Trabajo

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A new species of the *Liolaemus elongatus* group (Iguania: Liolaemidae)from Neuquén Province, Argentina, with comments on its genital morphology

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ABSTRACT

The *Liolaemus elongatus* group is a group of lizards that ranges from northwestern Argentina to the southern Patagonian steppe. In this study, we describe a new species of the *L. elongatus* group. The new taxon is distributed in the vicinity of *L. burmeisteri*, *L. crandalli*, *L. gununakuna*, *L. punmahuida* and *L. tregenzai*, and posseses a combination of unique character states and morphological characters that allows its formal description as a new species. The morphological evidence provides strong support that the population under study corresponds to a new taxon. With the description of the new species, the number of members of the *L. elongatus* group rises to twenty-two, but many populations likely represent undescribed species.

Key words: *Liolaemus*; Description; Patagonia; Taxonomy; Hemipenes.

RESUMEN

Una nueva especie del grupo *Liolaemus elongatus* (Iguania: Liolaemidae) de la provincia de Neuquén, Argentina, con comentarios sobre su morfología genital. El grupo de *Liolaemus elongatus* es un grupo de lagartijas que se distribuye desde el noroeste de Argentina al sur de las estepas patagónicas. En el presente estudio, describimos una nueva especie perteneciente al grupo de *L. elongatus*. El nuevo taxón se distribuye en cercanías de *L. burmeisteri*, *L. crandalli*, *L. gununakuna*, *L. punmahuida* y *L. tregenzai*, y la combinación de caracteres morfológicos en lepidosis y morfométricos permite describirla como nueva especie. La evidencia morfológica aporta un fuerte soporte que la población estudiada corresponde a un nuevo *Liolaemus*. Con la descripción de este nuevo taxón el número de especies del grupo de *L. elongatus* asciende a veintidós, aunque hay varias poblaciones que corresponden a especies no descritas.

Palabras clave: *Liolaemus*; Descripción; Patagonia; Taxonomía; Hemipenes.

Introduction

The genus *Liolaemus* Wiegmann, 1834 includes ~265 species (Abdala and Quinteros, 2014; Abdala *et al.,* 2016; Gutierrez *et al.,* 2018), of small to medium-size lizards, and it is the second most diverse amniote clade in the world, surpassed by *Anolis* Daudin, 1802 (*sensu* Poe, 2013). The works of Raymond Laurent (1983, 1985, 1995) split the genus into two main groups, later supported by Etheridge (1995), *Liolaemus* subgenus (*sensu stricto*) or "Chilean group", and subgenus *Eulaemus* or "Argentinian group", that ranges from west and east of the Andes. This split has been supported by many phylogenetic analyses based on both molecular and/or morphological evidence (Schulte *et al.,* 2000; Espinoza *et al.,* 2004; Pyron *et al.,* 2013; Olave *et al.,* 2014; Zheng and Wiens, 2016).

The subgenus *Liolaemus sensu stricto* has been the object of many phylogenetic studies, which proposed hypotheses recognizing several subgroups. Taking into account the proposals by Lobo (2005) and Díaz Gómez and Lobo (2006), within the *Liolaemus sensu stricto* subgenus, 12 monophyletic groups have been recovered (see also, Lobo *et al.,* 2010; Abdala and Quinteros, 2014). One of them is the *Liolaemus elongatus* group, which is distributed in central-south of Argentina and Chile, inhabiting rocky habitats. In the last 15 years, many new species that belong to this group were described (Abdala *et*

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al., 2010; Avila *et al.,* 2010, 2012, 2015; Troncoso *et al.,* 2016*,* 2018). The *L. elongatus* group was originally defined by Cei (1974) including three species: *L. elongatus* Koslowsky, 1896, *L. petrophilus* Donoso Barros and Cei, 1971, and *L. austromendocinus* Cei, 1974. Espinoza *et al.* (2000) redefined this group as including*: L. austromendocinus*, *L. capillitas* Hulse, 1979, *L. elongatus*, *L. heliodermis* Espinoza *et al.,* 2000, *L. petrophilus*, and *L. thermarum* Videla and Cei, 1996. Finally, Cei and Videla, (2003) placed *L. thermarum* in the *L. neuquensis* group, because it lacks precloacal pores, sharing this character state with: *L. coeruleus* Cei and Ortiz-Zapata, 1983*, L. cristiani* Núñez, Navarro and Loyola, 1991, *L. flavipiceus* Cei and Videla, 2003, and *L. neuquensis* Müller and Hellmich, 1939. *L. umbrifer* Espinoza and Lobo, 2003, *L. gununakuna* Avila, Morando, Perez and Sites*,* 2004 and *L. talampaya* Avila, Morando, Perez and Sites*,* 2004, *L. tregenzai* Pincheira-Donoso and Scolaro, 2007, *L. parvus* Quinteros, Abdala, Díaz Gómez and Scrocchi, 2008, *L. tulkas* Quinteros, Abdala, Gómez and Scrocchi*,* 2008 and *L. antumalguen* Avila, Morando, Perez and Sites*,* 2010, are included in the *L. elongatus* group which was composed at that time by eighteen species. The number of species increased with the descriptions of *L. choique* Abdala, Quinteros, Scrocchi and Stazzonelli, 2010, *L. shitan* Abdala, Quinteros, Scrocchi and Stazzonelli, 2010, *L. smaug* Abdala, Quinteros, Scrocchi and Stazzonelli, 2010, *L. burmeisteri* Avila, Perez, Medina, Sites and Morando, 2012, *L. carlosgarini* Esquerré, Nuñez and Scolaro, 2013, *L. riodamas* Esquerré, Nuñez and Scolaro, 2013, *L. crandalli* Avila, Medina, Perez, Sites and Morando, 2015, *L. scorialis* Troncoso-Palacios, Díaz, Esquerré and Urra, 2015, *L. zabalai* Troncoso-Palacios, Díaz, Esquerré and Urra, 2015, *L. lonquimayensis* Escobar-Huerta, Santibáñez-Toro and Ortiz, 2015, *L. janequeoae* Troncoso-Palacios, Diaz, Puas and Riveros-Riffo and Elorza, 2016 and *L. antonietae* Troncoso-Palacios, Esquerré, Urra, Díaz, Castro-Pastene and Ruiz, 2018. Several of these taxa were described following a classical species description approach, mostly based on few individuals from type locality, only a few included a phylogenetic hypothesis of the group or an explicit species concept and none an explicit delimitation method.

The *Liolaemus elongatus* group is formed by five clades. The *L. punmahuida* clade, which includes *L. punmahuida* and *L. flavipiceus*; it occupies a basal position with respect to the rest of the group. The *L. elongatus-petrophilus* clade, which includes three clades: the *L. kriegi*, *L. elongatus sensu stricto*, and *L. petrophilus* clades. The *L. kriegi* and *L. elongatus sensu stricto* clades were found to be sister clades (*L. elongatus-kriegi* clade hereafter). Within the *L. petrophilus* clade, we found the previously defined *L. capillitas* clade to be monophyletic group formed by: *L. capillitas*, *L. dicktracyi* Espinoza and Lobo, 2003, *L. heliodermis*, *L. talampaya*, *L. tulkas*, and *L. umbrifer*. In this work, the phylogenetic hypotheses followed to address the description are those proposed by Lobo *et al*. (2010), Avila *et al*. (2015), Medina *et al*. (2018) and Troncoso *et al*. (2018).

Hemipenial morphology varies extensively among squamate taxa, from cylindrical tubes to deeply bilobed structures ornamented with calyces, papillae, flounces, and spines (Dowling and Savage, 1960), and thus has been used extensively for systematic studies on snakes (Dowling and Duellman, 1978; Zaher, 1999; Myers and Donnelly, 2001; Schargel and Castoe, 2003; Schargel *et al.,* 2005) and to a lesser extent in lizards studies (Arnold 1983, 1986; Böhme, 1988; Köhler *et al.,* 2012; Nunes *et al.,* 2012; Klaczko *et al.,* 2015).

The reports of hemipenial morphology for liolaemids had been limited to descriptions of the structure and variation of the hemipenes by Böhme (1988), Cei (1986, 1993) and Lobo (2000). However, Quipildor *et al.,* (2018) recently reported on the hemipenial morphology of forty-two species in the *Liolaemus* genus, and they found differences between the subgenera as well as within the clades of each subgenus.

In this work we describe a new species of the *Liolaemus elongatus* group which inhabits the Añelo Department in the northeast of the Neuquén Province, Argentina. In addition, we incorporate a detailed description of its hemipenial morphology.

Material and methods

We studied 167 specimens representing sixteen species of the *Liolaemus elongatus* group (*sensu* Medina *et al*., 2018). This study was conducted in accordance with international standards on animal welfare, as well as being compliant with national regulations and the "Comité Nacional de Ética en la Ciencia y la Tecnología" of Argentina. Individuals were collected by hand or noose, euthanized with sodium Pentothal 1%, fixed in 10% formalin, and preserved in 70% ethanol. These steps were approved by the ethical committee of the Foundación Miguel Lillo (FML),

considering animal welfare laws. Field studies did not involve endangered species. We studied the morphological characters commonly included in *Liolaemus* taxonomy, such as described in Laurent (1985), Etheridge (1993, 1995, 2000) Cei (1986), Lobo (2001, 2005) Abdala (2007), and Quinteros (2013). Color pattern follow Lobo and Espinoza (1999) and neck folds follow Frost (1992). The description of colours in life was made in the field and based on photographs taken right after capture. Observations of squamation and body measurements were obtained using a binocular dissecting microscope (10-40×) and a precision calliper (0.01 mm). Specimens studied are listed in Appendix 1.

Hemipenies

We followed the Zaher and Prudente (2003) protocol for preparing snake organs. One hemipenis was removed from each specimen through a small incision at the base of the tail. The removed organ was immersed in a 2% KOH solution for 3–5 min or until it became translucent and flexible. The hemipenis was checked and everted manually using forceps to be sure that the whole hemipenis was completely everted. Once fully everted, the organ was filled with colored vaseline to allow better visualization of ornamentation structures. We obtained digital images of hemipenes in sulcate, asulcate, and lateral view using a camera (Olympus® DP25) attached to a stereomicroscope. Terminology of hemipenial character states follow that of Quipildor *et al.* (2018).

Results

Liolaemus quinterosi sp. nov.

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Holotype

FML 30505. Provincial Road Nº 7,24 Km to the North of Añelo (38°13'51.00"S; 68°57'13.70"W, 265 m a. s. l.), Añelo Departament, Neuquén Province, Argentina. Abdala C., Chafrat P., Bulacios A., Valdez J. cols. November 28, 2016.

Paratypes

FML 30504; FML 30506-08. Provincial Road Nº 7,24 Km to the North of Añelo (38°13'51.00"S; 68°57'13.70"W, 265 m a. s. l.), Añelo Departament, Neuquén Province, Argentina. Abdala C., Chafrat P., Bulacios A., Valdez J. cols. November 28, 2016. MPCN-H 436-38: Aguada Pichana (38°25'43.70"S; 69°09'31.3"W) Añelo Departament, Neuquén Province, Argentina. Chafrat P., Planchar A., Ubieta D., Retamal L. cols.

Etymology

The specific epithet *quinterosi* is in honor of Dr. Andrés Sebastián Quinteros, in recognition of his contribution to the knowledge in this genus for more than 13 years getting valuable taxonomic and systematic contributions, and for his participation in the description of 15 new species of *Liolaemus*.

Diagnosis

Liolaemus quinterosi sp. nov. is a member of the *L. elongatus* group (*sensu* Lobo *et al*., 2010, Avila *et al*., 2015, Medina *et al*., 2018; Troncoso *et al*., 2018), for its body shape, pattern of coloration, lepidosis and the distinctive ringed tail.

Lioleamus quinterosi sp. nov. differs from other species of the *L. elongatus* group in the number of scales around midbody, being higher in *L. quinterosi* (70–78) than *L. capillitas* (58–67), but lower than *L. antonietae* (86–98), *L. buergeri* (85–110), *L. carlosgarini* (86–95), *L. ceii* (85–110), *L. crandalli* (77–92), *L. cristiani* (83–89), *L. frassinettii* (85–92), *L. gununakuna* (84–97), *L. janequeoae* (82–98), *L. kriegi* (85–110), *L. lonquimayensis* (89–90), *L. riodamas* (80–93), *L. thermarum* (84–89) and *L. zabalai* (90–104). Moreover, specimens of *L. quinterosi* (Max. SVL=88.07) are smaller than specimens of *L. antumalguen* (Max. SVL=107.80), *L. crandalli* (Max. SVL=93.4), *L. gununakuna* (Max. SVL=97.5), *L. tregenzai* (Max. SVL=90.2), and *L. zabalai* (Max. SVL=90.3), but larger than specimens of *L. antonietae* (Max. SVL=77.6), *L. burmeisteri* (Max. SVL=85.2), *L. carlosgarini* (Max. SVL=68.80), *L. janequeoae* (Max. SVL=69.6), *L. lonquimayensis* (Max. SVL=69.7), *L. scorialis* (Max. SVL=69.9) and *L. smaug* (Max. SVL=71.30). Males of *L. quinterosi* (SVL=78.81–88.07 mm) are larger than males of *L. carlosgarini* (SVL=61.25–65.35 mm), *L. cristiani* (SVL=62.60–78.20 mm), *L. janequeoae* (SVL=69.90 mm), *L. parvus* (SVL=57.12–65.08 mm), *L. scorialis* (SVL=57.40–69.90 mm), *L. smaug* (SVL=50.40–71.25 mm) and *L. tulkas* (SVL=56.32–70.14 mm). Females of *L. quinterosi* (SVL=76.44–81.48 mm) are smaller than females of *L. antumalguen* (SVL=84–101.6 mm), *L. choique* (SVL=116.2 mm), but are higher than females of *L. carlosgarini* (SVL=53.46–68.80 mm), *L. janequeoae* (SVL=65.30 mm), *L. parvus*

(SVL=55.77–64.80 mm), *L. scorialis* (SVL=57.30–65.60 mm) and *L. tulkas* (SVL=60.25–69.35 mm).

Number of supralabials in *L. quinterosi* (6–8) is higher than *L. tregenzai* (4). Loreolabials in *L. quinterosi* (8–10) are higher than *L. lonquimayensis* (4–6), *L. cristiani* (6–7) and *L. tulkas* (6–7). Number of temporal scales in *L. quinterosi* (11–12) is higher than *L. choique*, *L. dicktracyi, L. heliodermis*, *L. lonquimayensis, L. parvus*, *L. shitan*, *L. smaug*, *L. umbrifer*, and *L. tulkas* (7–10). Surface of temporal scales is slightly keeled in *L. quinterosi*, differing from *L. tulkas* where temporal scales are smooth. Scales of dorsum in *L. quinterosi* are rhomboidal, distinguishing it from *L. ceii*, *L. cristiani, L. parvus*, *L. riodamas*, and *L. umbrifer* (rounded dorsal scales). Dorsal scales in *L. quinterosi* show a strong keel, differing from *L. ceii*, *L. cristiani*, *L. heliodermis, L. riodamas*, *L. thermarum*, and *L. umbrifer* (dorsals with a slight keel). In *L. quinterosi* scales of tail dorsally are laminar, strongly keeled, and mucronated, whereas in *L. cristiani* they are laminar, mucronate, and slightly keeled. Number of gular scales in *L. quinterosi* (35–41) is lower than *L dicktracyi, L. heliodermis*, and *L. umbrifer* (47–66). Number of neck scales in *L. quinterosi* (39–47) is lower than *L. tulkas* (49–58).

Number of scales from posterior margin of auditory meatus to antehumeral fold in *L. quinterosi* (26–35) is lower than in *L. heliodermis* (39–41). Number of scales of dorsum in *L. quinterosi* (66–79) is lower than in *L. gununakuna* (85–103), *L. kriegi* (87–110), and *L. zabalai* (86–96), but higher than in *L. heliodermis* (62–65). Number of ventrals in *L. quinterosi* (104–112) is higher than in *L. talampaya* (86–96), but lower than in *L. antonietae* (118–131), *L. choique* (118–134), *L. crandalli* (125–139), *L. elongatus* (119–129), *L. janequeoae* (124–132), *L. scorialis* (115–131), *L. shitan* (120–132), *L. smaug* (119–131), and *L. zabalai* (116–122).

Liolaemus quinterosi sp. nov. differs from all members of the *L. capillitas* group (*sensu* Lobo 2005): *L. capillitas*, *L. dicktracyi*, *L. heliodermis*, *L. umbrifer*, *L. talampaya*, and *L. tulkas,* (Lobo *et al.*, 2010) due to the absence of red coloration in the cloacal region and the absence of white spots on the shoulder (synapomorphies of the group *sensu* Lobo 2005). Sexual dichromatism is evident in *L. quinterosi*, differing from *L. austromendocinus, L. burmeisteri, L. carlosgarini*, *L. choique, L. crandalli*, *L. elongatus, L. gununakuna*, *L. lonquimayensis*, *L. parvus*, *L. petrophilus, L. punmahuida, L. riodamas, L. scorialis, L. thermarum* and *L. tulkas* (absence of sexual dichromatism). Cloacal region in males of *L. quinterosi* is yellowish, while females present a gray coloration, distinguishing it from *L. flavipiceus* (red or with orange or red spots), *L. tregenzai* (bluish green), *L. buergeri* and *L. kriegi* (reddish). The dorsum of males *L. quinterosi* show a pattern of dark spots along the vertebral line, but females shows light scales, differing from *L. burmeisteri, L. choique, L. janequeoae*, *L. punmahuida*, and *L. shitan* (absence of these stripes and lines).

Description of the holotype

Adult male. SVL 88.07 mm. Head length 20.56 mm. Head width 16 mm. Head height 10.30 mm. Subocular length 6.50 mm. Auditory meatus taller (3.22 mm) than wide (2.06 mm). Interorbital distance 8.62 mm. Trunk length 32.02 mm. Humerus length 8.71 mm, radio length 9.30 mm, and manus 12.43 mm. Femur length 15.39 mm, tibia length 14.89 mm, and foot length 21.74 mm. Base of tail width 10.55 mm.

Dorsal surface of the head smooth, with 17 scales. Nasal not in contact with rostral, surrounded by six scales, and separated from canthal by two scales. Six scales between frontal and superciliaries. Seven superciliaries. Frontal divided into two scales. Interparietal smaller than parietals, in contact with six scales. Semicircles incomplete. Five supraoculars. Preocular separated from lorilabial row by one scale. Twelve slightly keeled temporals. Eight lorilabials, six of them in contact with subocular. Eight supralabials, fourth upturned but not in contact with subocular. Seven infralabials, the second in contact with four scales. Four scales in contact with mental. Five posmental scales.

Seventy scales around midbody. Seventy-eight scales between occiput and hind limbs. Dorsal scales rhomboidal, laminar, imbricated, and keeled dorsal. Forty-one granular and smooth neck scales. Thirty-three scales between posterior margin of auditory meatus and antehumeral fold. Antehumeral, auricular and longitudinal folds evident. Thirty-eight gulars. One hundred and five ventrals. Seventeen pygals. Precloacal pores absent. Fourth finger with twenty-four subdigital lamellae, and fourth toe with twenty-eight subdigital lamellae. Dorsal tail scales laminar with mucron and keel.

Color of the holotype in life

Head brown with irregular dark spots in dorsum and lateral. Dorsal background coloration brown,

with dark spots in vertebral region. Vertebral region formed by dark scales forming spots. Paravertebral region brown and lateral fields have the same pattern paravertebral. Fore and hind limbs brown, speckled with dark spots. Ventrally, limbs are lead gray. Throat, chest and belly lead gray. Mental and posmental region with black spots. Cloacal region yellowish. Tail dorsally brown with faded light brown ringed pattern. The proximal region of tail, as a continuum of vertebral line, point shaped spots are evident. Ventrally, the tail is lead gray.

Color of the holotype in ethanol

Head brown, with black spots. Longitudinal black lines from posterior region of eye to upper margin of auditory meatus are evident. Dorsal background of body light brown with multiple white scales. Vertebral region defined by dark brown lines almost longitudinal. Paravertebral region lighter brown than the flanks. Fore and hind limbs dorsally the background color is light brown with dark brown lines, ventrally dark gray. Throat light brown with darker lines with almost longitudinal direction. Chest and belly light brown with some light scales. Tail dorsally light brown with faded ring pattern. Tail, ventrally lighter brown.

Variation

Based on eight specimens (five males and three females): males SVL 78.81 to 88.07 ($\overline{X}$= 84.56; SD=5.02) and, females 76.44 to 81.48 ($\overline{X}$=78.96; SD=3.56). Supralabials 6–8 ($\overline{X}$=7.20; SD=0.83). Infralabials 5–7 ($\overline{X}$=5.80; SD=0.83). Lorilabials 8–10 ($\overline{X}$=8.80; SD=0.83). Temporals 11–12 ($\overline{X}$=11.40; SD=0.54). Number of scales surrounding nasal by 5–7($\overline{X}$=6.4; SD=0.89). Two scales between canthal and nasal ($\overline{X}$=2.00; SD=0.00). Hellmich index 14–17 ($\overline{X}$=15.60; SD=1.34). Gulars 35–41 ($\overline{X}$=38.20; SD=2.38). Scales around midbody 70–78 ($\overline{X}$=73.40; SD=3.43). Scales between posterior margin of auditory meatus to antehumeral fold 26–35 ($\overline{X}$=30.80; SD=3.49). Neck scales 39–47 ($\overline{X}$=42.00; SD=3.46). Dorsals 66–79($\overline{X}$=73.00; SD=5.61), rhomboidal and keeled between occiput and limbs. Ventral scales 104–112 ($\overline{X}$=108.00; SD=3.80). Precloacal pores absent in all males and females. Sexual dichromatism evident (Fig. 1). In both, head brown with irregular dark spots in dorsum and lateral. In males, dorsal background coloration brown, with dark spots in vertebral region. In females, dorsal background coloration brown, with many white scales. Vertebral region formed by dark scales forming spots in males. In females, the vertebral region includes dark

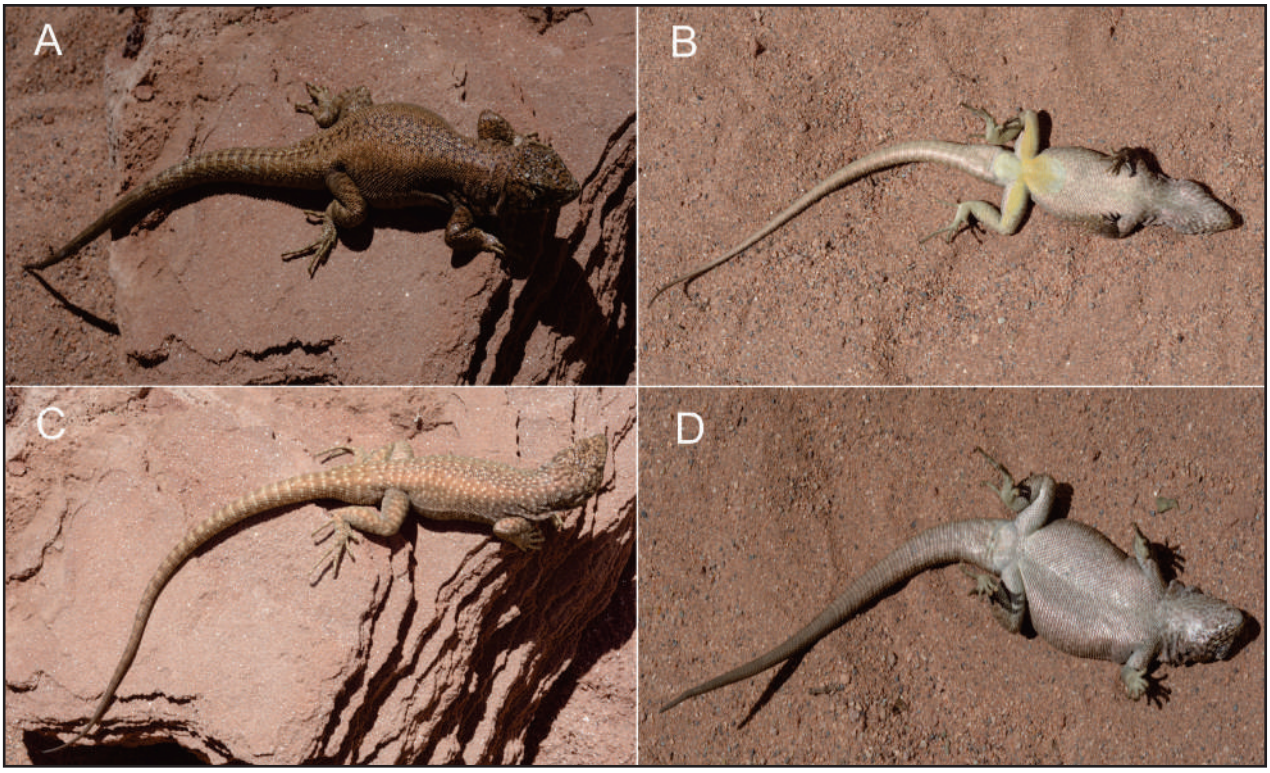

Figure 1. Color in life of *Liolaemus quinterosi* sp. nov. A: Dorsal view of a male. B: Ventral view of a male. C: Dorsal view of a female. D: Ventral view of a female.

spots and scales white. Paravertebral region brown in both but speckled with white scales in females. Lateral fields have the same pattern paravertebral corresponding to each sex. Fore and hind limbs brown, speckled with dark spots in both, but also with white scales in females. Ventrally, limbs are lead gray. Throat, chest and belly lead gray. Mental and posmental region with black spots. Cloacal region gray in females and yellowish in males. In both, tail dorsally brown with faded light brown ringed pattern. In males, the proximal region of tail, as a continuum of vertebral line, point shaped spots are evident. Ventrally, the tail is lead gray in both.

Distribution

All known specimens and observations of *Liolaemus quinterosi* sp. nov. are from the northeast of the Neuquén Province, in the Patagonian region of the Argentina (Fig. 2).

Natural History

The type locality of *Liolaemus quinterosi* sp. nov. is in an extensive endorheic depression of approximately 280 Km^2 known locally as the Bajo of Añelo, with a flat bottom whose average elevation is approximately 225 m a.s.l. Most specimens were found at an elevation of 268 m a.s.l. Wind erosion plays a very important role in the origin of this basin, in addition to a tectonic sinking process (Holmberg, 1978). From the geological point of view, the deep sediments underlying the Añelo region would have been deposited in an environment of coastal marine sedimentation (Uliana and Dellape, 1981).

The area is characterized by aridity and scarce but torrential rains, which create a soil moisture deficit and a typical vegetation of the Monte phytogeographic region (Cabrera, 1971). The vegetation at the type locality includes *Atriplex zampa, Sporobolus rigens*, *Larrea divaricata*, *Prosopis flexuosa* var. *depressa*, and *Neosparton darwinii* (Fig. 3).

Along with *Liolaemus quinterosi* sp. nov. are other species of lizards such as, *Liolaemus cuyumhue*, *Liolaemus gracilis*, *Liolaemus mapuche*, *Liolaemus*

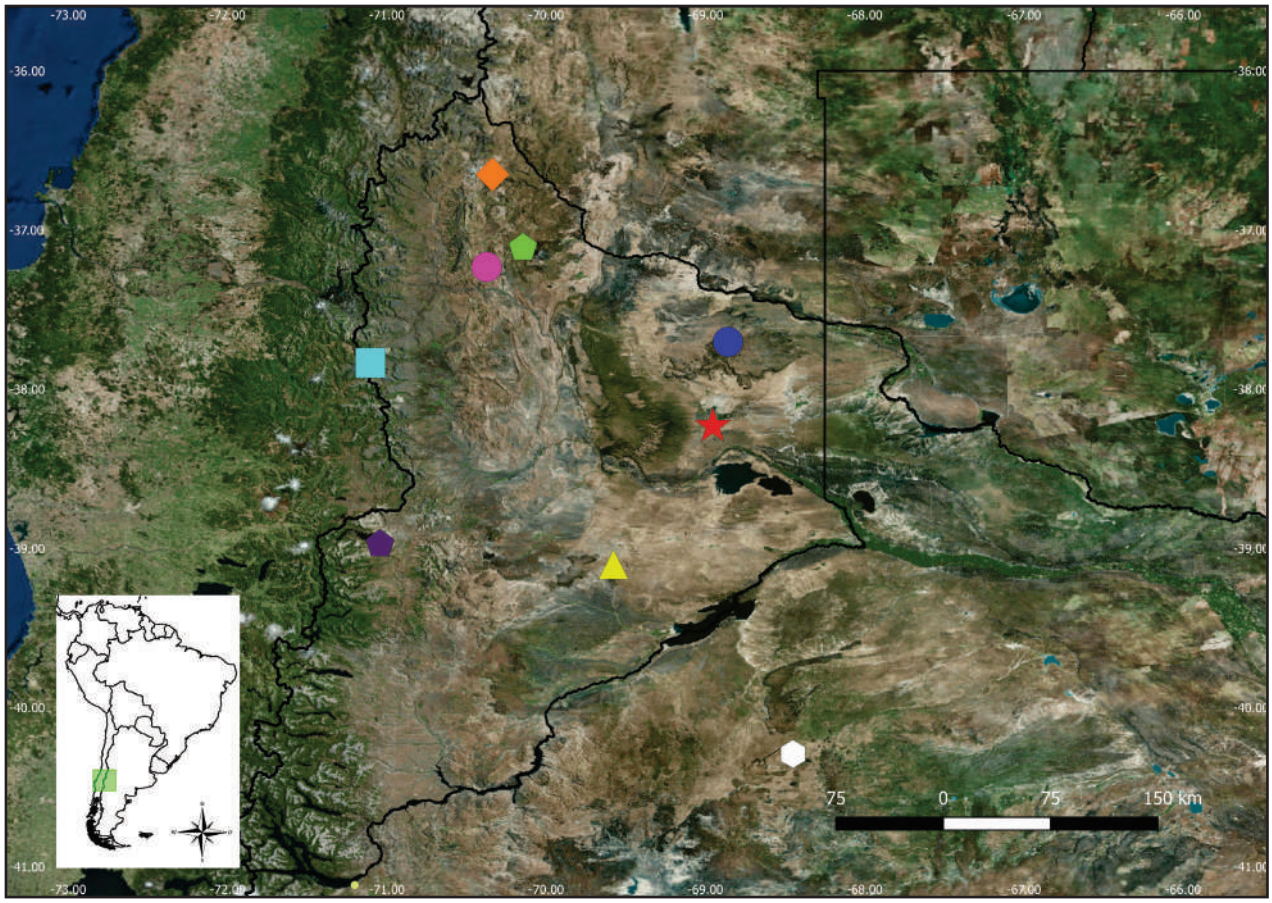

Figure 2. Map showing the distribution of the new species and some species close distributed. Red star: *Liolaemus quinterosi* sp. nov. Blue circle: *Liolaemus crandalli*. Pink circle: *Liolaemus burmeisteri*. Light blue square: *Liolaemus tregenzai*. Green pentagon: *Liolaemus punmahuida*. Violet pentagon: *Liolaemus ceii*. White hexagon: *Liolaemus shitan*. Orange diamond: *Liolaemus antumalguen*. Yellow triangle: *Liolaemus gununakuna*.

Figure 3. Habitat and type locality of *Liolaemus quinterosi* sp. nov. in the Bajo of Añelo.

grosseorum, Aurivela longicaudus, Leiosaurus belli, Homonota fasciata, and *Homonota darwinii.*

According to observations in the field, they do not utilize microhabitats with sandy substrates; rather they are restricted to rock outcrop microhabitats. However, additional fieldwork is needed to explore other apparently suitable habitats in the area. This new species lives in a region subject to intensive hydrocarbon exploration and production, which suggests some potential impact, given the construction of roads and oil infrastructure that is observed in the area.

Hemipenis morphology

The hemipenis of *Liolaemus quinterosi* sp. nov. are cylindrical with a shell-shaped apex (Fig. 4). The asulcate and sulcate faces have calyces. Asulcate face has diffuse calyces, homogenously distributed along the distal region of the organ, as well as a hump-shaped protrusion. Sulcate face has regular calyces, a narrow and open sulcus spermaticus, bifurcated at the base of distal lobes of the hemipenis. Apical lobes are conspicuously delimited.

Discussion

In recent years, the number of species that compose the *Liolaemus elongatus* group has markedly increased as new species have been described (Abdala *et al.,* 2016; Medina *et al.,* 2017; Troncoso *et al.,* 2016; Troncoso *et al.*, 2018; Gutierrez *et al*., 2018). Every year, the available molecular information on the species that comprise it has also increased (Avila *et al.,* 2015, Escobar Huerta *et al.,* 2015; Troncoso *et al.,* 2015; Troncoso *et al.,* 2018). However, the information on morphology has lagged behind, which accentuates the importance of the information provided by morphological diagnoses.

The recognition of *Liolaemus quinterosi* sp. nov. as a new taxon is well supported by the set of meristic, lepidosis and coloration characters presented in our study. *L. quinterosi* lives in sympatry with other species of the *L. elongatus* group (*L. crandalli* and *L. austromendocinus*). However, meristic, lepidosis and coloration characters differentiate them (see diagnosis). To these differences, we add the altitude at which we find these species: *L. quinterosi* sp. nov. at 225 masl, *L. crandalli* at 1560 m a. s. l. (Avila *et al*., 2015) and *L. austromendocinus* with a range of elevation from 900 to 2310 m a. s. l. (Espinoza *et al*., 2000).

The phylogenetic location of *Liolaemus quinterosi* sp. nov. within the *L. elongatus* group remains unknown and the morphological character states are ambiguous in this respect. Although, *L. quinterosi* sp. nov. presents a dorsal pattern of white scales, character that it shares with species of the *L. kriegi* clade, it also presents rhomboidal dorsal scales with a well-defined keel, while most species of the *L. kriegi* clade have more rounded dorsal scales and a weakly

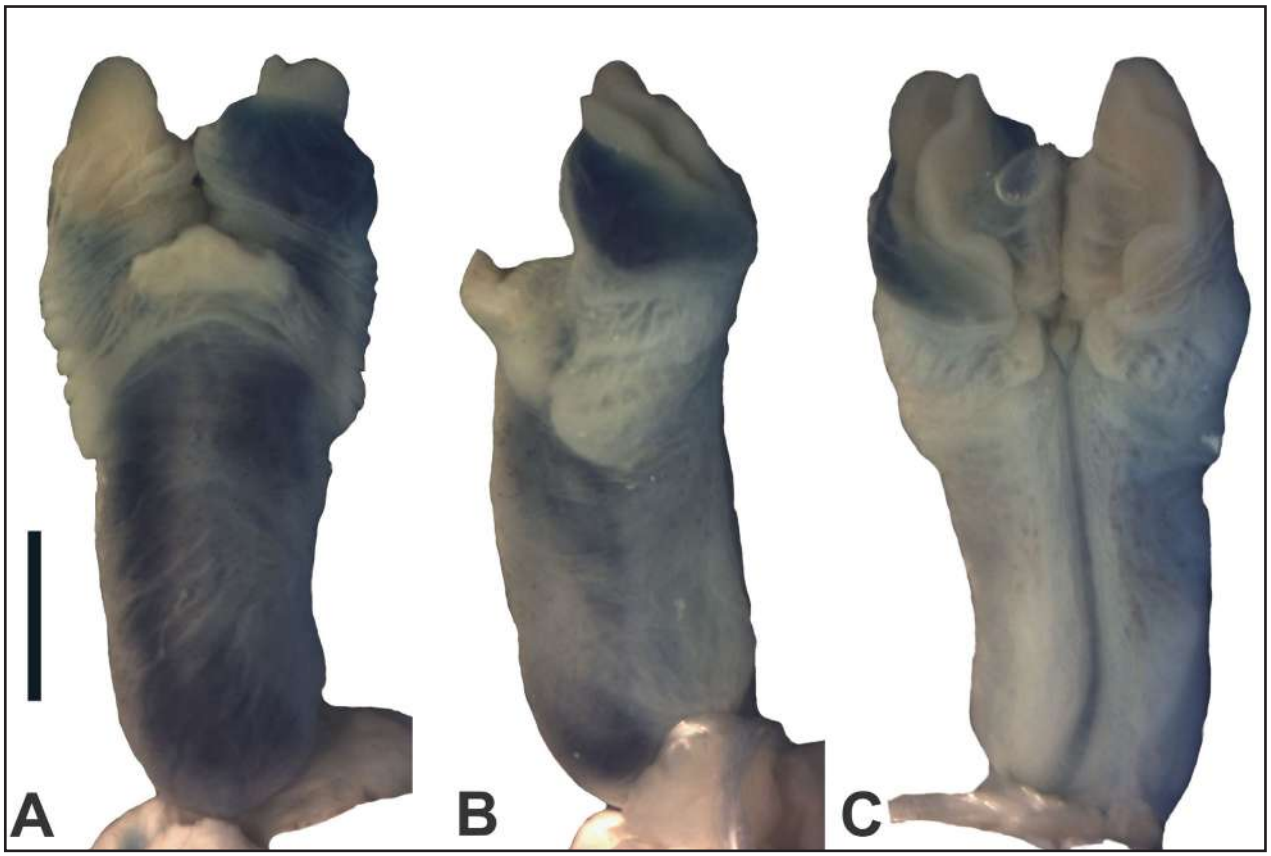

Figure 4. Hemipenial morphology of *Liolaemus quinterosi* sp. nov. A: Asulcate face. B: Lateral face. C: Sulcate face. Scale= 2 mm.

marked keel. *L. quinterosi* sp. nov. also has a marked vertebral pattern, with transverse spots and the typical dorsal scales of the *L. elongatus* clade. Therefore, a formal phylogenetic analysis is needed to resolve the phylogenetic position of this new taxon.

Regarding the description of the reproductive structure of *Liolaemus quinterosi* sp. nov. the general morphology is similar to that observed for species of the Chilean group (*Liolaemus sensu stricto*) by Quipildor *et al.* (2018). *L. quinterosi* sp. nov. presents chalices in the sulcate and distal margin of the elongated apex. This is in accordance with what was observed by Quipildor *et al.* (2018) for species of the *L. elongatus* group, since the apex is shaped like a leaflet, chalices with smooth edges and the ornamentation is distributed in the upper third of the organ. Within the group of *L. elongatus*, *L. kriegi* (*L. kriegi* clade) is the species that is geographically closest to *L. quinterosi* sp. nov. that has been described in Quipildor *et al.* (2018). However, the morphology of the copulatory organ of *L. quinterosi* sp. nov. is more similar to that observed for *L. austromendocinus* (*L. petrophilus* clade), since its chalices are not fleshy, have a hump on the asulcate face, and the shell-shaped apex is elongated.

Notably, the type locality of *Liolaemus quinterosi* sp. nov. is in an area of extreme importance for the economic future of Argentina. The Añelo basin is located within the Vaca Muerta Formation (Weaver, 1931), one of the most important shale oil gas reservoirs in the world and occupying the territory of the Argentine provinces of Neuquén, Rio Negro, La Pampa and Mendoza (Leanza *et al.*, 2011). It is one of the pillars on which Argentine policy aims to rest on to recover its economy. Nevertheless, when exploiting this basin, the habitat of *L. quinterosi* sp. nov. could be damaged, which to date is only known for its type locality.

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Appendix 1

Specimens examined. The acronym follows Leviton *et al.* (1985) except for MCN (Museo de Ciencias Naturales de la Universidad Nacional de Salta, Argentina).

Liolaemus austromendocinus. MCN 604-609. Mendoza: Malargüe (35°45'30.8'' S; 69°34'7.4'' W); FML 3432-433 (35°46'10.4" S; 69°38'46.8" W), 7189-191 (35°09'37.4" S: 69°52'09.0" W), 7240-243. 47 Km S de Malargüe (35°45'04.0" S; 69°34'49.0" W).

Liolaemus buergeri. FML 7192-195. Mendoza: Los Molles (35°09'24.0" S; 69°56'22.5" W); MCN 501-502. Las Leñas: Valle Hermoso (35°08'49"S; 70°11'59"); MCN 2023-2024. Las Loicas: Rio El Gancho (35°47'11.22" S; 70°05'21.33" W); MCN2188. San Rafael (35°28'18.27" S; 68°38'46.10" W).

Liolaemus capillitas. FML 1229, 2427. Catamarca: Andalgalá: Minas Capillitas (27°20'15" S; 66°23'6" W); FML 1316. Arroyo La Carrera (27°37'12" S; 66°7'18" W); FML 2029. Morro En Arenal: El Ingenio (27°15'21" S; 66°12'20" W); FML 3083-084. Belén: Laguna Blanca (26°36'10" S; 66°55'3" W); FML 1914, 1933. Tinogasta: La Ciénaga: Campo el Potrerito (27°21'5" S; 67°20'19").

Liolaemus choique. FML 22453 (Holotype), FML 22452, 22454-58 (Paratypes). Mendoza: Malargüe: Paso El Choique: Provincial Road 221 (36°19'11.8"S; 69°48'31.1"W).

Liolaemus dicktracyi. FML 9928 (Holotype), FML9929-33 (Paratypes), MCN 461-62(Paratypes). La Rioja: Famatina: Portezuelo Blanco (28°54'30" S; 67°41'30" W).

Liolaemus elongatus. FML 1606 (43°51'52" S; 69°2'38'' W). Chubut: Paso de Indios; FML 2112 (44°3'3" S; 70°35'55" W). Tehuelches: Gobernador Costa; FML 13070 (45°42'40,5"S; 70°15'49,2"W). Nacional Road 40; FML 13071. Rio Senguer: Provincial Road 20 (44°12'08,2"S; 70°26'44,6"W).

Liolaemus gununakuna. FML 12717 (Holotype), FML12718-20 (Paratypes). *Neuquén: Zapala: 2 Km al SE de la Amarga (*39°06'39" S; 69°34'09" W) FML 13043-44(Paratypes). Bosque Petrificado (39°07'32" S; 69°39'17" W).

Liolaemus heliodermis. FML 7196(Holotype), 6006-07 (Paratypes). Tucumán: Tafí del Valle: Provincial Road 307.

Liolaemus parvus. FML 16548 (Holotype), 16546-547, 16549 (Paratypes). *La Rioja: General Sarmiento (*28°29'24,3" S; 68°49'45,3" W); FML 2737. Agua Quemada (28°30'27" S; 68°47'11" W); FML 2965: Quebrada del Leoncito (28°27'53" S; 68°50'22" W); FML 2593 (Paratypes). Mendoza: Las Heras: Nacional Road 7 (32°02'09''S; 69°06'35'' W); FML 16121-125(Paratypes). San Juan: Jáchal: El Peñón (29°41'28,9" S; 68°48'39,3" W).

Liolaemus petrophilus. MCN 1346-347. Chubut: Paso de Indios (43°43'08.00"S; 69°04'45.54"W); FML 793. 10 Km S del Puesto Espinel (42°11'52.71"S; 67°03'01.61"W); FML 10074. Rio Negro: 25 de Mayo: 31.8 Km N de Intersección de RN 40 y RP 6 (41°37'33"S; 70°40'20"W).

Liolaemus quinterosi. CSA 2107-110. Neuquén: Provincial Road Nº 7,24 Km al North of Añelo (38°13'51.00"S 68°57'13.70"W, 265 m).

Liolaemus shitan. FML19276 (Holotype), FML 19277 – 283, FML23832-836 (Paratypes). Rio Negro: 25 de Mayo: Estancia Piedras Blancas; FML 13060-61, 8573. Provincial Road 8 (40°17'17,8"S; 68°27'26,9"W).

Liolaemus smaug. FML 22449(Holotype); FML 22444 –448 (Paratypes), FML 23817-18 (Paratypes), FML 22451(Paratype). FML 7216-18. *Mendoza:* Malargüe: Provincial Road 186; Laguna Niña Encantada (35°39'51,3"S, 70°12'00,9"W).

Liolaemus talampaya. MCN 2031-036. La Rioja: PN Talampaya (29°44'08.38"S; 67°45'11.07"W).

Liolaemus tulkas. FML 18316 (Holotype). FML 18317-321(Paratypes). Catamarca: Tinogasta: Road to Paso San Francisco (27°43'12,8" S; 66°58'33,4"W).

Liolaemus umbrifer. FML 9934 (Holotype), FML 9935-45 (Paratypes), MCN463-464 (Paratypes). MCN 488-89. Catamarca: Antofagasta: Provincial Road 43; Tinogasta: Chaschuil (26°51'27"S; 66°44'48"W); MCN 2185-2187. Entre Fiambalá y Cazadero Grande (27º 43' 11.6"S; 68º 08' 29.5" W).