

A NEW SPECIES OF *LIOLAEMUS* (IGUANIA: LIOLAEMIDAE) OF THE *ALTICOLOR* GROUP FROM LA PAZ, BOLIVIA

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ABSTRACT: We describe a new species of *Liolaemus*, belonging to the *alticolor* group, that was previously confused with *L. walkeri*. The new species inhabits the inter-Andean dry valleys at two localities in the department of La Paz (Ananta and Jupapina), Bolivia. We compared the new species with 11 morphologically similar taxa classified as part of the *alticolor* group. Our comparisons were based on external morphology and included lepidosis, morphometry, meristic characters, and color patterns. *Liolaemus* sp. nov. differs from other species of the same group by unique dorsal coloration and lepidosis characteristics.

RESUMEN: Describimos una nueva especie de *Liolaemus* perteneciente al grupo *alticolor*, previamente confundida con *L. walkeri*. Esta nueva especie habita en los valles secos inter-Andinos, en las localidades de Ananta y Jupapina, provincia Murillo, departamento de La Paz, Bolivia. Basándonos en caracteres de morfología externa (lepidosis, morfometría, caracteres merísticos y patrones de coloración), comparamos el nuevo taxón con 11 taxa morfológicamente similares que pertenecen al grupo *alticolor*. *Liolaemus* sp. nov. difiere de las demás especies del grupo por presentar un patrón de coloración dorsal y características de su lepidosis únicos. Estos resultados nos ayudan a concluir que se trata de una especie nueva del género *Liolaemus*.

Key words: *Alticolor* group; Bolivia; *Liolaemus*; New species

THE GENUS *Liolaemus* contains 233 species that range from Argentina (Tierra del Fuego) to central Perú, and occur in several habitats in Argentina, Bolivia, Chile, Paraguay, and the coasts of Uruguay and southeastern Brazil (Cei, 1993; Lobo et al., 2010). Several new species have been recognized in recent years, and thus the composition of the genus has increased over time dramatically and almost exponentially. Various taxonomic arrangements have been proposed, but it is widely accepted that the genus is divided in two subgenera: *Liolaemus sensu stricto*, or the primarily Chilean group (*chiliensis*), and *Eulaemus*, the primarily Argentinian group (Laurent, 1983). Several subgroups have been proposed within each of these two subgenera; for example, when first described, the *alticolor* group (Ortiz, 1981) included only three species (*L. alticolor*, *L. walkeri*, and *L. tacnae*) and was thought to be a subgroup of *chiliensis* (Cei, 1986; Lobo, 2001; Espinoza et al., 2004; Lobo, 2005). In the last few years, the taxonomic composition, diversity, and hypoth-

esized relationships of the *alticolor* group have changed dramatically, to the point that no fewer than 11 species are currently recognized (Lobo and Espinoza, 1999; Martinez-Oliver and Lobo, 2002; Lobo and Espinoza, 2004; Lobo et al., 2007).

The last checklist of Bolivian reptiles listed 16 species of *Liolaemus* for the country (González and Reichle, 2003), but two more were recently recognized by Ocampo and Aguilar-Kirigin (2008) and Aguayo et al. (2009), respectively; therefore, no fewer than 18 species are now thought to be present in Bolivia. In the course of ongoing studies on the diversity and systematics of Bolivian species of *Liolaemus*, we have obtained specimens of *Liolaemus* from a series of habitats in the Andean valleys. In two inter-Andean valleys near the city of La Paz (Ananta and Jupapina), we obtained a series of specimens, with distinct dorsal color patterns, that in the past were confused with *L. walkeri*. Detailed analyses of various meristic, morphometric, and qualitative characters indicated that these populations are distinct not only from *L. walkeri*, but also represent a new species, which we describe below.

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MATERIALS AND METHODS

To provide a diagnosis of morphological characters commonly used for *Liolaemus* taxonomy, we applied the methodology of Laurent (1985), Cei (1986), Etheridge (1993, 1995, 2000), and Lobo (2001). Terminology for the description of lepidosis, follows the work of Smith (1946), whereas neck-fold terminology follows Frost (1992). The description of color in life is based on observations made in the field or pictures taken at moment of capture; terminology for body color patterns follow Lobo and Espinoza (1999).

We took observations and measurements of scales using digital calipers to the nearest 0.02 mm under a stereoscope ($\times 10$ – $\times 40$). All measurements are in millimeters. We fixed the specimens in 10% formalin, then preserved them in 80% ethanol, and deposited them in the Colección Boliviana de Fauna (CBF), La Paz, Bolivia. Examined material is listed in the Appendix.

RESULTS

Liolaemus **aparcioi** *sp. nov.*
(Fig. 1)

Liolaemus alticolor walkeri Hellmich, 1962 in part; Forno and Baudoin 1991:433–437

Holotype.—CBF 3185 (field tag: MOB-175), adult male collected at Jupapina, La Paz Department, Bolivia, $16^{\circ}35'37.2''S$, $68^{\circ}04'36.1''W$, datum WGS84, elevation 3250 m, on 14 September 2008 by Mauricio Ocampo and Alvaro Aguilar Kirigin.

Paratypes.—Six males (CBF 3182, field number KIRI-223; CBF 3183, field number MOB-174; CBF 3184, field number KIRI-224; CBF 3187, field number MOB-176; CBF 2917, field number MOB-36; CBF 3017, field number MOB-85) and four females (CBF 3186, field number KIRI-225; CBF 3181, field number MOB-169; CBF 2999, field number MOB-76; CBF 2998, field number KIRI-128) from the same locality as the holotype. Two females (CBF 3180, field number KIRI-222; CBF 3177, field number MOB-167) from Ananta, La Paz Department, Bolivia, $16^{\circ}37'1.6''S$, $68^{\circ}4'28.6''W$, elevation 3250 m.



FIG. 1.—*Liolaemus aparcioi* sp. nov. (holotype; CBF 3185). Male, 56.55 mm SVL.

Diagnosis.—A small (61.7 mm maximum SVL), slender *Liolaemus* assigned to the *L. alticolor* group because it exhibits the defining characteristics of this group (Lobo and Espinoza, 2004), including small body size (rarely 60 mm SVL), a distinct pattern of dorsal stripes, and fine gray to black line segments or spots diffusely marking the ventral surface of the tail. Within the *L. alticolor* group, *L. aparcioi* differs from *L. bitaeniatus* and *L. pagaburoi* in having a smooth dorsal surface of the head (rough to slightly rough in those two species). It differs from *L. tacnae* and *L. walkeri* in having keeled temporal scales, as opposed to smooth temporal scales in these two species. The new species has paravertebral spots, which are absent in *L. alticolor*, *L. chaltin*, *L. tacnae*, *L. walkeri*, and *L. yanalcu*. *Liolaemus aparcioi* has dorsolateral stripes, absent in *L. tacnae*, *L. yanalcu*, and some males of *L. puna*. Also, the dorsolateral stripes in *L. aparcioi* are wider than those in *L. bitaeniatus*, *L. pagaburoi*, and *L. walkeri*. Most of the specimens of *L. aparcioi* lack a vertebral line, although a few

specimens had a trace or fragmented line, which is otherwise present in *L. alticolor*, *L. pagaburoi*, *L. ramirezae*, *L. walkeri*, *L. yanalco*, and females of *L. puna*. The color pattern of the throat is gray with some small black spots, which distinguishes *L. aparicioi* from *L. bitaeniatus*, *L. chaltin*, *L. incaicus*, *L. ramirezae*, and *L. yanalco*, which have an immaculate throat; and from *L. tacnae* (melanic throat) and *L. variegatus* (variegated throat). The females of *L. aparicioi* have precloacal pores, unlike females of *L. tacnae*, *L. puna*, *L. alticolor*, *L. walkeri*, *L. chaltin*, and *L. pagaburoi*. The tails of *L. aparicioi* females are almost twice the body length, whereas in females of *L. variegatus* the tails are one and a half times the body length. Other distinct features of the new species are the undivided preocular, which is not fused to the subocular; weakly keeled temporals; four infralabials; upturned posterior tip of fourth supralabial; and pores in 66.7% of males.

Description of holotype.—Male. Snout–vent length 56.55 mm. Head length (measured from snout to anterior border of auditory meatus) 12.78 mm. Head width (at widest point over posterior mandibles) 10.29 mm. Head height (at parietal) 6.87 mm. Axilla–groin (between the posterior insertion of forelimb and anterior insertion of thigh) 24.79 mm (43.8% of SVL). Foot length (from ankle to tip of the fourth toe including claw) 17.3 mm. (30.6% of SVL). Tail length (complete, not regenerated) 108.34 mm. (1.9 times SVL).

Twelve dorsal head scales (from a line drawn horizontally between anterior edges of external auditory meatus to anterior border of rostral). Dorsal head scales smooth, with scale organs more abundant in prefrontal, internasal, and supralabial regions. Six to seven scale organs on postrostral. Nasal scale in contact with rostral, separated from first supralabial by one scale. Nasal bordered by six scales. Canthal separated from nasal by one scale. Five supralabials (counting only the “enlarged” series of the main row) with fourth upturned posteriorly and contacting subocular on both sides of head. Three enlarged infralabials. Auditory meatus oval shaped (height 2.26 mm, width 1.2 mm), with four small, projecting scales on anterior margin

(three on left side). Eight convex, imbricate, keeled temporals (counting vertically from buccal commissure to posterior corner of orbit). Orbit–auditory meatus distance 4.82 mm. Orbit–anterior margin of rostral distance 3.8 mm. Rostral almost three times wider than high (width 2.8 mm; height 1.1 mm). Mental subpentagonal, about two times as wide as high (width 2.6 mm; height 1.6 mm). Interparietal pentagonal with an elongated posterior apex, bordered by eight scales, the parietal slightly larger. Frontal quadrangular. Supraorbital semicircles complete on both sides. Semicircles formed by 9 scales on left side and 11 scales on right side. Four/five (left/right) enlarged supraoculars. Five distinctly imbricate superciliaries on both sides. Fourteen upper and 11 lower ciliaries (left side) and 13 upper and 12 lower ciliaries (right side). Subocular elongate, 4.1 mm, longer than eye diameter (2.6 mm; measured between anterior and posterior commissure of ciliaries), separated from supralabials by a single, but interrupted row of lorilabials. Fourth supralabial elongate, 2.5 mm, about same length as eye diameter. Nine (right) seven (left) lorilabials with single and double rows of scale organs. Fourth–seventh lorilabials contacting subocular on the right side, and fourth–sixth lorilabials contacting subocular on the left side. Preocular small, separated from lorilabial row by two scales. Postocular two times larger than preocular. Mental in contact with four scales: first infralabials (on each side) and two enlarged chin shields. Chin shields form a longitudinal row of three enlarged scales separated one from the other by 10 smaller scales. Scales of throat round, flat, and imbricate. Twenty-eight gulars between auditory meatus. Longitudinal neck fold with keeled scales that are smaller than dorsal scales. Antehumeral pocket and antehumeral neck fold well developed. Twenty-eight scales between auditory meatus and shoulder (counting along postauricular and longitudinal neck fold), 14 scales between auditory meatus and antehumeral neck fold. Gular folds absent.

Dorsal scales lanceolate, keeled, and imbricate. Forty-four dorsal scales between occiput and groin. Forty-two scales around midbody. Twenty-two row of keeled scales on dorsum at

TABLE 1.—Variation in character states in *Liolaemus aparicioi*. All specimens were deposited in the Colección Boliviana de Fauna.

Variable	Min–max	Mean ± standard deviation
Snout–vent length	50.5–58.5	53.8 ± 2.5
Head length	10.9–12.7	11.7 ± 0.7
Head width	8.9–10.8	9.6 ± 0.6
Axilla–groin distance	23.5–25.9	24.6 ± 0.7
Tail length	97.8–113.7	104.2 ± 5.1
Times snout–vent length	1.8–2.2	2 ± 0.1
Midbody scales	39–46	43.1 ± 2.5
Keeled rows over the back	20–23	21.7 ± 1.2
Dorsal scales ^a	40–46	42.8 ± 1.8
Dorsal head scales	9–12	11.2 ± 0.9
Ventrals	74–88	79.9 ± 3.6
Scales around interparietal	6–8	6.4 ± 0.8
Enlarged supraoculars	4–5	4.5 ± 0.5
Temporals	6–8	7.5 ± 0.7
Scales on neck ^b	13–19	15.8 ± 1.4
Gulars	22–26	23.7 ± 1.2
Supralabials	6–8	6.5 ± 0.7
Scales around nasal	6–7	6.8 ± 0.5
Internasals	4–5	4.2 ± 0.4
Scales between rostral and frontal	4–7	5.4 ± 0.9
Scales organs in two postrostrals	3–11	6.7 ± 2.0
Lorilabials	7–10	8.4 ± 0.8
Subdigital lamellae on fourth finger	16–21	18.4 ± 1.4
Subdigital lamellae on fourth toe	21–29	24.4 ± 2.4
Preloacal pores in females	0–3	1.3 ± 1.2
Preloacal pores in males	4–6	5.3 ± 0.8

^a Between occiput and anterior surface of thighs.

^b Between auditory meatus and antehumeral fold.

midtrunk. Scales become smooth along flank and toward belly. Ventral scales about the same size as dorsals. Eighty-one ventral scales between mental and preloacal pores. Seven preloacal pores. Supracarpals laminar, round, and smooth. Subdigital lamellae of fingers with three keels, in number I: 9; II: 15; III: 20; IV: 20; V: 13 (right fingers). Claws moderately long. Supradigital lamellae convex, smooth, and imbricate. Infracarpals and infratarsals keeled, distinctly imbricate. Supratarsals distinctly keeled. Subdigital lamellae of toes I: 11; II: 15; III: 21; IV: 28; V: 16 (right toes).

Color patterns in ethanol.—Dorsal background color from occiput to base of tail gray brownish. Fragmented vertebral line present. Dark paravertebral spots. Paravertebral and vertebral fields of same background color. A distinctly beige dorsal stripe. Dark irregular

markings in lateral field. White ventrolateral stripe, beginning on the posterior edge of the eye, through the upper auricular meatus, continuing across the longitudinal neck fold, through the shoulders, ending in the groin. Dark and white small spots in the ventrolateral zone. White immaculate ventral field. Neck and gular region light lead gray. Background coloration of dorsum tail is brown, like a body, with some diffuse markings.

Variation.—The variations are shown in a table, based on 12 paratypes; 5 complete individuals and 7 specimens used in studies of diet (Table 1).

Color in life.—Without sexual dichromatism. Head, dorsally brown. Subocular white, dorsally borderer in black. A dark dashed vertebral line. The vertebral field lead gray. Paravertebral field light brown with dark brown paravertebral spots. A yellowish beige dorsolateral strip. The background color of lateral field red with dark, irregular markings. White ventrolateral stripe, beginning on posterior margin of the eye, through the upper auricular meatus, continuing from the longitudinal neck fold, through the shoulders, ending in the groin. Black and white small spots on the ventrolateral zone that exhibit the same background color of the lateral field. Fore and hind limbs same color as the vertebral field, with diffuse dorsal markings. Venter immaculate white. The ventral groin and ventral thigh with a yellowish coloration. Tail with some dorsal color of vertebral field, with some diffuse markings. Ventrally, the tail is white.

Etymology.—The specific epithet *aparicioi* is in honor of James Aparicio Effen, Curator of the herpetological collection of the Colección Boliviana de Fauna, in recognition of his contribution toward our understanding in the herpetology in Bolivia. The species name is thus a patronym in the genitive singular.

Distribution.—*Liolaemus aparicioi* (Fig. 2) is currently known from two localities in the biogeographical zone known as inter-Andean dry valleys (Ibisch et al., 2004) of La Paz, at elevations of 3000–3900 m. This ecological region is highly heterogeneous, and most valleys have particular and unique geological

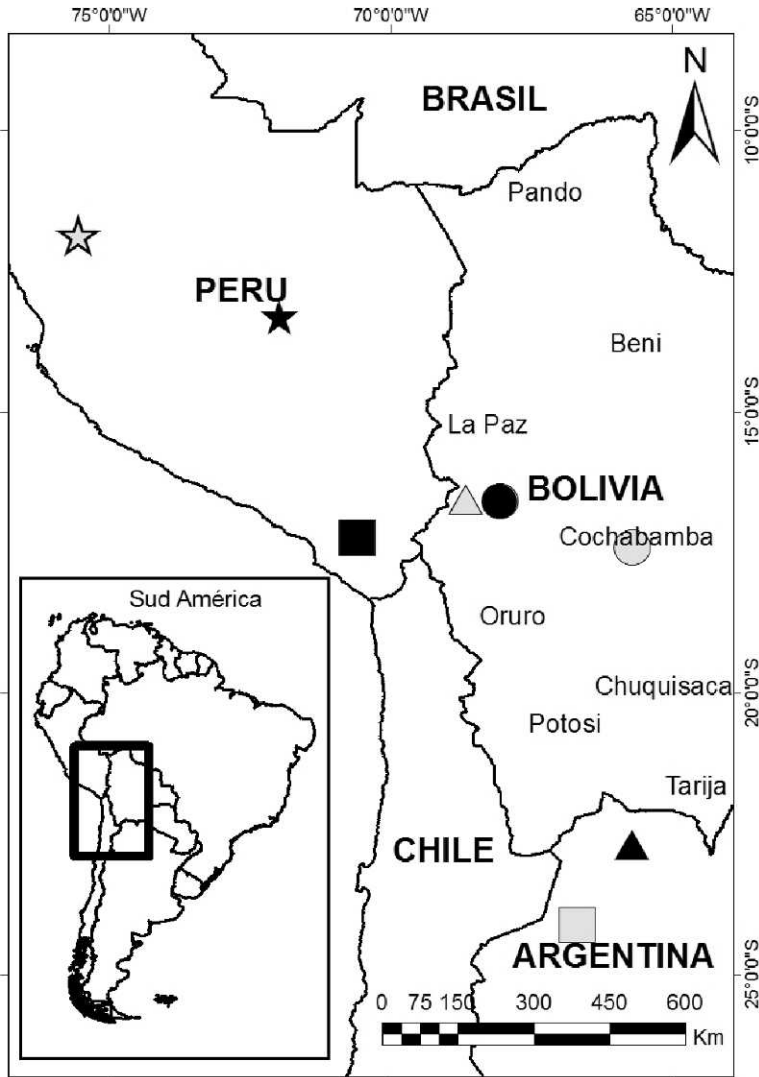


FIG. 2.—Distribution of *Liolaemus alticolor* group. All marks indicate the type localities: *L. aparicioi* (black circle), *L. walkeri* (gray star), *L. incaicus* (black star), *L. tacnae* (black square), *L. alticolor* (gray triangle), *L. variegatus* (gray circle), *L. chaltin* (black triangle), and *L. puna* (gray square).

histories. Because these areas represent areas with high levels of endemism and a long history of human impact (Ibisch et al., 2004), the conservation of these ecological units should be a priority.

Natural history.—*Liolaemus aparicioi* sp. nov. is a terrestrial lizard, which sometimes seeks shelter or food in shrubs up to 30 cm above the ground. When threatened, individuals of this species seek refuge in thorny vegetation (*Corryocactus* sp., *Opuntia* sp.,

Schinopsis sp., *Acacia* sp., and *Prosopis* sp.). Mostly insectivorous. Sexual dimorphism is not substantial, but males tend to be slightly larger than females.

DISCUSSION

Liolaemus walkeri was first described by Shreve (1938). Hellmich (1962) and Donoso-Barros (1966) considered it to be a subspecies of *L. alticolor*. Etheridge (1995) recognized

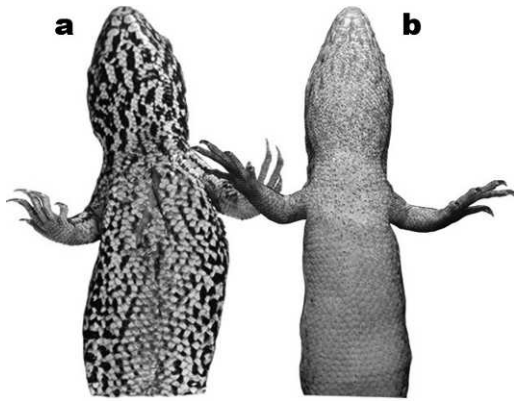


FIG. 3.—Differentiation of the throat and belly patterns in males of *Liolaemus variegatus* (a) and *L. aparicioi* (b).

the distinction of *walkeri*, but at the level of species. However, the nomenclature of Hellmich (1962) and Donoso-Barros (1966) is widely used in Bolivia, which is why *L. aparicioi* was confused with *L. alticolor walkeri* (Dirksen and De la Riva, 1999), hiding *L. aparicioi* inside *L. alticolor sensu stricto*. This nomenclatural inaccuracy overestimates the actual distribution of *L. alticolor* in Bolivia (Embert, 2007).

We agree with Lobo and Espinoza (2004) and Pincheira-Donoso and Nuñez (2005) that *L. walkeri* should be restricted to the Republic of Peru. Our analysis of 14 locations where this species was recorded (data from the Colección Boliviana de Fauna) suggested that *L. aparicioi* occurs between 3000 and 3900 m of elevation, and *L. alticolor sensu stricto* ranges between 4000 and 4800 m (Baudoin and Pacheco, 1991). No areas were found where the two species could live in sympatry, although this is a hypothesis that should be tested.

Liolaemus variegatus is the species most similar to *L. aparicioi*, but the geographical separation between both species is clear. The habitat of *L. aparicioi* is a dry valley dominated by thorny plants, whereas *L. variegatus* habitat is at higher elevation and is dominated by grasses (Beck and García, 1991; Ibsch et al., 2004). In males, the throat is clearly variegated, whereas in *L. aparicioi* it is gray with some small black spots (Fig. 3). The tails of female *L. aparicioi* are longer than those of female *L. variegatus*. All these factors togeth-

er seem sufficient to consider *L. aparicioi* a distinct species from *L. variegatus*.

Several members of the *alticolor* group have broad latitudinal and altitudinal distributions, and high variability in morphology, color, design, ecological characteristics, and reproductive strategies. This species complex deserves further scrutiny, as it may still harbor unrecognized species (Lobo and Espinoza, 2004).

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APPENDIX

Specimens Examined

Museum abbreviations follow Leviton et al. (1985), except for Colección Boliviana de Fauna (CBF), La Paz, Bolivia; Colección Herpetológica del Centro de Biodiversidad y Genética (CBGR; GRO), Cochabamba, Bolivia; Museo de Ciencias Naturales de la Universidad Nacional de Salta (MCN), Salta, Argentina; Colección Herpetológica del Museo de Historia Natural Alcide D'Orbigny (MHNC-R), Cochabamba, Bolivia; and Museo de Zoología de la Universidad de Concepción (MZUC), Concepción, Chile.

Liolaemus alticolor: BOLIVIA, Departamento de La Paz: CBF 2893–2896, 2925; MCZ 12409; MCZ-R 7287, 128518–525, 169064. ***Liolaemus aparioi***: BOLIVIA, Departamento de La Paz: CBF 2917, 2998–99, 3017, 3177, 3180–81. ***Liolaemus bitaeniatus***: ARGENTINA, Provincia de Catamarca: FML 1932, 3593, 6347, 7137–38, MCN 1717; Provincia de Salta: FML 1655 (6); Provincia de Tucuman: FML 2237 (2), 2345 (2), 2384 (4), 2462, 2475 (5), 2499 (2), MCN 900–901. ***Liolaemus chaltin***: ARGENTINA, Provincia de Jujuy: FML 1461 (5), 1871 (4), 2513 (2), 9874 (holotype), MCN 235, 2221–31. BOLIVIA, Tarija: MHNCR 191, 196, 215, 216, 343.

Liolaemus incaicus: PERÚ, Departamento de Calca: FMNH 266542 (holotype), 34104 (paratype), 34127 (40), AMNH 38068–070. ***Liolaemus pagaburoi***: ARGENTINA, Provincia de Tucumán: FML 16132–33, 16838, 1829 (4), 2435(9), 2722 (4), 2746 (11), 2633 (8). ***Liolaemus paulinae***: CHILE, Región de Antofagasta: FML 1196 (paratype), 1341 (2); MZUC 19360, 19362–367, 19370, 193671, 19382; SDSU 1909–11. ***Liolaemus puna***: ARGENTINA, Provincia de Jujuy: FML 929, 1265, 1512, 1517 (3), 1519 (2), 1533 (8), 1874, MCN 229–232, 698–99, 1718–19; Provincia de Salta, FML 1364 (holotype), 9914–27 (paratypes), 1661 (5), 1663 (9), 2779 (2), 3647, 3348 (2), 3649, MCN 949–50, 1890–92, 1894–97, 2177–79, SDSU 3579–82. CHILE, Región de Tarapaca: MCZ 149852, 149854–56, 149858, MZUC 19392 (3), SDSU 1697–99; USNM 165641; Región de Atacama: MNHN 583, 585, 588. ***Liolaemus ramirezae***: ARGENTINA, Provincia de Catamarca: FML 3612, 2561 (3); Provincia de Salta: FML 1658, 3006, 3335, MCN 1733–35; Provincia de Tucumán: FML 1367, 2240, 2275 (4), 2279 (2), 2330 (4), 2383 (2), 2384–86, 2436, 2463, 2481, 2486, 2715, 6012, 8182, 17438, MCN 466, 469–70. ***Liolaemus tacnae***: PERU, Departamento Arequipa: FML 1544; Departamento Tacna: MCZ 45806 (holotype), 45807 (Paratype), 49210–211. ***Liolaemus variegatus***: BOLIVIA, Departamento de Cochabamba: FML 1210 (2) (paratypes), CBGR S/N (4), GRO 90–92, 116, 118, 121, 122, 124, 130, 132–39, 145, 150–53, MHNCR 287, 288, 289, 291, MLP.S 841. ***Liolaemus walkeri***: PERU: AMNH 88324–326; Departamento de Ayacucho: FMNH 81380–387, 81388–389, 81395–396, MCZ 45850; Departamento de Junin: AMNH 63389–390 (paratypes), FML 371 (2), MCZ 43770–775, 43777, 43779–781, 45887–888, 100111, SDSU 1937; Departamento de Apurimac: FML372, 1283; Departamento de Lima: MCZ 45783. ***Liolaemus yanalcu***: Argentina, Provincia de Salta: MCN 360–61, 535–36, 541, 702, 705–07, 725–29, 955–60, 1038, 1449, 1635, 1750, 2236–39, 2501, 2613–16.