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A new species of lizard of the *Liolaemus elongatus* clade (Reptilia: Iguania: Liolaemini) from Curi Leuvu River Valley, northern Patagonia, Neuquén, Argentina

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Abstract

A new species of the Andean-Patagonian *Liolaemus elongatus* clade is described. *Liolaemus burmeisteri* **sp. nov.** differs from other members of its clade in a character combination of light brown general coloration, plain dorsal pattern, dark lateral areas, a very bright orange-yellow coloration on femoral area and lower belly, and other morphological and genetic traits. It is distributed on a restricted area on sedimentary rocky outcrops found in an intermountain valley. *Liolaemus burmeisteri* **sp. nov.** is known only for its type locality in Curi Leuvu River Valley in northwestern Patagonia above 1037 m. A mitochondrial DNA gene tree analysis found this new species as the sister taxon of *Liolaemus smaug*.

Key words: Argentina; Liolaemidae; *Liolaemus burmeisteri* **sp. nov.**; *Liolaemus elongatus* clade; Northwestern Patagonia

Resumen

Se describe una nueva especie de saurio andino-patagónica del clado *Liolaemus elongatus*. *Liolaemus burmeisteri* **sp. nov.** se diferencia de otros miembros del clado por una combinación de caracteres incluyendo una coloración general del cuerpo marrón clara, un patron dorsal homogéneo, una coloración amarillo-naranja muy brillante en la región femoral y parte baja del vientre y otros rasgos morfológicos y genéticos. Tiene una distribución geográfica restringida a afloramientos de rocas sedimentarias encontradas en un valle intermontano. *Liolaemus burmeisteri* **sp. nov.** se conoce sólo para su localidad tipo en el valle del río Curi Leuvu en el noroeste de la Patagonia por encima de 1037 m. Un arbol génico basado en ADN mitocondrial encontró a esta nueva especie como el taxon hermano de *Liolaemus smaug*.

Palabras Claves: Argentina; Liolaemidae; *Liolaemus burmeisteri* **sp. nov.**; clado *Liolaemus elongatus*; Noroeste Patagónico

Introduction

In 1896, Julio Koslowsky, one of the early explorers and naturalists of Patagonia, described a saxicolous lizard species from the western slopes of the southern Andes as *Liolaemus elongatus* (Koslowsky 1896). At that time it was very hard to obtain geographic references for some areas of Patagonia, a region recently occupied and explored by the Argentinean government; thus the type locality was indicated by Koslowsky as "Territorio del Chubut, cerca de las Cordilleras" and he did not assign an holotype specimen. More than 70 years had past after the original description when Donoso-Barros and Cei (1971) described *Liolaemus petrophilus* as a subspecies of *Liolaemus elongatus* and a few years later, Cei (1974) made the first revision of the group describing a new related species, with some variation in size and coloration between populations, and extending its geographic range from northern Mendoza to southern Chubut. A few years later some similar looking populations of *Liolaemus elongatus* were cited for north-

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ern San Juan by Cei *et al*. (1983), and finally cited for western Catamarca by Avila and Lobo (1999), the northernmost record for lizards of this clade. This vast geographic distribution along the western slopes of Cordillera de los Andes surely harbored more than one species, as was discovered in phylogenetic and phylogeographic studies carried out by Morando *et al*. (2003) and Morando (2004), who restricted the distribution of the *elongatus* clade (referred to as *elongatus* group) from Chubut to Mendoza provinces; and several potential new species became formally nominated. The previously named *Liolaemus elongatus-kriegi* complex (Cei 1979; Morando *et al*. 2003), includes now three clades: *petrophilus*, *kriegi*, and *elongatus*. As currently known, the *elongatus* clade includes *L. elongatus* Koslowsky 1896, *L. antumalguen* Avila *et al.* 2010, *L. chillanensis* Müller & Hellmich 1932, *Liolaemus smaug* Abdala *et al*. 2010, *Liolaemus choique* Abdala *et al*. 2010, *Liolaemus thermarum* Videla & Cei 1996, *Liolaemus shitan* Abdala *et al*. 2010 (but see Lobo *et al*. 2010 and discussion below), and several still undescribed species. These species are distributed on the eastern slope of the Andes, restricted to Andean and Patagonian steppe environments of southwestern Mendoza and western areas of Neuquén, Rio Negro, and Chubut (Morando *et al*. 2003; Morando 2004). Other authors have found or suggested different arrangements for these lizards (Lobo 2001, 2005; Pincheira-Donoso & Nuñez 2005; Pincheira-Donoso *et al*. 2008; but see Lobo *et al*. 2010). Resolution of alternative hypotheses of relationships must await more inclusive geographic, taxonomic, and character sampling. Here, we describe a new species of the *Liolaemus elongatus* clade from northwestern Neuquén province, a "hot spot" for lizards of the *Liolaemus* genus, as it has been shown by molecular (Morando *et al*. 2003, 2004, 2007; Avila *et al*. 2006) and morphological works (e.g. Avila *et al*. 2003, 2009, 2010; Martinez *et al*. 2011; Pincheira-Donoso & Scolaro 2007), that revealed a hidden diversity in several *Liolaemus* groups from this area.

Material and methods

We study lizards deposited in MLP.S and LJAMM-CNP herpetological collections. Measurements were taken with a digital caliper to the nearest 0.1 mm. Some character states were observed with the aid of a binocular stereomicroscope. Scale terminology follows Smith (1946). Where numbers of paired scales are provided they are given as left-right, and terminology of lateral neck folds follows Frost (1992). Descriptions of color in life are based on color photographs of recently captured animals. We examined samples of related species of the *elongatus* clade (Table 1) from the herpetological collections of Monte L. Bean Museum, Brigham Young University (BYU); Museo de La Plata, Universidad Nacional de La Plata (MLP.S/R); Museum of Vertebrate Zoology, University of California – Berkeley (MVZ); Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Buenos Aires (MACN), and the herpetological collection LJAMM-CNP of the Centro Nacional Patagónico, Puerto Madryn, Argentina (LJAMM-CENPAT). Additionally, morphological data from original species descriptions of this clade (Koslowsky 1896; Videla & Cei 1996) were taken to compare to the new species. Protocols for DNA extraction, mtDNA primer descriptions, PCR, and sequencing procedures for the cytochrome–b (805 bp) region, as well as analytical methodology follow Morando *et al*. (2003) and Morando (2004). We used JModeltest v0.1.1 (Guindon & Gascuel 2003; Posada 2008) to select the appropriate model of molecular evolution (GTR+I+G). Two independent MrBayes analyses were run for 10 million generations, with Markov chains sampled at intervals of 4,000 generations. The equilibrium samples (after 10% of burn-in) were used to generate a 50% majority rule consensus tree, and posterior probabilities (Pp) were considered significant when $\geq$ 0.95 (Huelsenbeck & Ronquist 2001).

Results

Species Description

Liolaemus burmeisteri sp. nov.

Holotype.—MLP.S 2612 (Figs. 1, 2), an adult male from Ruta Provincial 41, 7 km S Caepe Malal, Chos Malal Department, Neuquén, Argentina (37º13'51.4"S, 70º22'24.3"W, 1037 m), collected 19 January 2007.

Paratypes.—MLP.S 2613, LJAMM 5241–5242 (male) and MLP.S 2614-2617 (female) from same locality as holotype. Collected 20 January 2003. LJAMM 7639, 7641, 7646 (male) and 7637–7638, 7640, 7642–7645, 7647 (female) from same locality as holotype, collected 19 January 2007.

TABLE 1. Morphometric, meristic, and chromatic characteristics in species of the *Liolaemus elongatus* clade. Max. SVL= Maximum SVL, SAM= Scales around midbody, S. between O & R= Scales between occiput and rump and VS= Ventral Scales. Data for *Liolaemus chillanensis* were taken from Pincheira-Donoso and Nuñez (2005). Data for *Liolaemus choique* was obtained from Abdala *et al*. (2010).

Character	*Liolaemus burmeisteri* **sp.nov.** (n = 19)	*Liolaemus antumalguen* (n = 11)	*Liolaemus chillanensis*	*Liolaemus elongatus* (n = 99)	*Liolaemus smaug* (n = 21)	*Liolaemus choique*	*Liolaemus shitan* (n = 22)
Max. SVL (mm)	85.2	107.7	70.3	94.7	68.3	90.7	94.7
SAM	76.2±2.7(70-81)	77.0±3.6(68-82)	81-95	77.5±4.0(68-87)	74.1±2.6(70-79)	74-88	78.1±3.9(71-85)
S between O & R	81.1±2.8(76-85)	73.0±1.9(70-78)	---	73.4±5.2(60-87)	70.3±3.2(64-75)	---	70.6±3.0(66-78)
V S	104.7±2.8(99-110)	108.6±4.3(97-118)	---	108.1±5.6(92-121)	111.9±4.1(107-119)	118-135	120.6±5.9(106-129)
Precloacal pores	0-5	3-4	4	1-5	1-3	3-4	3
Dorsal pattern	Light brown speckled with white spots, flanked by band of dark brown between axilla and groin, with few white spots	Variable, from patternless to two dorsolateral series of black ocelli sometimes fused longitudinally	Variable but usually a wide vertebral band, with longitudinal lines of black dots in longitudinal lines	A vertebral band formed by transversal black lines irregularly fused, flanked by two more clear dorsal longitudinal bands	A vertebral band formed by small and irregular black dots, sometimes fused forming a black vertebral solid band to almost disappearing	Vertebral and Lateral Bands to Dorsum melanic	Indistinct
Ventral melanism	absent	present	absent	absent	absent	absent	present
Head color	Ochre	Black	Ochre	Dark brown with dark reticulate	Light brown / Grey	Brown	Black or Brown
Body color	Light brown/ kaki	Light gray to ochre	Ochre to light gray	Ochre to almost black	Light tan to ochre	Yellow with black	Black to Brown and yellow
Tail rings	weak	absent	absent	Present in some populations	absent	Absent	Weak to absent

Diagnosis.—*Liolaemus burmeisteri* can be easily distinguished from all other members of the *Liolaemus elongatus* clade, by its light brown/ochre general coloration not found in any of the other species and by its homogeneous dorsal pattern without bands, stripes or spotted areas (Table 1). *Liolaemus burmeisteri* lacks of a well-defined body-banding pattern and dark ochre/green, or black general coloration, typical of *L. elongatus*. *Liolaemus smaug* has darker coloration and fewer numbers of dorsal scales without overlapping (64–75, 0 = 70.3 vs 76–85, 0 = 81.1 in *L. burmeisteri*) and higher numbers of ventral scales (107–119, 0 = 111.9 vs 99–110, 0 = 104.7 in *L. burmeisteri*) with little overlap. *Liolaemus smaug* has a dorsal banding pattern characterized by a very variable but always present vertebral band ranging from a well marked gray-ochre zone to a dark spotted area, and a very wide and dark lateral band, all traits absent in live specimens of *L. burmeisteri*. *Liolaemus chillanensis* has a different dorsal coloration pattern, with a vertebral band formed by dark spots, more ochre dark general coloration, more darker lateral bands, and more scales around midbody (81-95 vs 70-81). *Liolaemus antumalguen* is a larger species (maximum SVL 107.7, 0 = 94.4 vs 85.2 mm, 0 = 74.5), with more enlarged neck pouches, and with fewer scales along

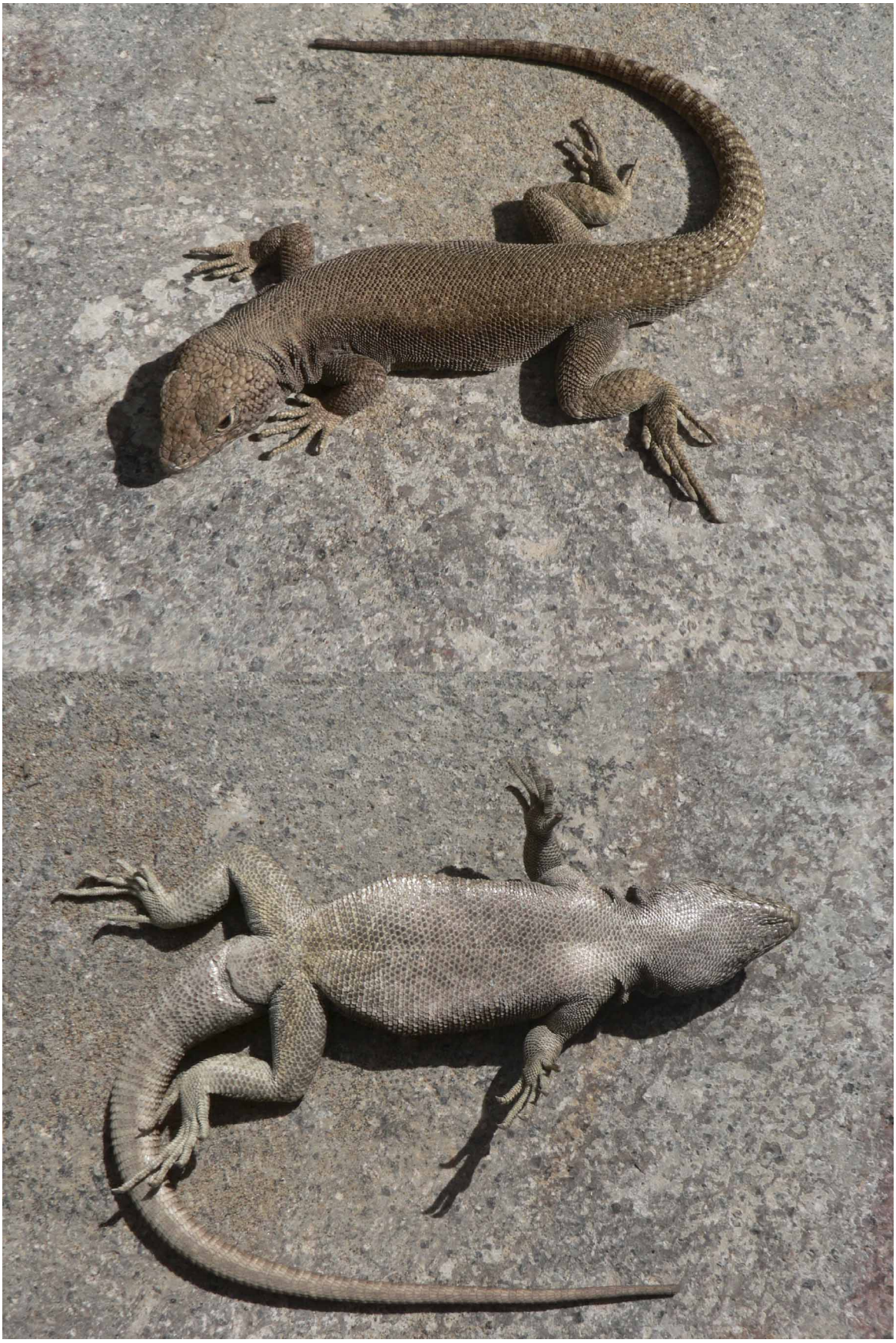

FIGURE 1. *Liolaemus burmeisteri*, holotype, adult male in dorsal and ventral view, from Curi Leuvu River Valley, on Ruta Provincial 41, 7 km S Caepe Malal, Chos Malal Department, Neuquén province, Argentina.

FIGURE 2. *Liolaemus burmeisteri*, holotype adult male in dorsal and ventral view (MLP.S 2612), from Curi Leuvu River Valley, on Ruta Provincial 41, 7 km S Caepe Malal, Chos Malal Department, Neuquén province, Argentina.

FIGURE 3. Dorsal variation in color pattern of males of the type series.

the dorsum and little overlap with *L. burmeisteri* (70-78, 0 = 73.0 vs 76-85, 0 = 81.1). General coloration is darker in *L. antumalguen,* usually with a dorsal pattern of black dots, and black head and belly, and tail without any pattern of tail rings, characteristics never found in *L. burmeisteri*. *Liolaemus shitan* has fewer numbers of dorsal scales (66–78, 0 = 70.6 vs 76–85, 0 = 81.1 in *L. burmeisteri*) and higher numbers of ventral scales (106–129, 0 = 120.6 vs 99–110, 0 = 104.7 in *L. burmeisteri*) with little overlap. *Liolaemus shitan* has a general melanic coloration without

any apparent pattern, a coloration trait absent in *L. burmeisteri*. *Liolaemus choique* has higher numbers of ventral scales (118–135 vs 99–110 in *L. burmeisteri*) without overlapping. General coloration is yellow in *Liolaemus choique* with a dorsal pattern of vertebral and lateral black melanic bands never found in *L. burmeisteri*.

FIGURE 4. Dorsal variation in color pattern of females of the type series.

Description of holotype.—Adult male. SVL 85.2 mm, total length 210.2 mm; tail incomplete, regenerated (125 mm length). Axilla–groin distance 35.2 mm. Head 19.2 mm long (from anterior border of auditory meatus to tip of snout), 16.6 mm wide (at anterior border of auditory meatus), 9.9 mm high. Arm length 23.1 mm. Tibia length 17.7 mm. Foot length 23.2 mm (ankle to tip of claw on fourth toe). Dorsal head scales irregular, some smooth and others with small holes (not scale organs), irregularities appearing more frequently in parietal–temporal areas. Scale organs more abundant in the anterior head region than in the parietal and temporal region. Nineteen scales between rostral and occiput (at level of anterior border of auditory meatus). Rostral scale wider (4.0 mm) than high (1.3 mm). Two postrostrals. Four internasals, irregular. Five frontonasals, irregular. Four prefrontals, irregular. Frontal scale divided longitudinally, forming two scale rows between circumorbitals. Four scales between frontal and rostral. Interparietal pentagonal, similar size to parietals. Interparietal surrounded by seven scales, with a central, small, and obscure ‘‘parietal eye’’ in the scale center. Supraorbital semicircles complete. Seven enlarged

supraoculars. Five scales between frontal and supercilliaries. Seven supercilliaries, irregular flattened and elongated. Nineteen temporals on each side, smooth and protruding with 1–3 scales organs. Canthal scales separated from nasal by one scale. Loreal region concave. Seven scales surrounding nasals on each side. Nasal in slight contact with rostral on each side. Orbit with 16 upper and 14 lower ciliaries. Orbit diameter 2.5 x 4.2 mm (measured between upper and lower ciliaries). Subocular scale elongate. Preocular fragmented on two scales. Six lorilabials, three in contact with subocular. Six supralabials on each side. Fourth supralabial curved upward posteriorly but fourth not in contact with subocular. Infralabials, four, first scale twice as high as posterior infralabials. Postrostrals, internasals, frontonasals, prefrontals, loreal, lorilabials, supra– and infralabials with conspicuous scale organs. Three outwardly projecting scales along anterior border of auditory meatus. Auditory meatus about twice as high (3.9 mm) as wide (1.7 mm). Lateral scales of neck granular with skin below appearing slightly inflated. Antehumeral, longitudinal, and postauricular neck folds distinct, oblique less conspicuous, gular incomplete, rictal not present. Thirty–seven scales between auditory meatus and antehumeral fold (counted along longitudinal fold). Scales of dorsal neck region similar to dorsals. Mental wider (3.9 mm) than long (2.1 mm), followed posteriorly by two rows of chinshields with four scales in the left side and six on right side. Chinshield rows four scales in contact with mental. Throat scales between chinshields slightly juxtaposed, strongly imbricated toward auditory meatus. Fourty–nine gulars between auditory meatus. Eighty–two dorsal scales between occiput and anterior surface of thighs. Thirty–six longitudinal keeled scales rows. Scales become larger and less keeled through flanks. Flank scales with one scale organ at the tip. Scales small and granular around limb insertions. Eighty scales around midbody. Ventral scales of similar size to dorsals, but smooth and round, 104 between mental and cloacal aperture. Precloacal scales slightly larger than ventrals. Five precloacal pores.

Tail quadrangular in cross section near cloacal area, becoming oval to round in the rest. Caudal scales in discernible annuli. Dorsal and upper lateral caudals scales keeled, imbricate, mucronate, and outward projecting. Lower lateral scales moderately keeled and mucronated, and ventral scales smooth. Suprabrachials, imbricate, moderately keeled; prebrachials imbricate, weakly keeled, grading into smaller subimbricate or granular infrabrachials. Supra–antebrachials imbricate, very weakly keeled; post–antebrachials imbricate, moderately keeled with 1–3 mucronated keeled toward the ventral region; pre–antebrachials imbricate, smooth; and infra–antebrachials imbricate, becoming of smooth in the posterior region to moderately keeled and mucronate at the anterior region. Suprametacarpals imbricate, smooth; inframetacarpals imbricate, keeled, 2–3 mucronate. Supradigitals of manus smooth, wider than long; subdigitals with three keels, each terminating in a short blunt mucron, numbering: I: 10, II: 15; III: 22; IV: 22; V: 16. Claws robust, moderately curved, opaque brown. Suprafemorals imbricate, moderately keeled; prefemorals and infrafemorals imbricate, smooth. Postfemorals small, granular. Supra– and pretibials imbricate, moderately blunty keeled; infratibials imbricate, smooth. Supratarsals imbricate moderately keeled; and infratarsals imbricate, 3– keeled, mucronate. Supradigitals of foot smooth, wider than long; Subdigital scales keeled, becoming of 4–keeled in the posterior region of digit to 3–keeled in the tip, mucronate, numbering: I: 13; II: 18; III: 25; IV: 30; V: 19. Claws robust, moderately curved, opaque brown.

Color of holotype in life.—General body coloration uniform, light brown or light ochre. Dorsal and lateral head scales, with scattered few dark brown smudges on postrostral, internasal, frontonasal, prefrontal, temporals and frontal scales. A thin black line on the superior border of the subocular scale. Infralabial scales whitish with small dark brown areas. Dorsal scales between occiput and cloacal region light brown/ochre without definite pattern, speckled with very small (one scale) white or black spots. Tail light brown, weakly ringed with ochre bands. Body lateral region with a dark brown band between axilla and groin, darker than dorsal scales, speckled with a few white spots (one scale). Upper limb surfaces ochre with reticulated of dark brown. Ventral scales of throat, neck, chest, belly and forelimbs light gray with some melanic sectors, more marked in belly midline. Ventral scales of lower belly and femoral region, bright yellow. Ventral scales of cloacal region and tail whitish.

Color of holotype in preservative.—After five years in preservative, the dorsal coloration of the head, dorsum, body flanks and tail become darker while maintaining the contrast, but the white spots largely disappeared. Ventral scales of throat, neck, chest, belly and forelimbs darkened, and distinctive yellow ventral coloration of the femoral region and belly turned dark gray. General pattern of coloration become more marked and general coloration disappeared.

Variation.—*Liolaemus burmeisteri* adults ranging from 60.5–85.2 mm SVL. As in other members of this group, no obvious body size sexual dimorphism was observed (except tail expansion in cloacal areas of males and slightly smaller head width in females). In seven males (Table 2, Fig. 3): SVL: 77.8–85.2 mm. Head length: 17.3–

19.25 mm. Head width: 13.6–16.6 mm. head height: 8.15–9.95 mm. Foot length: 23.2–24.9 mm. Tibial length: 17.4–18.9 mm. Arm length: 21.9–25.4 mm. Midbody scales: 73–81. Dorsal scales (between occiput at the anterior margin of auditory meatus and anterior surface of thighs): 76–83. Ventral scales 101–109. Fourth toe lamellae: 29–31. Supralabial scales: 6–8. Infralabial scales: 5. Cloacal pores: 0–5. In twelve females (Table 2, Fig. 4): SVL: 58.3–78.9 mm. Head length: 13.6–16.7 mm. Head width: 10.9–13.8 mm. head height: 6.30–8.15 mm. Foot length: 20.5–23.0 mm. Tibial length: 13.9–17.6 mm. Arm length: 18.7–23.4 mm. Midbody scales: 70–79. Dorsal scales: 76–85. Ventral scales: 99–110. Fourth toe lamellae: 27–31. Supralabial scales: 7–9. Infralabial scales: 4–5. For nineteen individuals (males and females): dorsal scales: 81.15 ±2,89 (76–85). Interparietal scale usually pentagonal shaped, bordered by 6–8 scales. Supralabial scales 6–9. Infralabial scales 4–5. Third finger lamellae ranges 19–23. Fourth toe lamellae ranges 27–31.

Dorsal and lateral coloration in life is almost identical in all individuals and varies only in intensity. Yellow ventral coloration of males in femoral and lower belly region is variable in extent and intensity in the areas indicated. In preservative, dorsal coloration of all individuals fades to a darker, although all retained the contrast between back and head and flanks and in some individuals scattered dorsal white spots disappeared. All distinctive femoral areas and lower belly coloration fades in preservative from yellow to dark gray.

Etymology.—The specific name is to honor Karl Hermann Konrad Burmeister, a German naturalist, paleontologist and zoologist. Carlos Germán Conrado Burmeister (as he was known in Argentina) was born in Stralsund, Germany in 1807 and past away in Argentina in 1892 after a prolific work with near 300 publications about animals, plants, geology, and paleontology of South America, including its *Description Physique de la République Argentine d'après des observations personnelles et étrangères* (with a version in German). He was director of the Museo Público de Buenos Aires (now Museo Argentino de Ciencias Naturales Bernardino Rivadavia) for 30 years and was in charge of the organization of the National Academy of Sciences in Córdoba, founded by the Argentinean president Domingo F. Sarmiento.

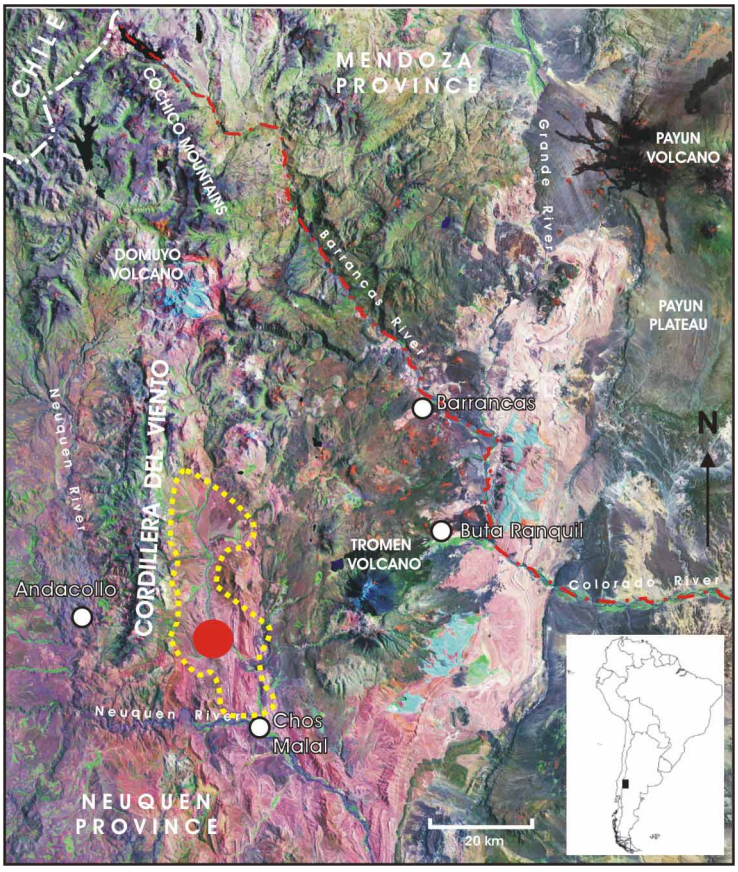

FIGURE 5. Map of northwestern Neuquén province showing the complex landscape of northern Patagonia Andes. Red circle marks the *Liolaemus burmeisteri* type locality. Main mountain ranges, cities, and roads are marked. Yellow outline: approximate boundaries of the Curi Leuvu River Valley Inset: Region in South América.

Distribution.—*Liolaemus burmeisteri* is known only from the type locality (Fig. 5), Ruta Provincial 41, 7 km S Caepe Malal (37º13'51.4"S, 70º22'24.3"W, 1037 m), northwestern Patagonia, Chos Malal Department, Neuquén Province, Argentina.

Natural history.— The collection area was on a small plateau with sedimentary rocks and sparse vegetation. The type locality is a plateau with rocky soils and with medium to big–sized rocks scattered or rocky outcrops, alternating with areas of loose sand (Fig. 6). This area is only sparsely vegetated, with soil erosion resulting from grazing by goats and horses. However, in undisturbed areas, typical vegetation is composed of plants of the genera *Stillingia*, *Colliguaja*, *Nassauvia*, *Haploppapus*, *Fabiana*, *Schinus* and *Stipa*, which are representatives of the Payunia District, Patagónica Province, Andino–Patagónico Domain (Roig 1998). *Liolaemus burmeisteri* appears to be restricted to rocky areas, similar to many other members of this clade (Cei 1974, 1979, 1986, 1993; Espinoza & Lobo 2003; Espinoza *et al.* 2000; Hulse 1979). When active, lizards move across the rocky substratum and bask on horizontal surfaces or on top of medium–sized stones. When disturbed, *L. burmeisteri* usually attempts to escape into the cracks and crevices in the rocks. Based on analyses of stomach contents, *L. burmeisteri* feeds on a variety of insects and other small arthropods. In two digestive tracts, we found Orthoptera, Coleoptera, Formicidae, Solifugae, Araenae, sand grains and indeterminate parts of arthropods. These contents are very similar to those found by Videla (1983) in *L. elongatus* from Mendoza Province. Detailed biological information has been published only for a few phylogenetically related lizards (e.g. Ibargüengoytıa & Cussac 1998; Quatrini *et al*. 2001; Videla 1983), with observations in Cei (1986), Espinoza & Lobo (2003), Espinoza *et al.* (2000), Hulse (1979), and Schulte *et al.* (2000). No conclusive evidence of viviparity can be offered, but all related species of the *elongatus* clade share this reproductive mode (Cei 1986; Espinoza & Lobo 2003; Espinoza *et al*. 2000; Hulse 1979; Schulte *et al*. 2000). At the type locality, *L. burmeisteri* was found in syntopy with *Homonota darwinii*, and no other species of lizards were observed.

Remarks—A mtDNA gene tree analysis, including the new described species as well as other related species and candidate species of this and other related clades is depicted in Fig. 7. This tree is based on the mitochondrial gene fragment cyt-b (805 bp). *Liolaemus burmeisteri* is recovered as the sister taxon of *L. smaug* but with very low support. The *petrophilus* and *kriegi* clades also include candidate species and are recovered with strong support (0.95 and 0.99 respectively). Recently a typographic error named this clade as *buergeri* in the remarks section of the description of *L. antumalguen* (Avila *et al*. 2010). The objective of this tree is to show the position of this new species in relation with these three related clades. Phylogenetic relationships for these clades, including several lines of evidence, are under study by our research group and a detailed analysis will be published elsewhere.

TABLE 2. Morphometric and meristic variation in *Liolaemus burmeisteri* type series. Means and standard deviations (SD) of the main morphometric and meristic characters. Measures in mm and scale in numbers. AGD = Axilla–groin distance, HL = Head length, HW = Head width, HH = Head high, FL = Foot length, TL = Tibial length, AL = Arm length, SAM = Scales Around Midbody, DS = Dorsal Scales, VS = Ventral scales, 4TL = Fourth toe lamellae, SL = Supralabial Scales, IL = Infralabial scales, PC = Cloacal pores.

	Males (N= 7)			Females (N= 12)		
	Mean	SD	Range	Mean	SD	Range
SVL	80.94	2.71	77.8–85.2	70.75	7.33	58.3–78.9
AGD	32.66	1.75	31.2–35.3	30.78	4.82	21.0–36.9
HL	18.32	0.62	17.3–19.25	15.41	1.16	13.6–16.7
HW	15.19	0.99	13.6–16.6	12.81	1.03	10.9–13.8
HH	8.92	0.65	8.15–9.95	7.32	0.67	6.30–8.15
FL	24.18	0.77	23.2–24.9	22.03	0.88	20.5–23.0
TL	18.28	0.57	17.4–18.9	16.04	1.07	13.9–17.6
AL	24.05	1.15	21.9–25.4	21.55	1.59	18.7–23.4
SAM	77.71	2.69	73–81	75.33	2.46	70–79
DS	81.28	2.98	76–83	81.08	2.96	76–85
VS	105	2.70	101–109	104.58	2.96	99–110
4TL	30.14	0.69	29–31	29.75	1.13	27–31
SL	6.85	0.69	6–8	7.66	0.65	7–9
IL	–	–	5	4.91	0.28	4–5
PC	0.85	1.86	0–5	–	–	–

FIGURE 6. Type locality of *Liolaemus burmeisteri*. Upper: general view of the area. Below: close view of the common outcrops where lizards were collected.

TABLE 3. Simplified history of the proposed taxonomic groupings for the *Liolaemus* species included in the *elongatus* clade, with the different assignments to groups according to several authors: E = *elongatus*, K = *kriegi*, P = *petrophilus*, C = *capillitas*, X = no named clade.

	antumalguen	*austromendocinus*	*buergeri*	*capillitas*	*ceii*	*chillanensis*	*curis*	*cristiani*	*dicktracy*	*elongatus*	*flavipiceus*	*gununakuna*	*heliodermis*	*kriegi*	*parvus*	*leopardinus*	*petrophilus*	*punmahuida*	*talampaya*	*thermarun*	*tregenzai*	*tulkas*	*umbrifer*	*villaricensis*
Cei, 1974		E								E							E							
Cei, 1975		E	B		K					E				K			E							
Cei, 1979		E	K		K					E				K			E							
Ortiz, 1981		E	K		K					E				K			E							
Cei, 1986		E	K		K					E				K			E							
Cei, 1993		E		E						E							E							
Espinoza *et al*., 2000		E		E						E			E				E			E				
Schulte *et al*., 2000		X	X	X	X					X						X	X							
Lobo, 2001		E	K	E				E		E				K			X							
Morando *et al*., 2003		P	K	P	K					E				K	P		P					P		
Avila *et al*., 2004		P	K	P					P	E		P		K	P		P		P			P	P	
Lobo, 2005				C					C				C										C	
Díaz Gómez & Lobo, 2006																								
Torres-Pérez *et al*., 2009						E				E				K										
Lobo *et al*., 2010		E	X	C	X			X	C	E	E	E	C	X	E		E	X	C	X	E	C	C	
Avila *et al*., 2010	E					E				E								E		E				

Species composition of the *elongatus* clade has changed during the last thirty years (Table 3), but based on available knowledge and ongoing systematic studies of the *petrophilus* (Feltrin *et al*. in prep.) and the *elongatus* (Medina *et al*. in prep.) clades; we consider the *elongatus* clade composition to include: *L. elongatus* Koslowsky 1896, *L. antumalguen* Avila *et al*. 2010, *L. chillanensis* (Torres-Perez *et al*. 2009), three recently described species, *Liolaemus smaug*, *L. choique* and *L. shitan* (Abdala *et al*. 2010), and *L. burmeisteri* . The three described species by Abdala *et al*. (2010) were considered in previous studies as populations of *Liolaemus elongatus* (Morando *et al*. 2003; Morando *et al*. 2004).

Liolaemus thermarum was described from a type locality named Termas del Azufre, Malargüe, in Mendoza Province, 10 km from the Peteroa volcano (Videla & Cei 1996); according to the description of the type locality all lizards were collected in a glacial valley named "Baños del Azufre" along a volcanic relief Azufre-Planchon-Peteroa. Later, Espinoza *et al.* (2000) cited this species for Laguna Niña Encantada, close to Las Leñas, but Cei & Videla (2003) point out that those samples do not correspond to *L. thermarum*. Morando *et al.* (2003) suggested that their sample named *Liolaemus sp.* 5, from an area close to *L. thermarum* type locality, could correspond to this species. However, adequate comparison to type specimens deposited in the MACN was not possible due to the poor preservation conditions, and the few characters that could be observed showed some discordance (e.g., absence of precloacal pores in *L. thermarum* whereas two to four pores are present in *Liolaemus sp.* 5). Later, we analyzed samples from Rio Grande Valley and Baños del Azufre and considered that *Liolaemus sp.* 5 from Morando *et al*. (2003) could be assigned to *L. thermarum* (e.g. Avila *et al.* 2010). In the same year, Abdala *et al*. (2010) described our previously discovered *Liolaemus sp.* 5 as a new species, *Liolaemus smaug*, with an extended type locality between Las Loicas and Baños del Azufre. Recently, we were able to obtain a small sample of lizards from north of Baños del Azufre (*L. thermarum* type locality), in a glacial valley between this locality and Paso Vergara, east to the volcanic system Peteroa-Azufre Planchon, along the Río de los Ciegos. These lizards, from 5 km north of Baños del Azufre, fit the description of *L. thermarum*, and they differed from our previously studied specimens referred to as *Liolaemus sp.* 5 (Morando *et al.* 2003) and from *L. thermarum* (Avila *et al*. 2010). We consider that the original description of *L. thermarum* type locality was not precise enough, and this led Avila *et al.* (2010), to erroneously assume that specimens analyzed from Baños del Azufre corresponded to *L. thermarum*. The new

evidence indicates that the Baños del Azufre population is the most northern distribution of *Liolaemus smaug* along the Rio Grande Valley, and the true type locality of *L. thermarum* , based on the original morphological description of this species, could be located in the valley of Rio de los Ciegos.

In a recent review publication, Lobo *et al*. (2010) proposed as part of the *elongatus* clade the following species: *L. austromendocinus, L. elongatus, L. flavipiceus, L. gununakuna, L. parvus, L. petrophilus, L. punmahuida, L. thermarum, L. tregenzai*; but no well-supported phylogenetic hypothesis has been proposed for all of these taxa. There are several proposed candidate species, unsampled geographic areas, and more taxonomic and character sampling are needed tor resolve these issues.

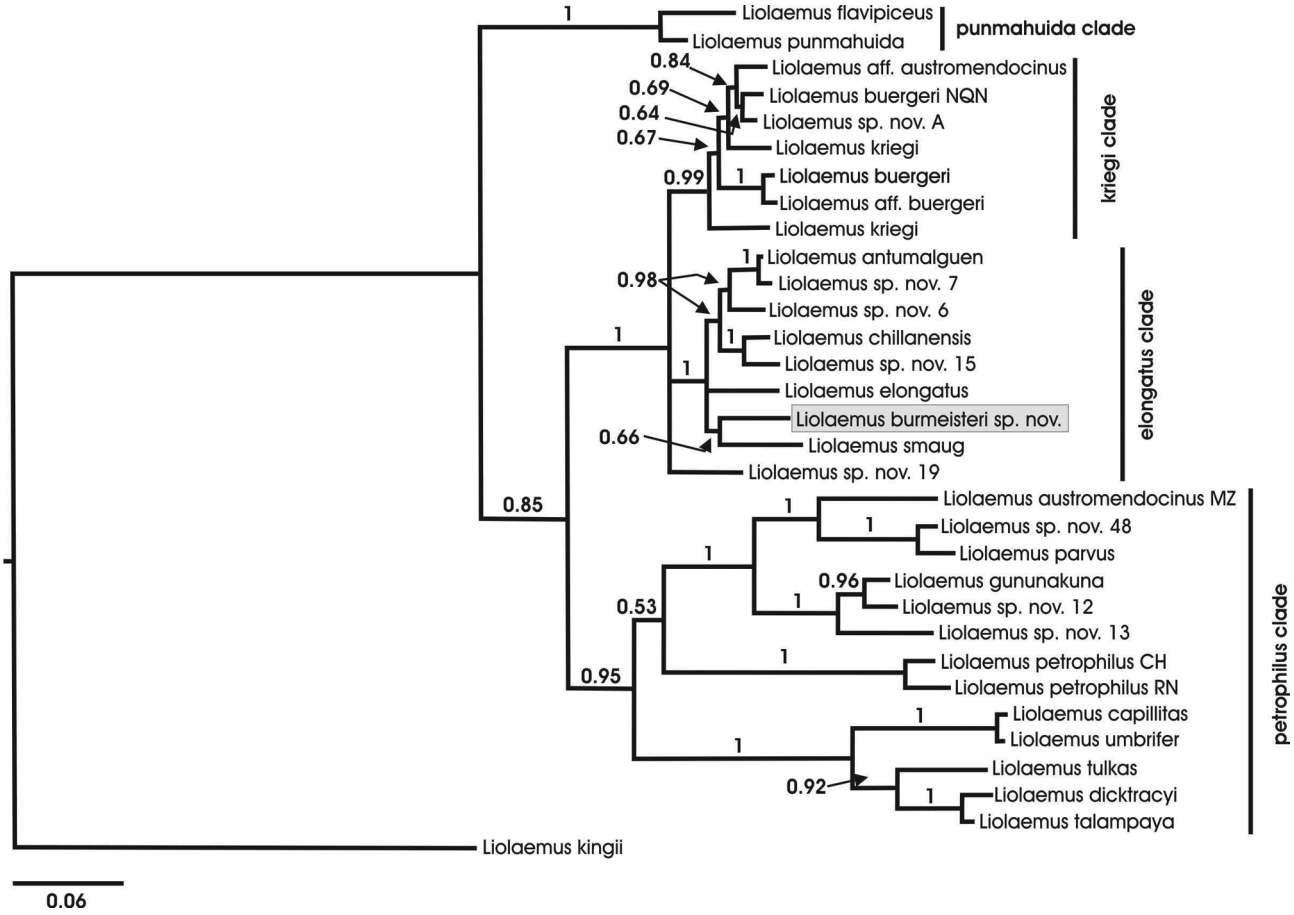

FIGURE 7. Cytochrome b gene tree showing *Liolaemus burmeisteri* in relation with other members of the *elongatus* clade and species of the *petrophilus* and *kriegi* clades, based on Bayesian analyses; numbers above nodes are posterior probability values.

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Appendix I

Specimens examined

Liolaemus antumalguen (11).—ARGENTINA: NEUQUEN: Chos Malal Department, eastern piedmont of Domuyo volcano, around Chadileu Creek: MACN 38985 to 87, MLP.S 2592 to 5, LJAMM-CNP 6167, 6172–3, BYU 12592.

Liolaemus buergeri (12).—ARGENTINA: MENDOZA: Malargue Department, 16 km W Las Leñas: LJAMM-CNP 2682, 2732. Mallines Colgados: LJAMM-CNP 2744-5, 2747. NEUQUEN: Ñorquin, Cascada del Rio Agrio: LJAMM-CNP 3286-3292.

Liolaemus burmeisteri (19).—ARGENTINA: NEUQUEN: Chos Malal Department, Curi Leuvu River Valley, on Ruta Provincial 41, 7 km S Caepe Malal: LJAMM-CNP 7637-7638, 7641-7642, 7645-7647, 5239-5244.; MLP-S 2612-2617.

Liolaemus ceii (14).—ARGENTINA: NEUQUEN: Alumine Department, Provincial Road 13, Pampa de Lonco Luan: LJAMM-CNP 1174-5, 1198, 2606-16.

Liolaemus elongatus (99).—ARGENTINA: CHUBUT: Cushamen Department: Ruta Provincial 12, 9.1 km E La Cancha Railroad Post, road to Gualjaina: LJAMM-CNP 8852. Futaleufu Department: Ruta Nacional 40, Km 1530, 17 km S Esquel, 5 km S junction Ruta Nacional 40 and Ruta Nacional 259: LJAMM-CNP 2128, 2156/7, 2262. Ruta Nacional 40, Km 1589, 18 km N Tecka: LJAMM-CNP 2164. Languineo Department: Ruta Nacional 25, 5 km W Colan Conhue, Cuesta del Paisano: LJAMM-CNP 6177 to 80. Rio Senguer Department: Ruta Provincial 20, 23 km W Los Manantiales: FML13070, LJAMM-CNP 3046/7. Tehuelches Department: Ruta Nacional 40, 22 km S Gobernador Costa: FML 13071, LJAMM-CNP 3049. Ruta Provincial 53, 40 km S junction Ruta Nacional 25: LJAMM-CNP 4681 to 83. Near Gobernador Costa: LJAMM-CNP 6145/6. NEUQUEN: Alumine Department. Portal La Atravesada, 3 km S, 7 km W Primeros Pinos: MVZ 232401/5. 3 km ENE Lago Ruca Choroi, 8 km E, 9 km N Cerro Ruca Choroi: MVZ 188761. Along Arroyo Rucaco, SE end of Lago Ruca Choroi, 3.5 km E and 6.5 km N Cerro Ruca Choroi: MVZ 188762/3. Catan Lil Departament. Campo de la Pistola, 4 km W and 2 km N Las Coloradas: MVZ 188766/67, 188769/70, 188772/3/4. On E side of Rio Alumine, 31 km S Rahue via Ruta Provincial 23: MVZ 188746. Lacar Department. Pampa de Alicura on Ruta 40 and 237, 5 km W and 6 km N Paso Flores: MVZ 188768. Los Lagos Department, on W side of Rio Limay, 2 km E and 16 km S Confluencia: MVZ 18845. Sandy flat along highway, Estancia Tehuel Malal, ca. 6 km WNW Nahuel Huapi: MVZ 188760. 0.5 km S, 3 km W Cerro de las Ardillas: MVZ 232399. Zapala Department. Ruta Provincial 13, 12 km W, 1 km N Zapala Station: MVZ 232402/4/7/8. SW end of Laguna Blanca, 8.5 km W and 1 km N Cerro Mellizo Sud: MVZ 188777/8. W end of Laguna Blanca: MVZ 126476. Ruta Provincial 46, 0.5 km N limite PN Laguna Blanca: MVZ 232410. RIO NEGRO: Bariloche Deparment. Ridge above Refugio Neumeyer, 15 km S Bariloche: MVZ 188779/90/81/82. Chalhuaco Valley: FML 13072/3, LJAMM-CNP 2811, 3051/2, 2055 to 57, 3051/2, 3055 to 7. El Cuy Department: Ruta Provincial 67, 20 km

S Mencue: LJAMM 5559/60. Ñorquinco Department. Along Rimrock, 4 km S and 1 km E Alto del Escorial: MVZ 188736, 188743, 188922. Along Rio Chenqueniyen, 10 km E and 3 km S Cerro Pico Quemado: MVZ 188732 to 34, 188740 to 41. Los Juncos Lagoon, Chenqueniyen rimrock, 5 km N Alto del Escorial: LJAMM-CNP 188758/9. Ruta Provincial 6, 1 km NW Ojo de Agua: LJAMM-CNP 2139. Pilcaniyeu Department. Rocky knoll, Cañadon Bonito, 23 km NE Pilcaniyeu: MVZ 188727/8. Ruta Provincial 23, 2.3 km SE Comallo: LJAMM-CNP 5424. Ruta Provincial 23, 4.8 km SE Comallo: LJAMM 5449/50. Ruta Nacional 40, 2.7 km S Estancia San Pedro: LJAMM-CNP 5428 to 5435. Ruta Provincial 67, 2 km N Cañadon Chileno, 37 km NE Comallo: LJAMM-CNP 5644. Ruta Provincial 67, 3.5 km 3.5 km N Cañadon Chileno: 5621 to 26. Veinticinco de Mayo Department: Ingeniero Jacobacci: LJAMM-CNP 263/4, 269/70, 278, 5868.

Liolaemus flavipiceus (4).—ARGENTINA: MENDOZA: Malargüe Department: Provincial Road 145, Paso Pehuenche: LJAMM-CNP 7906-9.

Liolaemus kriegi (22).—ARGENTINA: RIO NEGRO: Ñorquinco Department: Provincial Road 6, 1 km NW Ojo de Agua: LJAMM-CNP 2154-5, 2267-8, 2336-7. National Road 1s40, 2.5 km N Chenqueniyen: LJAMM-CNP 3498-9, 3501, 3503. 25 de Mayo Department: Provincial Road 76, 57 km S Ingeniero Jacobacci: LJAMM-CNP 3044, 3071, 3073-4, 3565-8. Provincial Road 5, 40 km SE Maquinchao. LJAMM-CNP 3045, 3081-2, 3379.

Liolaemus smaug (27).—ARGENTINA: MENDOZA: Malargüe Department: Provincial Road 226, 1 km N Baños del Azufre: LJAMM-CNP 5782-3, 5786 to 5791. Provincial Road 226, 11.4 km S Baños del Azufre: LJAMM-CNP 5799 to 5805. Provincial Road 226, Paraje Mallines Colgados: LJAMM-CNP 2748 to 2751. San Carlos Department: Along Rio Diamante, 3 km S Lago Diamante: MVZ 188729; S side Laguna Diamante: MVZ 180741 to 180745.

Liolaemus shitan (22).—ARGENTINA: RIO NEGRO: Veinticinco de Mayo Department: Ruta Provincial 8, 17 km S San Antonio del Cuy: FML 13060/1, LJAMM-CNP 1519/20, 1615, 1636/7, 1639 to 1641, 1818 to 22, 1915, 2433 to 36, 2721, 2726.

Specimens used for gene tree analyses (all in LJAMM-CNP except noted)

***-kriegi* clade**: *Liolaemus aff. austromendocinus*: 2244; *L. buergeri* NQN: 5796; *L.* **sp. nov.** A: 2533; *L. kriegi*: SDSU 3695; *L. aff. buergeri* 5297; *L. kriegi*: fn 174. ***-elongatus* clade**: *L. antumalguen*: 6155; *L.* **sp. nov.** 7: 2602; *L.* **sp. nov.** 6: 2454; *L. chillanensis*: 3434; *L.* **sp. nov.** 15: 5268; *L. elongatus*: 2128; *L. burmeisteri*: 16: MLP-S 2617; *L. smaug*: 5791; *L.* **sp. nov.** 19: 5537. ***-petrophilus* clade**: *L. austromendocinus* MZ: 5147; *L.* **sp. nov.** 48: 540; *L. parvus*: 2711; *L. gununakuna*: 2690; *L.* **sp. nov.** 12: 5375; *L.* **sp. nov.** 13: 5356; *L. petrophilus* CH: 2125; *L. petrophilus* RN: 1914; *L. capillitas*: 2786; *L. umbrifer*: 5029; *L. tulkas*: 4227; *L. dicktracy*: 5750; *L. talampaya*: 1972. ***-punmahuida* clade** *Liolaemus flavipiceus*: 7906; *L. punmahuida*: 2626. Outgroup: *L. kingii*: 2309.