = 91.3 mm) than L. carlosgarini (maximum SVL = 68.8 mm, Fig. 4). All males of L. pikunche have precloacal pores, whereas only 50% of L. carlosgarini males have precloacal pores. These species do not overlap in the PC1 vs PC2 graph.

Liolemaus pikunche differs from L. choique, which has bright yellow dorsal color with black spots or black stripes on the dorsum, or occasionally totally melanic trunk, and a tail with inconspicuous or no rings; whereas L. pikunche never has bright yellow or melanic dorsal coloration and has marked tail rings.

Liolemaus curis (Fig. 4) is the geographically most proximate species of the L. elongatus group to L. pikunche; however, these species can be easy differentiated by several characters. Liolemaus curis has a yellowish dorsal coloration accompanied by series of black transversal dorsal spots or an overall melanic dorsal coloration; whereas L. pikunche never has yellowish or melanic dorsal coloration. Moreover, L. pikunche has more midbody scales (82–90, 84.0 ± 3.0) than L. curis (68–76, 72.0 ± 4.6, Table 4), more dorsal scales (71–76, 73.8 ± 1.7) than L. curis (56–64, 61.3 ± 3.8, Table 4) and more ventral scales (119–127, 122.3 ± 3.1) than L. curis (102–116, 109.0 ± 6.2, Table 4). Males of L. pikunche have 3–4 precloacal pores, whereas males of L. curis have 0–2 precloacal pores.

Liolemaus pikunche can be differentiated from L. crandalli because dorsolateral field in L. pikunche are light brown color and the occipital stripe is marked and narrow, whereas L. crandalli has brown color on the dorsolateral field and the occipital stripe is inconspicuous and wide. Moreover, L. crandalli is endemic to the Auca Mahuida volcano in Argentina and separated by almost 350 km (airline).

Some specimens of Liolemaus elongatus have a wide deep black occipital stripe and some have totally melanic dorsal color. However, individuals of L. pikunche never have a deep black occipital stripe or melanism, but instead have a dark brown occipital stripe. Although L. elongatus is widely distributed, the northern most Chilean record from Lonquimay Volcano (Escobar-Huerta et al., 2015b; Troncoso-Palacios et al., 2016) is approximately 490 km (airline) south of the type locality of L. pikunche.

Liolemaus pikunche differs from L. janequeoi, because the latter species does not feature any dorsal pattern, apart from a few black or white dots and is smaller (maximum SVL 66.9) than L. pikunche (maximum SVL = 91.3 mm). Moreover, L. pikunche has fewer dorsal scales (71–76, 73.8 ± 1.7) than L. janequeoi (77–89, 85.0 ± 4.2, Table 4).

Liolemaus pikunche differs from L. quinterosi, which has more midbody scales (82–90) than L. quinterosi (70–78) and more ventral scales (119–127) than L. quinterosi (104–112). Besides, L. quinterosi has marked sexual dichromatism, a feature absent in L. pikunche. Liolemaus quinterosi has no precloacal pores in males, whereas males of L. pikunche have 3–4 precloacal pores.

Liolemaus pikunche is larger (maximum SVL = 91.3 mm) than L. scorialis (maximum SVL = 69.9 mm) and has more supralabial scales (6–8, 7.3 ± 0.8) than L. scorialis (6–7, 6.2 ± 0.4, Table 4).

Liolemaus pikunche differs from L. smaug because it is larger (maximum SVL = 91.3 mm) than L. smaug (maximum SVL = 71.3 mm) and has more midbody scales (82–90) than L. smaug (73–80). Moreover, L. smaug has inconspicuous or absent tail rings, whereas L. pikunche has dark brown tail rings.

Liolemaus pikunche differs from Liolemaus that do not belong to the L. elongatus group, but have similar size and occur near L. pikunche (though allopatric). In fact, L. pikunche differs from all species of the L. leopardinus group because the lack of “leopard type dorsal spots” and the lack of intense yellow or reddish ventral coloration present among the species of this group (Esquerré et al., 2019). In particular, L. pikunche can be easily differentiated from L. normae, because this latter species has red color on the flanks, ventral surface and even on the snout of some individuals, whereas L. pikunche has no red color. Liolemaus ubaghisi (Fig. 4) is characterized by a very variable dorsal pattern (occipital stripe absent/present, fragmented vertebral line absent/present, transversal dorsal whitish stripes absent/present, whitish dorsal dots on the trunk absent/present and yellow color on the flanks absent/present); whereas all specimens of L. pikunche have the same dorsal pattern with variation only in the shades. In L. ubaghisi, 69.2% of our sample totally lack or have an inconspicuous occipital stripe, whereas all specimens
Troncoso-Palacios & Ramírez-Álvarez – New species of Liolaemus

Figura 4. Algunas especies que habitan geográficamente cerca de Liolaemus pikunche sp. nov. A) Liolaemus curis del grupo de L. elongatus (Fotografía por DRA). B) Liolaemus carlosgarini del grupo de L. elongatus (Fotografía por JTP). C) Liolaemus cristiani del grupo de L. chillanensis (Fotografía por JTP). D–E) Parte de la variación fenotípica en Liolaemus ubaghsi del grupo de L. leopardinus (Fotografías por JTP y DRA, respectivamente).

Figure 4. Some species that are found in geographic proximity to Liolaemus pikunche sp. nov. A) Liolaemus curis of the L. elongatus group (Photograph by DRA). B) Liolaemus carlosgarini of the L. elongatus group (Photograph by JTP). C) Liolaemus cristiani of the L. chillanensis group (Photograph by JTP). D–E) Part of the phenotypic variation in Liolaemus ubaghsi of the L. leopardinus group (Photographs by JTP and DRA, respectively).
of *L. pikunche* have a marked occipital stripe. Several specimens of *L. ubaghsi* have whitish dots dispersed on the dorsum of the trunk, which from transversal stripes only in the 23.1% of our sample, whereas in *L. pikunche* white scales of the dorsum from transversal stripes in all specimens. Several specimens of *L. ubaghsi* have yellow color on the flanks, tail, limbs and snout (clearly observable from lateral view), whereas inconspicuous yellowish color in *L. pikunche* is only observable from ventral view. In *L. ubaghsi* the ventral surface has several dark gray spots dispersed, whereas *L. pikunche* lacks spots on the ventral surface or has inconspicuous light gray spots (one specimen). These species show only marginal overlap in multivariate morphological space, and their type localities are separated by more than 90 km (airline, including the Cachapoal, Claro and Tinguiririca river basins) without intermediate populations (Fig. 5).

There is no published morphological diagnosis for the species of the *L. chillanensis* group, but *L. pikunche* differs from all them, because in this group the males have no precloacal pores (Troncoso-Palacios, unpublished data). In particular, *L. pikunche* is larger (maximum SVL = 91.3 mm) than *L. cristiani* (maximum SVL = 78.2 mm) and has fewer dorsal scales (71–76, 73.8 ± 1.7) than *L. cristiani* (84–93, 88.5 ± 6.4). Moreover, *L. cristiani* has two color pattern features that are totally absent in *L. pikunche*, which are: metallic light green dorsolateral stripe and red ventral color (Fig. 4). Males of *L. pikunche* have 3–4 precloacal pores, whereas males of *L. cristiani* have no precloacal pores. These species do not overlap in the PC1 vs PC2 graph. *Liolaemus pikunche* can be easily differentiated from *L. riodamas* because this latter species has inconspicuous or absent dorsal pattern, has no tail rings and has light green color on the flanks, whereas *L. pikunche* has marked occipital and lateral stripes, tail rings and never has light green color on the flanks. These species do not overlap in the PCA space.

In regards to the *L. kriegi* group, *L. pikunche* differs because the species of this group have a very robust aspect, short limbs, and

---

**Tabla 4. Resultados de la ANOVA de una vía con grados de libertad (df) y la comparación post hoc (Holm-Sidak method). Solo se proveen los resultados significativos.**

**Table 4. Results of the One Way ANOVA with degrees of freedom (df) and the post hoc comparison (Holm-Sidak method). Only significant results are provided.**

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>P</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Midbody scales</strong></td>
<td>12.04</td>
<td>&gt; 0.01</td>
<td>12</td>
</tr>
<tr>
<td><strong>Dorsal scales</strong></td>
<td>18.33</td>
<td>&gt; 0.01</td>
<td>12</td>
</tr>
<tr>
<td><strong>Ventral scales</strong></td>
<td>7.35</td>
<td>&gt; 0.01</td>
<td>12</td>
</tr>
<tr>
<td><strong>Supralabial scales</strong></td>
<td>3.41</td>
<td>&gt; 0.01</td>
<td>11</td>
</tr>
<tr>
<td>L. sp. &gt; L. scorialis; L. antumalquen &gt; L. scorialis; L. janequeoae &gt; L. scorialis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
very developed neck folds (Pincheira-Donoso & Núñez, 2005), all traits absent in *L. pikunche*. In particular, *L. pikunche* has fewer dorsal scales (71–76, 73.8 ± 1.7) than *L. buergeri* (78–91, 83.9 ± 4.3, Table 4). Moreover, *L. buergeri* has inconspicuous or absent tail rings, whereas *L. pikunche* has dark brown tail rings. These species do not overlap in multivariate morphological space.

**Description of the holotype**

**Adult male.** SVL = 90.6 mm. Horizontal diameter of the eye: 4.3 mm. Subocular length: 6.0 mm. Length of the fifth supralabial: 3.3 mm. Head length (from the anterior border of the auditory meatus to the tip of the snout): 20.7 mm. Head height (at the level of ear openings): 10.3 mm. Head width (distance between the two ear openings): 16.1 mm. Neck width: 22.1 mm. Interorbital distance: 7.3 mm. Ear-eye distance: 8.5 mm. Internasal scales distance: 2.7 mm. Ear width: 1.3 mm. Ear height: 3.4 mm. Axilla-groin distance: 38.2 mm. Body width: 26.8 mm. Forelimb length: 27.8 mm. Hindlimb length: 47.9 mm. Tail length (not autotomized): 151 mm, with relation tail length/SVL = 1.7. Rostral scale, wider (4.4 mm) than high (1.4 mm).

Two postrostrals. Four internasals. Interparietal is
subtriangular, with a small central spot marking the position of the parietal eye. The interparietal is slightly smaller than the parietals, and is surrounded by six scales. The parietal scales are in contact. Ten scales between the interparietal and rostral. Sixteen scales between the occiput and the rostral (Hellmich index; Lobo 2005). Orbital semicircles are complete and formed by 15 scales on both sides. Five supraoculars on the right side and six on the left. Seven supernumerary scales. Frontal area divided into three scales, from back to front: 1 and 2. Preocular separated from the lorilabials by one loreal scale. Two scales between nasal and canthal. Nasal separated from the rostral by one scale, surrounded by seven scales. One row of lorilabials between the supralabials and the subocular. Seven supralabials, the fifth is curved upward without contacting the subocular. Five infralabials scales. Pentagonal mental scale, in contact with four scales. Four pairs of post-mental shields, the second is separated by two scales. Temporal of variable shape, but mainly hexagonal, slightly keeled, juxtaposed. Nine temporal scales between the level of supernumerary scales and the rictal level. Four small scales on the anterior edge of the eye, slightly projected, which do not cover the auditory meatus. Differentiated auricular scale, wide, restricted to the first third of the auditory meatus. Forty-eight gular scales between the auditory meatuses. The lateral neck fold is “Y” shaped. There is a slightly developed ventro-lateral fold running from the axilla to the half the trunk.

Midbody scales: 90. Dorsal scales are lanceolate, subimbricate, keeled (without mucrons) and with interstitial granules. Dorsal scales and ventral scales have similar size. Dorsal scales: 73. Ventral scales are rounded, smooth, imbricated and without interstitial granules. Ventral scales: 122. Four orange precloacal pores. Supra-femoral scales are lanceolate, imbricate and slightly keeled. Infra-femoral scales are lanceolate or rhomboidal, smooth and imbricated. Supra-antebrachials scales are lanceolate, imbricate and keeled. Infra-antebrachials are rounded or rhomboidal, imbricated and smooth, with some interstitial granules. Dorsal scales of the first third of the tail are rhomboidal, imbricate, keeled and mucronate. Ventral scales the first third of the tail are lanceolate, smooth and imbricate. Lamellae of the fingers: I: 10, II: 14, III: 19, IV: 21 and V: 12. Lamellae of the toes: I: 10, II: 16, III: 22, IV: 28 and V: 15.

Color in life: The dorsal surface of the head has light brown color and the dorsum has yellowish light brown color, but there are several dark brown spots on the dorsal surface of the head, especially on the supraocular and occipital areas, which gives to the head a darker color compared to the dorsum. Temporal area, snout and cheeks are light brown color with few dark brown spots dispersed. The subocular scale is dark brown on the upper half and whitish in the bottom half. There is an inconspicuous narrow occipital stripe (running from the occiput to the base of the tail) formed by small dark brown spots.

There are 14 series of whitish transversal stripes on the dorsolateral field (running from the shoulder to the base of the tail), with dark brown spots on the anterior border. There is a dark brown lateral wide stripe, running from the temporal area to the groin, with few whitish stripes into it. The limbs are light brown, with dispersed dark brown spots. The tail has a light brown dorsal coloration, with marked dark brown rings. Ventrally, the throat, the belly, the limbs and the tail are light gray, with more dark shades on the middle of the belly. Inconspicuous yellowish color on the sides of the belly.

Variation
In four males: SVL: 77.6–91.3 mm. Axilla-groin distance: 30.8–32.1 mm. Axilla-groin distance: 30.8–32.1 mm. Head length: 17.4–20.7 mm. Head width: 14.0–16.3 mm. Head height: 8.1–11.3 mm. Leg length: 47.6–53.8 mm. Arm length: 26.0–31.2 mm. Foot length: 23.4–27.5 mm. Tail length: 128–154 mm (three specimens, autotomized in another). Tail length/SVL = 1.6–1.8. In two females: SVL: 85.2–89.0 mm. Axilla-groin distance: 35.6–39.1 mm. Head length: 18.5–19.1 mm. Head width: 15.8–16.4 mm. Head height: 7.9–11.2 mm. Leg length: 46.0–47.4 mm. Arm length: 29.2–29.9 mm. Foot length: 25.1–25.4 mm. Tail length: 140–145 mm (no autotomized), with relation tail length/SVL = 1.6–1.7. The juvenile has: SVL: 62.0 mm. Axilla-groin distance: 26.8 mm. Head length: 14.4 mm. Head width: 11.9 mm. Head height: 6.6 mm. Leg length: 36.9 mm. Arm length: 22.7 mm. Foot length: 21.1 mm. Tail length: 109 mm (not autotomized), Tail length/SVL = 1.8.

The variation in the scolation of the adult specimens is as follows. Midbody scales: 82–90 (84.0 ± 3.0). Dorsal scales: 71–76 (73.8 ± 1.7). Ventral scales 119–127 (122.3 ± 3.1). Fourth finger lamellae: 21–24 (23.0 ± 1.5). Fourth toe lamellae: 28–31 (29.2 ± 1.2). Supralabial scales: 6–8 (7.3 ± 0.8), the fifth curved upward. Infra-oral scales: 4–6 (5.0 ± 0.6). Interparietal scale subtriangular, pentagonal, hexagonal or heptagonal, bordered by 6–9 scales (7.0 ± 1.3). Interparietal and parietal scales have similar size. Nasal and rostral always separated by one scale. Precloacal pores in males: 3–4. Precloacal pores are absent in females.

Males and females have a similar color patterns compared with the holotype, with small variations on the shades. Some specimens have a fragmented dark brown vertebral line on the center (running from the occiput to the first third of the tail). One male has a sky-blue transversal stripes instead of whitish
stripes, which are placed all over the dorsal surface (trunk and tail), and also it is the only specimen with whitish dots dispersed on the head and limbs. Another male has light brown dorsal color with yellowish shade on the paravertebral fields. A female has light gray spots dispersed all over on the ventral surface. A specimen with autotomized tail has no dorsal pattern on the regenerated portion of the tail. Inconspicuous yellowish color on the cloaca, thighs and sides of the belly is present in both, some adult males (n = 2) and one adult female. Precloacal pores in the males are orange, but are discolored in alcohol. The juvenile has the same color described for the holotype, but has light gray spots dispersed all over on the ventral surface.

**Distribution and natural history**

Known only from the type locality in the O’Higgins Region, Chile: Alto Huemul (34°56’ S, 70°38’ W, Fig. 5). Specimens were found between 1790 and 1900 m asl. As in almost all species of the L. elongatus group (Morando et al., 2003; Avila et al., 2015; Troncoso-Palacios et al., 2018), L. pikunche is saxicolous and specimens were seen basking on medium to large rocks generated by the fragmentation of basaltic formations on the sides of the Claro River basin and its tributaries Los Nucos and Los Lagartos. On two occasions, we found a male near a female (few than five meters), with juveniles found approximately 20 meters away. The vegetation has been described as “lower-bush of the Chilean Mountain range” (Luebert & Pliscoff, 2006), the most abundant shrubs are Chaquiraga oppositifolia, Ephedra andina, Discaria trinervis and Berberis empetrifolia. The most abundant herbs are Festuca sp., Hypericum perforatum, Viguiera revoluta and Acaena sp. Some trees were found near the river: Maytenus boaria and Escallonia revoluta. Liolaemus pikunche is not an abundant lizard and few other individuals, apart from those collected, were seen. At the dates of capture (January and February, summer), females have no embryos but have several small oocytes. Liolaemus pikunche was found in syntopy with L. chilensis (Lesson, 1830), L. curicensis Müller & Hellmich, 1938, L. tenuis (Duméril & Bibron, 1837) and the snake Tachymenis chilensis (Schlegel, 1837), which may represent a predator. The variable hawk, Geranoaetus poliosoma (Quoy & Gaimard, 1834), was also seen and likely preys on L. pikunche, since this hawk usually preys on lizards in Andean habitats (Martínez-Piña & González-Cifuentes, 2017).

**Etymology**

The epithet “pikunche”, is a noun in apposition, from the Mapudungun language meaning “north people” (“pikun” = north; “che” = people). We named this species after the native Pikunche people of Central Chile (between Aconcagua and Biobío rivers) where we found this new species.

**DISCUSSION**

Although we have tentatively assigned L. pikunche to the L. elongatus group because it is found in the latitudinal range of this group and matches all the morphological and ecological features previously reported for these lizards (Abdala et al., 2010; Avila et al., 2015; Troncoso-Palacios et al., 2018), further DNA study is required to confirm this hypothesis. Liolaemus pikunche was previously confused with L. cristiani, which is a member of the L. chillanensis group (Troncoso-Palacios et al., 2018). As a consequence of our study, the distribution of L. cristiani is restricted to the Peine Mountain and Siete Tazas National Park of the Maule Region, Chile (Núñez et al., 1991; Castro-Pastene et al., 2015), and must not be listed for the O’Higgins Region as was suggested previously by Ramírez-Álvarez (2018). Additionally, it is possible that L. pikunche was referred to in two previous publications. Esquerré et al. (2014) mention two specimens (MNHNCL 4081–82) of “Liolaemus sp.” from Alto Huemul, type locality of L. pikunche, collected by H. Núñez, J.C. Torres-Mura and P. Henríquez in 2006. Later, Núñez and Gámez (2015) assigned those same specimens to L. ubaghsi, a member of the L. leopardinus group. Although we did not examine MNHNCL 4081–82 and no photographs of these specimens were published by either Esquerré et al. (2014) or Núñez and Gámez (2015), it is likely that both records refer to L. pikunche because we did not find another large Liolaemus in Alto Huemul. If indeed L. pikunche was confused with L. ubaghsi, this was probably because some similarities of the color pattern, size and shape (see Diagnosis section).

Given that several lineages have been proposed as candidate species of the L. elongatus group through molecular phylogenetic studies (Morando et al., 2003; Medina et al., 2017; Troncoso-Palacios et al., 2018) whose taxonomic status remains undetermined and that several additional species of the group have been recently described (Troncoso-Palacios et al., 2018; Ruiz et al., 2019a; this study), it is probable that the described diversity of this group of lizards will continue to increase in the coming years. For example, as was noted by Troncoso-Palacios et al. (2019), it is needed a deeper study to clarify the taxonomic status of the population of lizards that occur in Altos de Lircay, Maule Region, which has been listed with several names: L. monticola Müller & Hellmich, 1932, L. carlosgarini, L. sp. 1 and L. sp. Linxay (Pincheira-Donoso & Núñez, 2005; Escobar-Huerta et al., 2015a; Medina et al., 2017; Troncoso-Palacios et al., 2018, 2019). We hope that further studies help to clarify these issues.

**Acknowledgements.**- We thank P. Zavala (Pontificia Universidad de Católica de Chile) for allowing us to review and deposit
material into the collection under his care. We thank the following colleagues and institutions for allowing us to review specimens: H. Núñez (Museo Nacional de Historia Natural), and J.N. Artigas (Museo de Zoolobia de la Universidad de Concepción). To I. Salgado and F. Fadel for their help in the field. L. Abello for plants identification. C.S. Abdala and A. Laspur for sending literature. To I. Salgado and F. Fadel for their help in the field. L. Abello for plants identification. C.S. Abdala and A. Laspiur for sending literature. We thank to the two reviewers that helped us to improve this manuscript, especially for take their time to correct our manuscript under the current pandemic situation. J. Troncoso-Palacios thanks M. Penna (Programa de Fisiología y Biofísica, Universidad de Chile) for his support. We thank the Servicio Agrícola y Ganadero (SAG) its support with the field campaigns.

CITED LITERATURE


(Iguania: Liolaemidae) and description of a new species in the *Liolaemus elongatus* group. Zoological Studies 57:22.


**APPENDIX I**

**Specimens examined.** Museum codes are as follow: LCUC (Laboratorio de Citogenética, Facultad de Ciencias, Universidad de Chile), MNHNCL (Museo Nacional de Historia Natural, Chile), MRC (Museo Regional de Concepción), MZUC (Museo de Zoología de Universidad de Concepción) and SSUC (Colección de Flora y Fauna Patricio Sánchez Reyes, Pontificia Universidad Católica de Chile).


