

Article

# Three New Lizard Species of the *Liolaemus montanus* Group from Perú

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**Abstract:** Three new species of *Liolaemus* belonging to the *L. montanus* group are described from Perú. Two new species are restricted to the Ica and Moquegua departments on the Pacific coast, and one new species is only known from an isolated highland in Ayacucho department. These three new species differ from closely related species in their coloration patterns and head shape. We comment on the conservation issues of the new species and other Peruvian species of the *L. montanus* group.

**Keywords:** Andes; conservation; Pacific coast; Perú; species description; threats

## 1. Introduction

*Liolaemus* species of the *L. montanus* group comprise about 60 species and several candidate species [1–3]. The geographic distribution of this group ranges from central Perú and Bolivia to northern Argentina and Chile, and from sea level to more than five thousand m.a.s.l. Thirteen species in the northern range of this group are known in Perú: *L. annectens*, *L. aymararum*, *L. etheridgei*, *L. evaristoi*, *L. insolitus*, *L. melanogaster*, *L. ortizi*, *L. poconchilensis*, *L. polystictus*, *L. robustus*, *L. signifer*, *L. thomasi*, and *L. williamsi* ([2,4] this paper). Recently, two candidate species (“Nazca” and “Abra Toccto”) have been proposed based on an integrative approach in the northern range of the *L. montanus* group, but species description are still lacking [2].

Moreover, a more comprehensive phylogeny of the *Liolaemus montanus* group identified another well supported candidate species (*Liolaemus* “Moquegua”) based on two mitochondrial and five nuclear markers. This candidate species forms a clade with *Liolaemus* “Nazca”, *L. insolitus* and *L. poconchilensis* [3]. *Liolaemus poconchilensis* is one of these rare “toad-like” or “phrynosauroid” head lizards (eye diameter longer than snout-eye distance, poorly differentiated scale heads, short snout, short and triangular lower jaw), with eyes surrounded by enlarged ciliary scales or “combs” [5] *Liolaemus* “Moquegua” is similar in head shape to *L. poconchilensis*, but it lacks the “combs” surrounding the eyes and other traits we describe here. In this paper, we also describe two new species previously identified as *Liolaemus* “Abra Toccto” and *Liolaemus* “Nazca”, and comment on conservation issues threatening the new species and other Peruvian species of the *L. montanus* group.

## 2. Material and Methods

### 2.1. Sampling

Lizards were collected by hand, photographed and sacrificed with an injection of pentobarbital. Liver tissue was collected for DNA samples, and whole specimens were fixed in 10% formaldehyde and transferred to 70% ethanol for permanent storage in the Bean Life Science Museum at Brigham Young University (BYU) and the Museo de Historia Natural de San Marcos (MUSM). Tissue samples were collected in duplicate, stored in 96% ethanol and deposited in both museum collections.

### 2.2. Species Descriptions

Species descriptions follow the format of [6]. We examined 47 specimens of the new species and 259 specimens of Peruvian species of the *Liolaemus montanus* group. We followed [7] for terminology of scale descriptions and [8] for neck fold terminology. Color descriptions are based on photographs of live animals taken in the field, and specimens examined are provided in Appendix A. Measurements were taken using a digital caliper to the nearest 0.1 mm. Bilateral scale counts and mensurable data were taken from the right side of lizards. Scale state characters were taken using a stereoscope (10×–40×).

## 3. Results

Below we describe three new species previously recognized as candidate species [2,3]. However, as candidate species without a formal description they probably will not get legal protection. Legal protection is afforded for taxa with scientific names in a formal species description. Once candidate species have names, they will be available and can be incorporated into local protected and international conservation lists. For this reason, we describe three new species of *Liolaemus* lizards and we hope in the near future they will be evaluated and be part of a conservation program if needed.

### Species Description

#### *Liolaemus nazca*

2017. *Liolaemus* “Nazca” Aguilar et al.

Holotype. MUSM 31523: adult male collected in Marcona District, Nazca Province, Department of Ica, Peru, 15.120 S, 75.338 W, 466 m, on 17 January 2013 by César Aguilar, César Ramírez and Alejandro Mendoza.

Paratypes. MUSM 16100, 31520, 31526, 31541: four adult males, same data as holotype. MUSM 31,521, 31,525, 16,101: three adult females, same data as holotype. MUSM 31524, 31527, 31522: three juveniles, same data as holotype.

Referred specimens. BYU 50471–50472: two males, same data as holotype. BYU 50506–50508, BYU 50510: four females, same data as holotype.

Diagnosis. *Liolaemus nazca* belongs to the *L. montanus* group because it lacks a patch of enlarged scales on the posterior thighs. *Liolaemus nazca* forms a clade with other Pacific coast species, *L. insolitus*, *L. poconchilensis* and *L. chiribaya* sp. nov. It differs from *L. poconchilensis* in being larger (with a maximum SVL of 59.8 mm; 55.9 mm in *L. poconchilensis*) and lacking enlarged serrate ciliary scales. *L. nazca* differs from *L. insolitus* and *L. chiribaya* sp. nov. by having slightly keeled dorsal scales on the body, which become more conspicuous towards the vertebral line. *Liolaemus nazca* also differs from *L. poconchilensis* and *L. chiribaya* sp. nov. by lacking a “phrynosauroid” or “toad-like” head. *Liolaemus nazca* presents an intense orange or yellow ventral region with dark spots, in contrast to *L. insolitus* and *L. poconchilensis*, both of which have clearer ventral regions, and *L. chiribaya* sp. nov. which has two orange lateral stripes on venter.

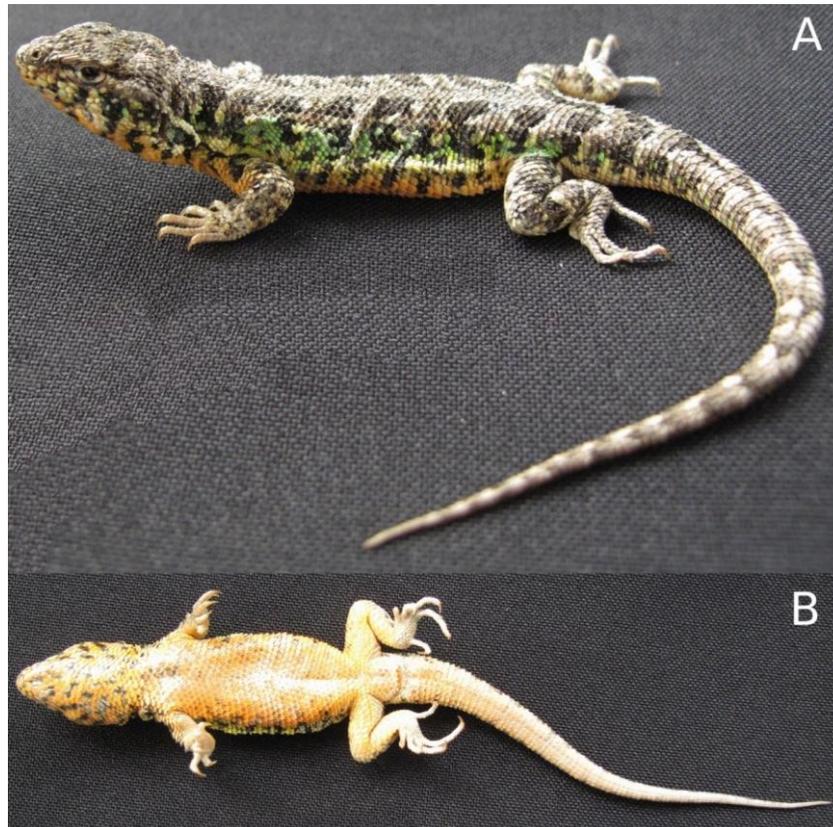
*Liolaemus nazca* is distinguished from other Peruvian species of the *L. montanus* group by its bright green and turquoise scales on body flanks surrounded by yellow and black scales. *Liolaemus nazca* also differs from *L. aymararum*, *L. evaristoi*, *L. melanogaster*, *L. polystictus*, *L. robustus*, *L. thomasi* and *L. williamsi*

in having a smaller SVL (65.9 mm versus 70.1–103.0 mm). *Liolaemus nazca* has fewer scales around midbody (53–62) than *L. signifer* (67–110), and the number of vertebral scales (between the occiput and anterior level of hind limbs) in *L. nazca* is smaller (53–57 scales) than *L. evaristoi* and *L. signifer* (60–129 scales), and greater than those of *L. aymararum*, *L. ortizii* and *L. thomasi* (30–53). *Liolaemus nazca* differs from *L. etheridgei*, *L. ortizii* and *L. thomasi*, all of which have noticeably keeled scales. *Liolaemus nazca* females differs from *L. melanogaster*, *L. polystictus* and *L. thomasi* females by having vestigial precloacal pores. *Liolaemus nazca* males have fewer precloacal pores (3–6) than males of *L. annectens* (6–7) and *L. etheridgei* (6–9).

Description of the holotype. Adult male, SVL 64.5 mm, head length 16.3 mm, head width 13.2 mm, head height 9.5 mm, groin armpit distance 26.4 mm (39.8% SVL), foot length 16.3 mm (25.3% SVL), tail length 77.6 mm (120.3% SVL). 20 dorsal head scales (between the anterior edge of the auditory meatus to the anterior edge of the rostral); dorsal head scales smooth, occipitoparietal scales irregular and convex, frontonasal and parietal area with convex scales; scale organs more abundant in the prefrontal, internasal, lorilabial and loreal regions; supralabial region without scales organs; three organs in the left and one in the right post-rostral. Nasal scale separated from rostral, and separated from the first supralabial by one scale, right nasal bordered by eight scales; cantal separated from nasal by two scales. Six supralabials. Ten lorilabial scales, four in contact with subocular. Six infralabials. Oval auditory meatus (height 2.4 mm, width 1.0 mm) with two small scales on anterior margin. Seven smooth and convex temporal scales. Distance between orbit and auditory meatus 6.5 mm. Rostral almost three times as wide as tall (width 2.8 mm; height 1.1 mm). Mental subpentagonal, almost twice as wide as tall (width 2.7 mm; height 1.5 mm). Hourglass-shaped interparietal, with elongated posterior apex, bordered by eight scales, parietals of similar size as interparietal. Frontal quadrangular. Complete supraorbital semicircles on both sides. Semicircles formed by 13 scales. Four enlarged supraoculars. Six superciliares overlapping on both sides. Ten upper and nine lower ciliary scales. Subocular elongated, larger than eye diameter, separated from supralabials by a single row of lorilabials. Supralabials of similar size. Eight lorilabials, with double and triple rows of scale organs. Eighth, seventh, sixth and fifth lorilabials in contact with subocular. Preocular separated from the lorilabial row by two scales. Postocular as large as preocular. Mental in contact with five scales, three infralabials (on each side) and two enlarged chin scales. Chin scales forming a longitudinal row of four enlarged scales separated one from the other by seven small scales. Gular scales rounded, flat and imbricated. 24 gulars between auditory meatus. Longitudinal neck fold without keeled scales, almost half in size of dorsal scales. Antehumeral pocket and folds well developed. 36 scales between auditory meatus and shoulder (counting along the post-auricular and longitudinal neck fold), 21 scales between the auditory meatus and the neck fold. Gular fold absent. Dorsal scales imbricated, slightly keeled, more conspicuous towards vertebral line. 53 dorsal scales between the occiput and groin level. 54 scales around midbody. Dorsal scales smooth towards flanks and belly. Ventral scales slightly wider than dorsal. 65 ventral scales between mental scale and cloaca; four precloacal pores. Supracarpals smooth and laminar with oval margins. Subdigital lamellae of fingers with three keels, formula I:8; II:12; III:17; IV:17; V:10 (right hand). Supradigital lamellae smooth and imbricated. Infracarpals and infratarsals keeled and imbricated. Supratarsals smooth and angular, but slightly keeled on fourth finger. Subdigital lamellae toe formula I:8; II:13; III:17; IV:21; V:13 (right foot).

Color pattern in life. (Figure 1) Dorsal color light brown with two paravertebral series of eight dark brown spots, more or less symmetrical, between occiput and pelvis, dark brown spots bordered by lighter scales. Lateral region of the body from cheek (postocular region) to the post-cloacal zone (tail base) with patches of emerald green scales on a bright yellow background, interrupted by dark brown transverse spots. Dorsal head brown with dark black spots. Area surrounding loreal, subocular, mental and ocular scales with bright yellow background color; five dark stripes on lateral head, one projects from eye to postocular and temporal region, one to mouth corner, two through subocular and labial region, and one through preocular and nasal. Dorsal limbs light brown with dark spots not reaching

phalanges. Tail with dark brown subtriangular spots, which merge towards tip of tail. Ventral head, body and tail bright orange, with dark spots on head, and some on neck and belly.



**Figure 1.** Holotype (male, SVL = 64.5 mm, MUSM 31523) of *Liolaemus nazca* in dorsal (A) and ventral (B) views.

Color pattern in preservative. Dorsal background from neck to tip of tail is brown. On dorsal head, dark spots become more evident. Ventral region presents a whitish background coloration; dark spots accentuate and become more conspicuous.

Variation. (Figures 2 and 3). Variation in selected characters is summarized in Table 1. Sexual dichromatism present. Males have two paravertebral series of 6–8 dark brown spots on dorsum surrounded or not by white scales; body flanks with emerald green spots surrounded by yellow and dark brown spots; emerald green spots are present from lower temporal region of head to first third of tail; in young specimens emerald green spots are smaller and do not reach first third of tail. Males with orange or yellow on ventral surface of body, and limbs, with small dark spots in gular region, sometimes forming reticulations. Adult females have throat, belly and base of tail orange, yellowish or whitish, with or without dark spots or reticulations on belly.

Distribution and natural history (Figure 4). *Liolaemus nazca* is only known in Nazca province, Ica department, at elevations of 450–700 m. It was found on the ground or in shallow holes on the ground, mainly in hills (“Lomas”) with low shrub vegetation and sandy soil, less frequently in areas with *Tillandsia* sp. In the summer, some individuals were active as early as 7:27 and as late as 16:22; on winter no individuals were observed. Body temperature of ten specimens ranged 22.7–34.0 °C (substrate temperature: 22.8–44.1 °C; air temperature: 21.4–31.0 °C). It was found together with *Ctenoblepharys adspersa*, *Microlophus* sp. and *Phyllodactylus gerrophygus*. This species is viviparous, one female had two embryos on each side at an advanced stage of development. On the Pacific coast, *L. nazca* is the northernmost species of *Liolaemus*.

**Table 1.** Variation in selected characters among type specimens of *Liolaemus nazca*. All specimens from Museo de Historia Natural Universidad Mayor de San Marcos.

MUSEUM NUMBER	31523	31520	31541	31526	31525	31521	16100	16101	31524	31527	31522
Sex	Male	Male	Male	Male	Female	Female	Male	Female			
Reproductive stage	Adult	Adult	Adult	Adult	Adult	Adult	Subadult	Subadult	Juvenile	Juvenile	Juvenile
SVL	64.5	60.9	63.4	54.4	61.4	56.4	54.2	49.4	28.9	28.1	27.3
Groin armpit distance	26.4	26.0	26.0	23	29.0	26.2	21.0	20.5	11.1	11.3	11.3
Head length	16.3	17.4	16.5	13.6	13.7	13.4	13.8	12.5	8.0	7.8	7.7
Head width	13.2	13.7	14.3	10.5	11.5	11.2	11.3	10.4	6.3	6.0	5.9
Forelimb length	18.5	20.3	17.9	19.6	19.5	19.0	19.5	17.3	9.9	10.8	10.2
Hindlimb length	29.7	31.2	28.5	28.2	27.4	27.4	28.3	26.4	15.6	17.1	13.8
Snout length	6.72	7.2	6.0	5.6	6.2	5.3	5.4	5.2	3.0	3.2	3.0
Scales around midbody	54	58	59.0	57	56	55	59	56	55	57	57
Dorsal scale number	53	56	54	53	53	56	54	50	57	54	55
Head scale number	20	19	19	20	21	21	18	16	18	15	17
Scales around interparietal	8	6	6	5	6	5	7	6	7	7	6
Ventral scale number	65	70	71	70	73	71	74	75	61	75	69
Precloacal pores	4	3	3	6	1 *	3 *	4	6	0	0	0
Supralabial scales	6	7	8	9	8	7	7	9	9	7	8
Gular scales	24	24	21	25	25	23	25	25	21	21	20

\* Vestigial precloacal pores.

### Etymology

The specific epithet *nazca* is a noun in apposition and is given in honor to the Nazca culture (100–800 A.D.). Among the famous Nazca lines, there is a lizard geoglyph.

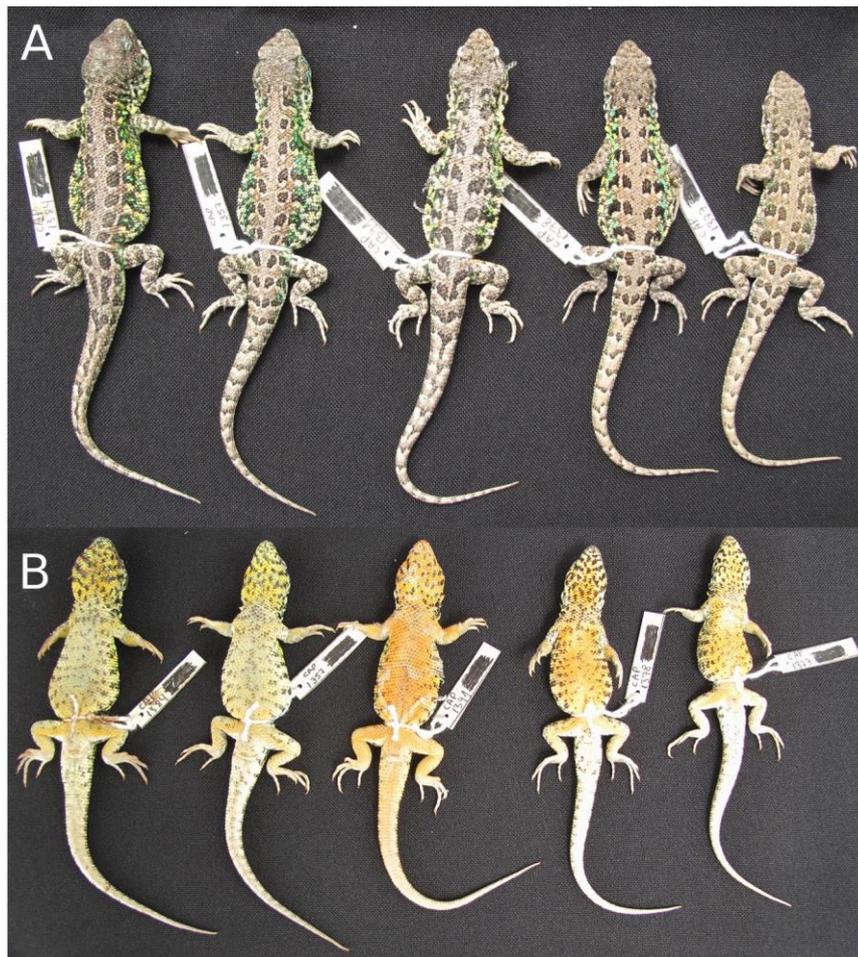
### *Liolaemus chiribaya*

2018. *Liolaemus* “Moquegua” Aguilar-Puntriano et al.

Holotype. MUSM 31547: adult male collected near “Cerros Los Calatos”, 16.91892S, 70.89596W, Torata District, Mariscal Nieto Province, Moquegua Department, Perú, 2615 m, December 19, 2014 by César Aguilar, Jessie Montalvo and Maribel Angeles.

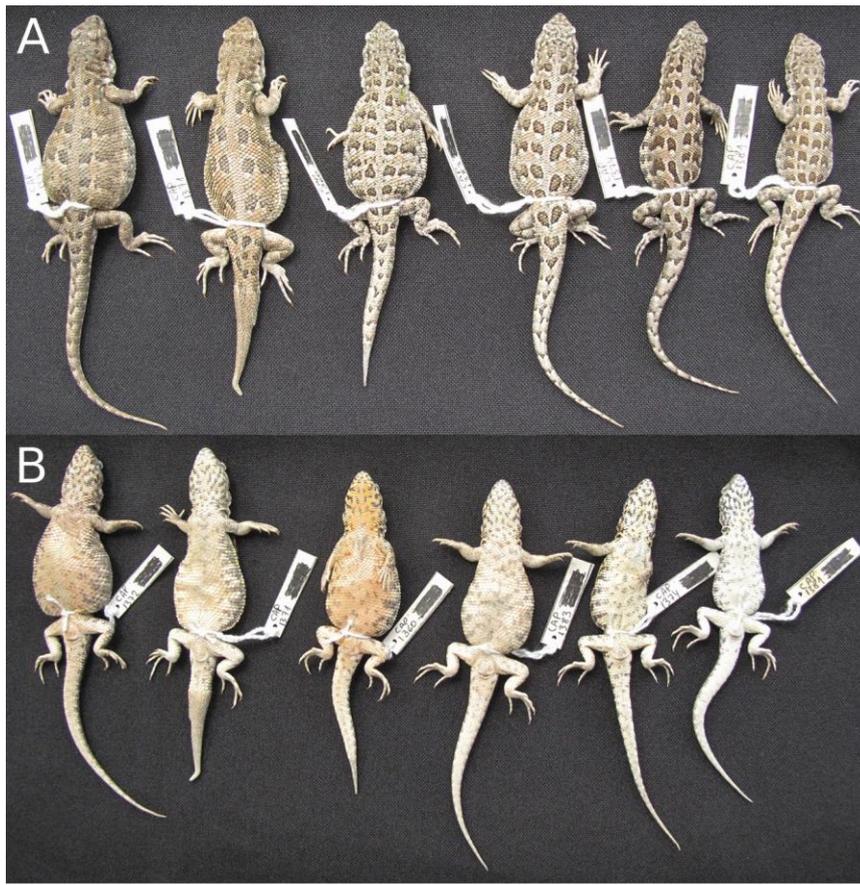
Paratypes. MUSM 31553: adult male collected in Jaguay Chico, Torata District, Mariscal Nieto Province, Moquegua Department, Peru 16.94567 S, 70.88486 W, 2928 m, December 19, 2014; MUSM 31549–31550: one female and juvenile collected in the same location and date as previous specimen, 2942 and 2913 m respectively; MUSM 31548: a female collected near the Asirune Archaeological Zone, near Jaguay Chico, Torata District, Mariscal Nieto Province, Moquegua Department, Peru, 16.95213 S, 70.87854 W, 2990 m; all above paratypes collected by César Aguilar, Jessie Montalvo and Maribel Angeles; MUSM 31386–31388, 31390–31391: five males and MUSM 31389: one female collected in “Cerro Los Calatos”, Torata District, Mariscal Nieto Province, Moquegua Department, Perú, 2794–2988 m, 27–29 December 2012 by Juana Suárez.

Referred specimens. BYU 51568, BYU 51570: two males, collected in Jaguay Chico, Torata District, Mariscal Nieto Province, Moquegua Department, Perú; MUSM 31546: male collected near the Asirune Archaeological Zone, near Jaguay Chico, Torata District, Mariscal Nieto Province, Moquegua Department, Perú; BYU 51564, BYU 51566–51567: two females and one juvenile with same data as MUSM 31546.



**Figure 2.** Dorsal (A) and ventral (B) variation in males of *Liolaemus nazca*. From left to right: MUSM 31520 (SVL = 60.9 mm), BYU 50472 (SVL = 64 mm), MUSM 31523 (holotype, SVL = 64.5 mm), BYU 50471 (SVL = 60.0 mm), MUSM 31526 (SVL = 53.1 mm).

**Diagnosis.** *Liolaemus chiribaya* is identified as a member of the *L. montanus* group by the absence of a patch of enlarged scales on posterior thighs. *Liolaemus chiribaya* forms a clade with *L. insolitus*, *L. poconchilensis* and *L. nazca* sp. nov. It differs from *L. poconchilensis* by having a fourth finger extending beyond the armpit when a hindlimb is brought forward (fourth finger does not exceed past the armpit in *L. poconchilensis*); male *L. chiribaya* further differs from *L. poconchilensis* by the presence of dorsal turquoise spots (absent in males of *L. poconchilensis*), and differs from *L. nazca* by having smooth dorsal body scales (dorsal body scales slightly keeled in *L. nazca*). In addition, *L. chiribaya* lacks an orange or yellow venter with dark spots. *Liolaemus chiribaya* differs from *L. insolitus* by having a greater number of scales around midbody (58–69 vs. 45–53). *Liolaemus chiribaya* differs from *L. nazca*, *L. insolitus* and other Peruvian species of the *L. montanus* group (except *L. poconchilensis*) by having a “phrynosauroid” head. *Liolaemus chiribaya* also differs from other Peruvian species of the *L. montanus* group by having dorsal turquoise scales and a maximum 68.8 mm SVL, being a smaller species than *L. aymararum*, *L. evaristoi*, *L. melanogaster*, *L. polystictus*, *L. robustus*, *L. thomasi* and *L. williamsi* (SVL 70.1–103.0 mm). *L. chiribaya* has fewer scales around midbody (54–66) than *L. signifer* (67–110), fewer maximum number of dorsal scales (between occiput and anterior level of hindlimb; 64) than *L. evaristoi* (75) and *L. signifer* (129), and more than *L. aymararum*, *L. ortizii* and *L. thomasi* (all  $\leq 53$ ). It also differs from *L. etheridgei*, *L. ortizii* and *L. thomasi* by lacking strongly keeled scales. Females of *L. chiribaya* also have vestigial preloacal pores, which are absent in females of *L. melanogaster*, *L. polystictus* and *L. thomasi*.



**Figure 3.** Dorsal (A) and ventral (B) variation in females of *Liolaemus nazca*. From left to right: MUSM 31525 (SVL = 61.4 mm), BYU 50506 (SVL = 66.1 mm), BYU 50507 (SVL = 54.9 mm), MUSM 31521 (SVL = 56.4 mm), BYU 50508 (SVL = 52.6 mm), BYU 50510 (SVL = 47.2 mm).



**Figure 4.** Habitat of *Liolaemus nazca*.

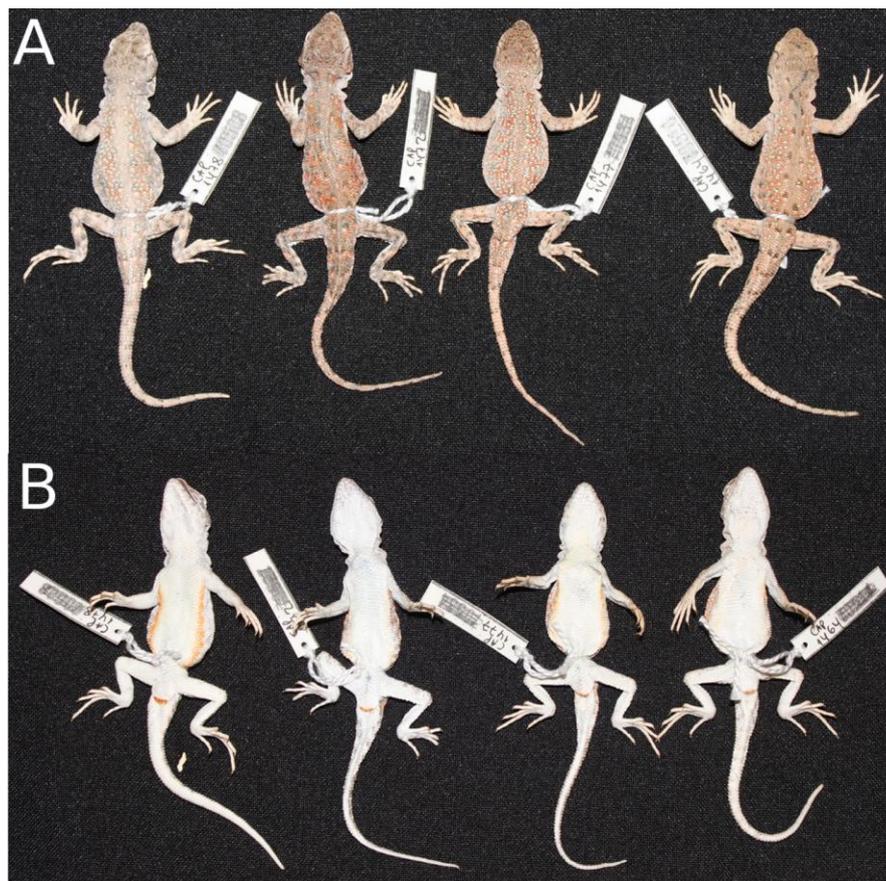
Description of the holotype. Adult male, SVL 52.6 mm, head length 14.2 mm, head width 11.7 mm, head height 7.6 mm, groin armpit distance 20.3 mm (38.6% SVL), foot length 14.3 mm (27.2 % SVL),

tail length 54.2 mm (103% SVL). 21 dorsal scales on head; smooth dorsal head scales, occipital, parietal and frontonasal area with convex scales, parietal scales polygonal; scale organs numerous in prefrontal, lorilabial and loreal scales; supralabial scales with few scale organs; five organs in the left postrostral and four in the right. Nasal scale separated from rostral, separated by a scale from first supralabial, right nasal limited by eight scales; canthal separated from nasal by two scales. Seven supralabials. Eight lorilabial scales, three in contact with the subocular. Seven infralabials. Oval auditory meatus (height 1.8 mm; width 1.2 mm), with two small protruding scales on anterior margin. Eight smooth and convex temporal scales. Distance between orbit and auditory meatus 4.1 mm. Rostral three times wider than high (width 2.4 mm; height 0.8 mm). Mental subpentagonal, almost twice as wide as high (width 2.4 mm; height 1.3 mm). Interparietal pentagonal, with elongated posterior apex, bordered by five scales, parietals larger than interparietal. Frontal scales polygonal. Complete supraorbital semicircles on both sides. Semicircles formed by 13 scales. Three enlarged supraoculars. Eight superciliares. 14 upper and 12 lower ciliares. Subocular divided into three, longer than eye diameter, posterior subocular larger and separated from supralabials by a single row of lorilabials. Supralabials of similar size. Lorilabial eighth and seventh in contact with subocular. Preocular of medium size, separated from lorilabial row by a scale. Postoculars of similar size to preocular. Mental scale in contact with four scales: two infralabials (on each side) and two enlarged chin scales. Chin scales forming a longitudinal row of four enlarged scales separated from each other by 12 scales. Gular scales rounded, flat and overlapped with very few scale organs. 25 gular scales between auditory meatus. Longitudinal neck fold without keeled scales, almost half in size of dorsal scales. Antehumeral pocket and well developed antehumeral neck folds. 30 scales between auditory meatus and shoulder (counting along post-auricular and longitudinal neck fold), 25 scales between the auditory meatus and the neck fold. Gular fold absent. Dorsal scales juxtaposed or poorly imbricated. 60 dorsal scales between occiput and groin level. 64 scales around midbody. Dorsal scales smooth on flanks and belly. Ventral scales slightly wider than dorsal scales. 74 ventral scales between mental and cloaca; four precloacal pores present. Smooth laminar supracarpals, with oval or rounded margins. Subdigital lamellae of fingers with three keels, and with formula I:7; II:11; III:15; IV:17; V:8 (right hand). Smooth and imbricated supradigital lamellae. Smooth infratarsals and keeled infracarpals, both strongly imbricated. Supratarsal smooth, oval or rounded. Subdigital lamellae of toes with formula I:9; II:11; III:16; IV:18; V:13 (right foot).

Color pattern in life (Figure 5). Dorsal paravertebral orange and turquoise scales from neck region to tail base. Dorsal head with pale orange and brown scales on occipital and frontal region. Dark brown scales on supraocular, parietal region and snout. Dorsal limbs pale orange, with some orange scales and dark brown scales forming zigzag spots up to base of digits (hand) or on digits (foot). First third of tail with turquoise and orange scales, with dark scales forming transverse bands or spots. Ventral scales on head, limbs and tail white smoke, belly with two orange lateral stripes separated by a central area of pale yellowish scales. Ventral tail white smoke.

Color pattern in preservative. Dorsal light gray scales on vertebral region and dark brown scales on paravertebral region, from neck to tail base. Dorsal head with light gray scales on occipital, parietal, frontal and prefrontal regions. Dark olive scales on supraocular, and some on parietal and temporal region, creamy scales on snout. Dorsal limbs pale gray, with gray scales forming zigzag marks up to base of digits (hand) or on digits (foot). Tail pale gray with dark scales forming transverse bands or spots. Ventral scales white smoke on head, limbs, tail and belly.

Variation. (Figures 5 and 6). Variation in selected characters is summarized in Table 2. Sexual dichromatism present. Females and juveniles on dorsal body have 6 to 8 triangular or quadrangular marks, sometimes bordered by lighter scales; without turquoise blue scales; males with or without triangular or quadrangular marks, but if present marks are usually covered by turquoise blue scales; venter whitish without orange lateral stripes.

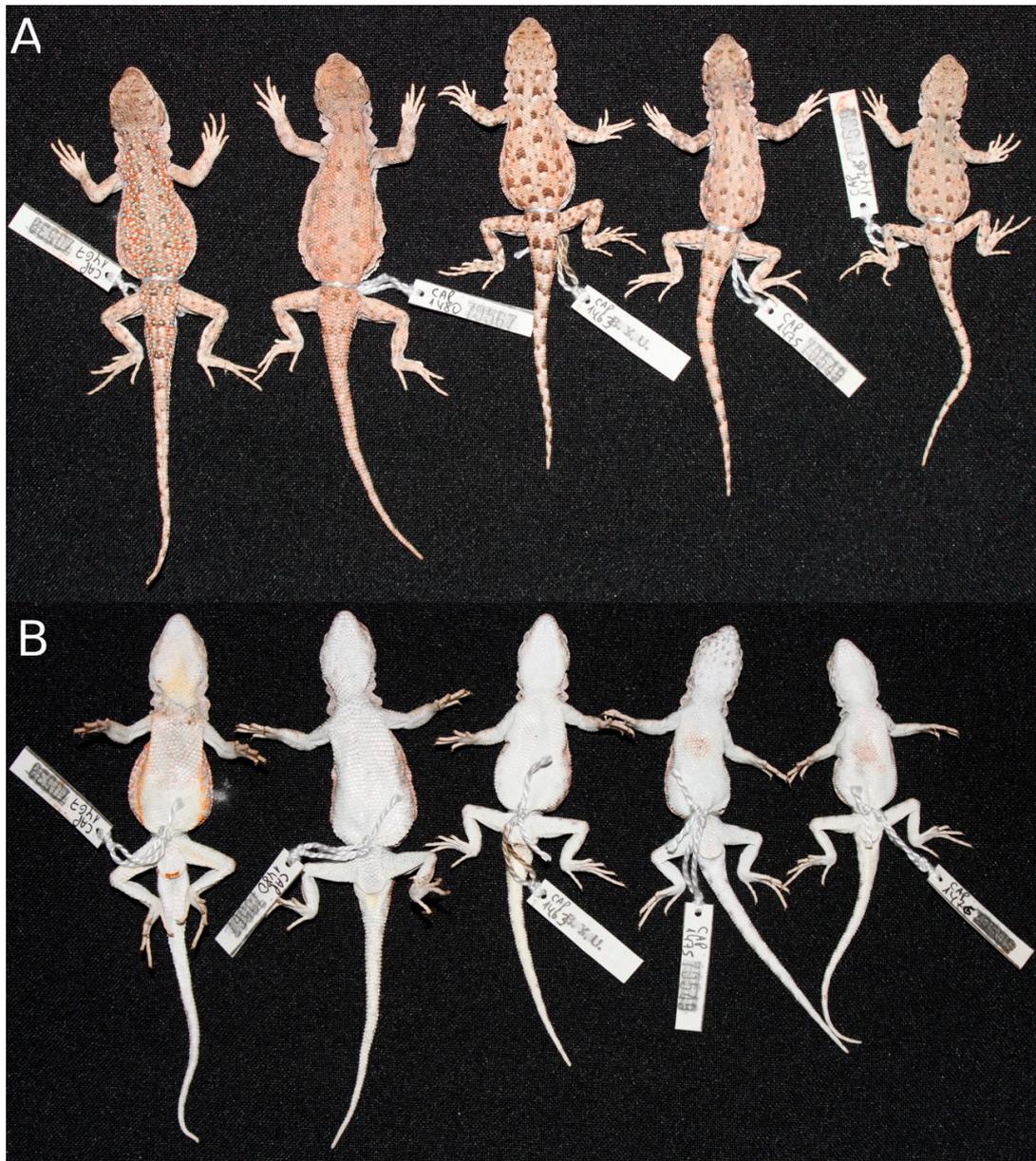


**Figure 5.** Dorsal (A) and ventral (B) variation in males of *Liolaemus chiribaya*. From left to right: MUSM 31547 (Holotype, SVL = 52.6 mm), BYU 51568 (SVL unknown), BYU 51570 (SVL unknown), MUSM 31553 (SVL = 52.7 mm).

**Table 2.** Variation in selected characters among type specimens of *Liolaemus chiribaya* sp. nov. All specimens from Museo de Historia Natural Universidad Mayor de San Marcos.

MUSEUM NUMBER	31547	31386	31387	31391	31390	31388	31548	31549	31389	31553	31550
Sex	Male	Male	Male	Male	Male	Male	Female	Female	Female	Male	
Reproductive stage	Adult	Adult	Adult	Subadult	Juvenile						
SVL	52.6	66.8	68.8	61.8	61	64.9	49.6	57.0	66.2	46.8	46.4
Groin armpit distance	20.3	33.0	34.9	31.5	30.6	32.4	20.3	25.0	35.9	21.0	21.0
Head length	14.2	16.0	16.3	15.5	14.6	15.6	13.0	13.5	14.5	12.3	12.4
Head width	11.7	14.0	13.3	13.5	12.7	13.9	11.4	11.7	13.0	10.5	10.4
Forelimb length	23.6	24.4	25.8	24.5	23.2	24.0	20.4	22.5	22.5	19.1	19.6
Hindlimb length	33.8	34.0	33.7	34.6	34.8	34.3	30.9	32.4	32.5	30.1	30.1
Snout length	5	7	6.8	6.8	6.2	6.1	5.1	5.6	5.9	5.1	4.9
Scales around midbody	64	65	66	63	60	65	57	55	60	63	58
Dorsal scale number	60	55	58	59	52	63	56	53	61	57	61
Head scale number	21	20	20	23	20	24	18	18	20	19	21
Scales around interparietal	5	6	7	6	6	6	6	6	7	7	5
Ventral scale number	74	76	72	73	73	73	77	67	73	69	74
Precloacal pores	4	5	5	3	3	3	4*	2*	4*	5	2*
Supralabial scales	7	9	9	8	9	10	9	7	9	9	7
Gular scales	25	22	21	23	22	19	20	21	20	24	20

\* Vestigial precloacal pores.



**Figure 6.** Dorsal (A) and ventral (B) variation in *Liolaemus chiribaya*. From left to right: MUSM 31546 (male, SVL = 52.5 mm), BYU 51564 (female, SVL unknown), MUSM 31548 (juvenile, SVL = 49.6 mm), BYU 51566 (juvenile, SVL unknown), BYU 51567 (juvenile, SVL unknown).

Distribution and natural history (Figure 7). *Liolaemus chiribaya* is only known in the District of Torata, Province of Mariscal Nieto, Department of Moquegua, at elevations of 2615–3005 m; they were found under rocks or on ground in desert areas with cacti and low shrubs; they were active between 10:00 and 14:00. Other lizard species present in the area were *Phyllodactylus gerrophygus* and *L. tacnae*.

**Etymology.** The specific epithet *chiribaya* is a noun used in apposition and honors the Chiribaya culture (900–1350 A.D.). Chiribayans were settled in the basin of the Ilo River, and expanded north to the Tambo valley (Arequipa) and the south to the Azapa valley (Chile), including the high altitude regions, up to nearly 3000 m of elevation.

#### *Liolaemus victormoralesii*

2017. *Liolaemus* “Abra Toccto” Aguilar et al.

2018. *Liolaemus* “Abra Toccto” Aguilar-Puntriano et al.

Holotype. MUSM 31461: adult male collected at Abra Toccto, Huamanga Province, Ayacucho Department, Perú, 13.346 S, 74.184 W, elevation 4222 m, on 01 June 2012 by César Aguilar, Víctor J. Vargas, Frank Huari and Elver Coronado.

Paratypes. MUSM 31371–31372, 31460: three adult males collected at Abra Toccto, Huamanga Province, Ayacucho Department, Perú, 13.298 S, 74.091 W, elevation 4193–4215 m on 3 December 2012 by Alfredo Guzmán and Víctor J. Vargas; MUSM 31460, 31468: two adult females, same data as holotype; MUSM 31463: juvenile collected at Abra Toccto, Huamanga Province, Ayacucho Department, Perú, 13.35 S, 74.187 W, elevation 4182m, on 04 June 2012 by César Aguilar, Víctor J. Vargas, Frank Huari and Elver Coronado. MUSM 25700, adult male collected at Chiara, Huamanga Province, Ayacucho Department, Perú, 13.341 S, 74.216 W, elevation 4145m, on 30 November 2006 by Margarita Medina.



Figure 7. Habitat of *Liolaemus chiribaya*.

Referred specimens. BYU 50431, BYU 50427, MUSM 31462: three males, same data as holotype; BYU 50433, BYU 50428: two females, same data as holotype.

Diagnosis. *Liolaemus victormoralesii* is identified as a member of the *L. montanus* group by the absence of a patch of enlarged scales on posterior thighs. *Liolaemus victormoralesii* forms a clade with *L. evaristoi*, *L. melanogaster*, *L. polystictus*, *L. robustus* and *L. williamsi*. It differs from closely related *L. evaristoi* by lacking blue scales on the dorsum and flanks, having a larger size (maximum SVL 88.9 mm in *L. victormoralesii* and 70.1 mm in *L. evaristoi*) and by lacking vestigial preloacal pores in females. *Liolaemus victormoralesii* differs from *L. melanogaster* by lacking black belly scales (gray scales in adult *L. victormoralesii*). Adult females of *L. victormoralesii* differ from *L. polystictus* and *L. williamsi* females by having a darker dorsal background coloration and few large contrasting marks dorsally (*L. polystictus* and *L. williamsi* have a lighter dorsal background coloration and large number of small contrasting marks dorsally). *Liolaemus victormoralesii* further differs from *L. williamsi* by having a larger size (maximum SVL 74.9 mm in *L. williamsi*) and by lacking vestigial preloacal pores in females. *Liolaemus victormoralesii* differs from *L. robustus* by lacking dorsal yellow greenish scales. Adult males of *Liolaemus victormoralesii* differs from *L. etheridgei* by lacking light blue dorsolateral scales, from *L. annectens* by having a darker dorsum, and from *L. signifer* by lacking bright yellow and fewer maximum number of dorsal scales (57 vs. 129). *Liolaemus victormoralesii* differs from *L. ortizi* and *L. thomasi* by lacking strongly keeled and by having smaller dorsal scales. *Liolaemus victormoralesii* differs from *L. aymararum* by having more scales around midbody (51–64 vs. 48–52) and smaller dorsal scales. It differs from *L. nazca* sp. nov. by lacking emerald green spots surrounded by black and yellow scales laterally on body. It differs from *L. chiribaya* and *L. poconchilensis* by lacking a “phrynosauroid”

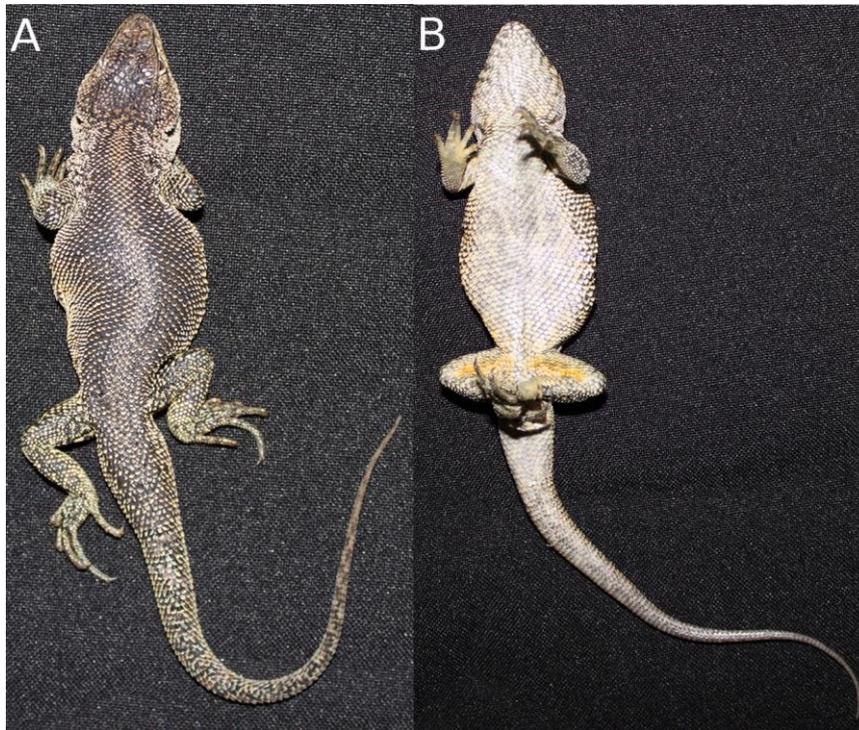
head, and from *L. poconchilensis* by lacking well-developed ciliary scales (serrate “combs”) surrounding the eyes. It differs from *L. insolitus* by lacking dorsal and lateral blue spots. *L. victormoralesii* further differs from *L. insolitus* and *L. poconchilensis* by lacking dorsal smooth scales. *Liolaemus victormoralesii* also differs from *L. chiribaya* sp. nov., *L. etheridgei*, *L. nazca* sp. nov., *L. ortizii* and *L. poconchilensis* in having a larger SVL (88.9 mm versus 56–77 mm). *Liolaemus victormoralesii* females also differs from *L. annectens*, *L. aymararum*, *L. chiribaya*, *L. etheridgei*, *L. insolitus* and *L. nazca* sp. nov by lacking vestigial preloacal pores.

Description of the holotype. Adul male, SVL 83.8 mm, head length 19.2 mm, head width 18.2 mm, head height 10.8 mm, groin armpit distance 29 mm (34.6% SVL), foot length 19.5 mm (23.4 % SVL), tail length 107 mm (128.5% SVL). 19 dorsal scales on head; smooth dorsal head scales, occipital, parietal and frontonasal area with slightly convex scales, parietal scales polygonal, similar in size to interparietal; numerous scale organs in prefrontal and lorilabial, and few in loreal and supralabial scales; six and four scale organs on left and right postrostral respectively. Nasal scale separated from rostral, separated by a scale from first supralabial, right nasal limited by six scales; canthal separated from nasal by one scale. Nine supralabials. Seven lorilabials, six in contact with subocular. Seven infralabials. Oval auditory meatus (height 3.5 mm; width 2.7 mm). Eight smooth temporal scales. Distance between orbit and auditory meatus 9.4 mm. Rostral two times wider than tall (width 3.2 mm; height 1.5 mm). Mental trapezoidal, almost twice as wide as high (width 3.8 mm; height 2.1 mm). Interparietal hexagonal, with elongated posterior apex bordered by six scales, interparietal similar in size as parietals. Frontal divided into two scales. Complete supraorbital semicircles on both sides. Semicircles formed by 16 scales. Seven enlarged supraoculars. Seven superciliaries. 14 upper and 12 lower ciliaries. Subocular not divided, longer than eye diameter. Supralabials of similar size. Some lorilabials with rows of scale organs. Five lorilabials in contact with subocular. Preocular separated from lorilabial row by two scales. Postoculars similar in size as preocular. Mental scale in contact with four scales: one infralabial (on each side) and two enlarged chin scales (one on each side). Six chinshields (three on each side), second pair separated by four scales. Gular scales rounded, flat and without scale organs. 23 gular scales between auditory meatus. Longitudinal neck fold without keeled, but granular scales. Without antehumeral pocket, well developed antehumeral neck folds. 44 scales between auditory meatus and shoulder (counting along post-auricular and longitudinal neck fold). Gular fold absent. Dorsal scales rhomboid, slightly imbricate or juxtaposed, and slightly keeled. 57 scales between occiput and groin level. 58 scales around midbody. Scales of flanks rhomboidal and smooth. Ventrals slightly larger than dorsals, flat, and imbricated. 74 ventral scales between mental and cloaca; five preloacal pores present. Smooth laminar supracarpals, with oval or angular margins. Subdigital lamellae of fingers with three keels, and with formula I:8; II:13; III:16; IV:17; V:12 (right hand). Smooth and imbricated supradigital lamellae. Infratarsals and infracarpals keeled, both strongly imbricated. Supratarsals keeled, triangular or angular in shape. Subdigital lamellae of toes with formula I:8; II:14; III:18; IV:20; V:14 (right foot).

Color pattern in life (Figure 8). Dorsal head between snout and anterior level of eyes brown with black on scale margins, and between anterior level of eyes and occipital region mainly black. Anterior third of dorsal body with a central band of reddish cream scales and posterior two thirds mostly black with reddish cream scale tips; dorsal flanks mostly black with reddish cream scale tips. Lateral body mostly reddish cream but some with scales half black. Dorsal region of tail, anterior and posterior limbs, similar to dorsal body but also with pale blue scales. No vertebral line or scapular spots. Ventral body and tail gray with pale yellow scales, throat region with gray longitudinal stripes, ventral thighs orange.

Color in preservative. Head darker than body, dorsal head mostly dark beige but some scales completely black, parietal zone dark beige. Trunk with scales having black anteriorly and beige posteriorly, scales close to neck with one third black and two thirds beige, scales close to middle and posterior body two thirds black and one third beige. Fore and hind limbs same color as trunk, but with lighter scales close to hands and foot. Without vertebral line, scapular or paravertebral spots nor dorsolateral stripes. Lateral body with scales having one half black anteriorly and other half beige.

Dorsal tail similar to trunk, but with lighter scales close to scale tips. Ventrally, from mental scale to tail tip, mostly light gray but some scales cream.



**Figure 8.** Holotype (male, SVL = 83.3 mm, MUSM 31461) of *Liolaemus victormoralesii* in dorsal (A) and ventral (B) views.

Variation (Figures 9 and 10). Variation in selected characters is summarized in Table 3. Sexual dichromatism present in ventral coloration, with males having yellow scales on thighs. Juveniles exhibit gray dorsal background coloration. Juveniles with black spots on paravertebral region, sometimes enclosing pale orange scales. Females and juveniles ventrally from mental region to tail tip white or white with gray or black scales, some specimens with reddish or orange scales on body venter.

Distribution and natural history (Figure 11). *Liolaemus victormoralesii* is only known in Huamanga Province, Department of Ayacucho, at elevations of 4175–4252 m; *L. victormoralesii* was found under rocks or on the ground in grassland areas. It was found together with *Liolaemus wari* and the snake *Tachymenis peruviana*. Díaz [9] recorded body temperatures of 104 specimens of *Liolaemus victormoralesii* (as *L. aff. melanogaster*; mean  $\pm$  standard deviation):  $21.3 \pm 6.4$  °C (substrate temperature:  $14.5 \pm 4.1$  °C; air temperature:  $13.2 \pm 3.4$  °C). However, lower body temperatures were recorded in the summer:  $18.9 \pm 6.8$  °C (substrate temperature:  $14.1 \pm 3.1$  °C; air temperature:  $12.1 \pm 2.7$  °C); and higher body temperatures were recorded in the fall:  $29.9 \pm 0.1$  °C (substrate temperature:  $19.5 \pm 3.4$  °C; air temperature:  $15.7 \pm 2.2$  °C). *Liolaemus victormoralesii* feeds on Araneae, Acari, Collembola, Scorpiones, Coleoptera, Diptera, Hymenoptera, Orthoptera, Lepidoptera, insect larvae and pupae, and vegetal matter [9]. *Liolaemus victormoralesii* feeds more on vegetal matter during summer and winter, and more on arthropods during spring ( $n = 56$ ; [9]). This species is viviparous, one female had three embryos on each side at an advanced stage of development.



**Figure 9.** Dorsal and ventral (B) variation in *Liolaemus victormoralesii*. (A): BYU 50431 (male, SVL = 87.8 mm), (B): MUSM 31462 (juvenile, SVL = 60.9 mm), (C): BYU 50427 (juvenile, SVL = 52.2 mm).



**Figure 10.** Dorsal and ventral variation in females of *Liolaemus victormoralesii*. (A): BYU 50433 (SVL = 79.7 mm), (B): BYU 50428 (SVL = 69 mm), (C): MUSM 31468 (SVL = 75.4 mm).

**Table 3.** Variation in selected characters among type specimens of *Liolaemus victormoralesii* sp. nov. All specimens from Museo de Historia Natural Universidad Mayor de San Marcos.

MUSEUM NUMBER	31461	31373	31372	25700	31460	31371	31468	31463
Sex	Male	Male	Male	Male	Female	Female	Female	
Reproductive stage	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Juvenile
SVL	83.8	84.1	81.1	89	79.3	77.7	75.4	63.3
Groin armpit distance	29	32	30.2	33.8	35.6	35.1	34.5	25.8
Head length	19.22	21.2	20.7	20.1	17.7	17.6	16.6	14.4
Head width	18.2	19.1	18.2	18.7	16.4	15.1	15.5	12.8
Forelimb length	26.4	25.3	22.4	34.0	26.8	23.7	25.0	20.1
Hindlimb length	44.1	36.4	34.7	45.0	41.3	33.1	40.1	31.7
Snout length	7.6	8.9	8.2	8.6	7.6	7.8	6.6	5.7
Scales around midbody	58	56	61	52	56	60	51	60
Dorsal scale number	57	50	53	45	53	55	46	56
Head scale number	19	22	21	15	16	21	17	16
Scales around interparietal	7	4	8	7	6	7	7	5
Ventral scale number	74	72	79	66	75	78	70	74
Precloacal pores	7	4	8	7	0	0	0	4
Supralabial scales	11	10	10	10	9	9	10	9
Gular scales	23	26	25	25	24	24	21	27



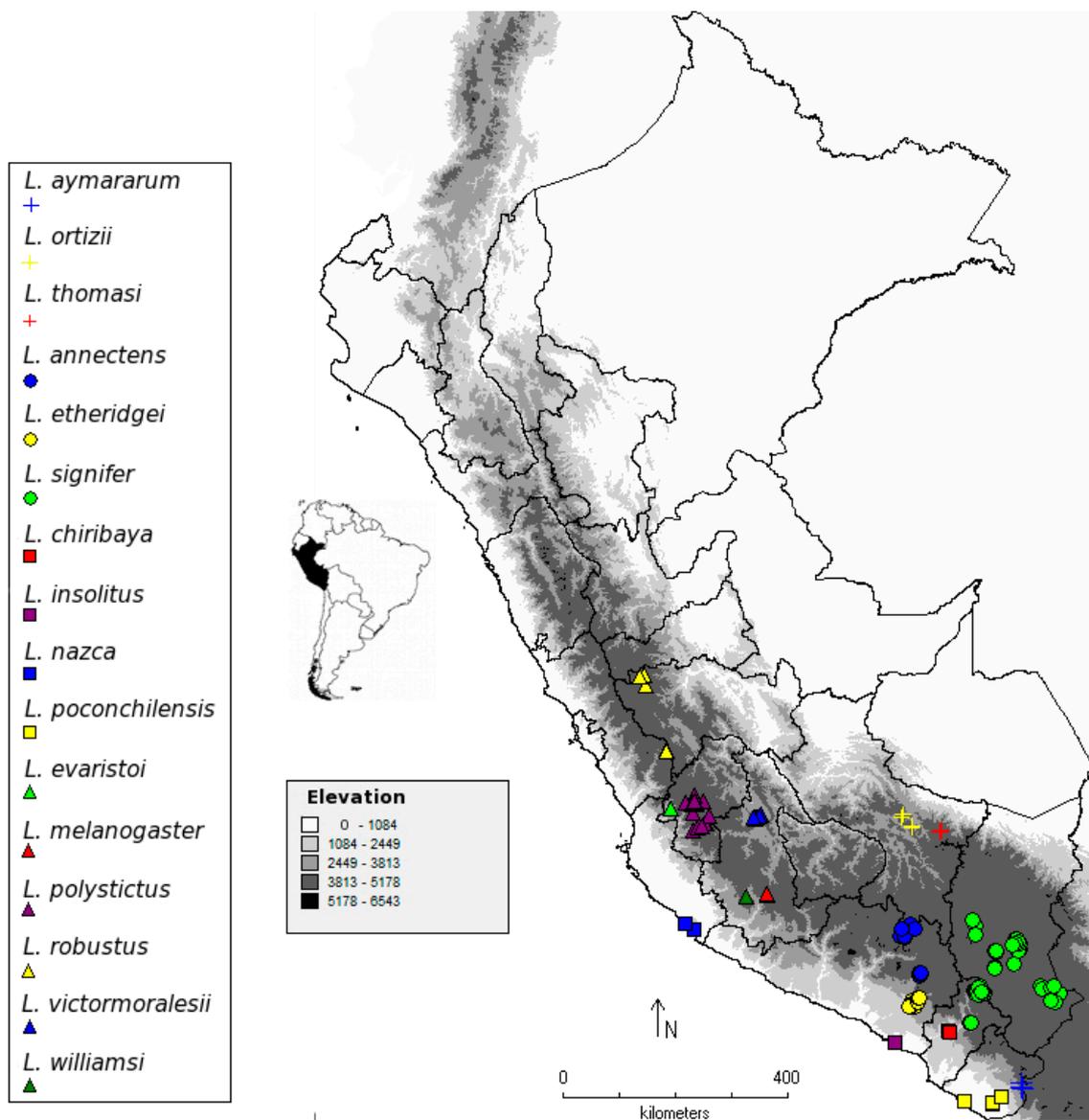
**Figure 11.** Habitat of *Liolaemus victormoralesii*.

*Etymology.* The specific term *victormoralesii* is a noun in apposition and is given to honor our friend and colleague Víctor Morales for his contributions to herpetology. Víctor Morales passed away in December 2015, but his publications and memory live on with us.

#### 4. Discussion

In this paper we describe three new species of *Liolaemus* from Perú (Figure 12), all are assigned to the *L. montanus* group. Two of these new species (*L. nazca* and *L. chiribaya*) inhabit the Pacific Peruvian coast. Although *L. nazca* could be present in San Fernando National Reserve, other populations are outside of any protected area and close to a mining concession in southern Perú. All *L. chiribaya*

specimens were found outside any protected area, and some individuals of this species were found in a mining concession in Moquegua department. Other Pacific lowland *Liolaemus* species from the *L. montanus* group face additional threats. *L. insolitus*, for instance, has experienced habitat loss due to increased urbanization of coastal areas, and is categorized as Endangered by the IUCN [10]. Even though *L. poconchilensis* is also categorized as Endangered by the IUCN [11], Peruvian populations of this species lacks any legal protection as they are not included in the local list of protected species [12], and they are not present in any protected area.



**Figure 12.** Map showing localities of species of the *Liolaemus montanus* group present in Perú.

Andean *Liolaemus* species of the *L. montanus* group present in Perú face similar threats as their lowland relatives. Some undescribed populations are initially found in mining concessions as a result of consulting activities and as part of environmental impact assessments [13]. For instance, the habitats of likely new, distinct populations related to *L. annectens* in southern Perú might have been destroyed or polluted before these lizards can be described and receive legal protection. Most probably these unnamed lizard populations are not present in any Peruvian protected area either.

Key to the Peruvian species of the *Liolaemus montanus* group.

1a. Dorsal scales larger, maximum of 53 from occiput to anterior level of thighs	2
1b. Dorsal scales smaller, up to 85 from occiput to anterior level of thighs	4
2a. Lateral scales without keels or slightly keeled	<i>L. aymararum</i>
2b. Lateral and dorsal scales strongly keeled	3
3a. Adults with dark belly	<i>L. thomasi</i>
3b. Not as above	<i>L. ortizii</i>
4a. Short snout, short and triangular lower jaw	5
4b. Not as above	6
5a. Ciliary scales well developed, without dorsal green spots	<i>L. poconchilensis</i>
5b. Ciliary scales not as above, with dorsal green spots	<i>L. chiribaya</i>
6a. Dorsal scales smooth	<i>L. insolitus</i>
6b. Dorsal scales keeled or slightly keeled	7
7a. Emerald green spots dorsolaterally, orange or yellow venter	<i>L. nazca</i>
7b. Not as above	8
8a. Blue spots dorsally and laterally on body, limbs and tail	9
8b. Not as above	10
9a. No blue spots on head	<i>L. evaristoi</i>
9b. Blue spots on head present	<i>L. etheridgei</i>
10a. Adult males with orange or bright yellow dorsal body scales (Arequipa, Moquegua and Puno regions)	11
10b. Not as above	12
11a. Small dorsal scales, up to 129 from occiput to anterior level of thighs	<i>L. signifier</i>
11b. Fewer scales not as above, maximum of 72 scales from occiput to anterior level of thighs	<i>L. annectens</i> (type locality)
12a. Adults with dorsal yellow-greenish scales on body, tail or limbs, and whitish venter	<i>L. robustus</i> (type locality)
12b. Not as above	13
13a. Only black scales on belly	<i>L. melanogaster</i>
13b. Not as above	14
14a. Females with precloacal pores present	<i>L. williamsi</i>
14b. Females without precloacal pores	15
15a. Females with large dorsal marks in a dark background coloration	<i>L. victormoralesii</i>
15b. Females with small dorsal marks in a light background coloration	<i>L. polystictus</i>

**Author Contributions:** Conceptualization, C.A.-P., C.R. and J.W.S.J.; Methodology, C.A.-P. and C.R.; Software, C.A.-P.; Validation, C.A.-P., C.R., E.C., A.M., V.V. and J.W.S.J.; Formal Analysis, C.A.-P. and C.R.; Investigation, C.A.-P., C.R., E.C., A.M., V.J.V. and J.W.S.J.; Resources, C.A.-P. and J.W.S.J.; Data Curation, C.A.-P. and C.R.; Writing—Original Draft Preparation, C.A.-P.; Writing—Review & Editing, C.A.-P., C.R., E.C., A.M., V.J.V. and J.W.S.J.; Visualization, C.A.-P.; Supervision, C.A.-P.; Project Administration, C.A.-P. and J.W.S.J.; Funding Acquisition, C.A.-P. and J.W.S.J.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

Specimens used in this study. FMNH= Field Museum of Natural History; ZSM = Zoologische Staatssammlung München; MCZ = Museum of Comparative Zoology.

*Liolaemus aymararum* (7): Tacna Department: Tacna Province: Palca: MUSM 21336-40; 21529, 21533.

*Liolaemus ortizii* (14): Cusco Department (Holotype: ZSM 647/1979; Paratype: MCZ 11061); Cusco Department: Paucartambo Province: Abra Huancarani: MUSM 31509-12; BYU 50476-79; Cusco Department: Calca Province: Chaupimayo: BYU 50473, 50475; MUSM 31513-14

*Liolaemus thomasi* (7): Cusco Department: Quispicanchis Province: Hualla Hualla: MUSM 31515, 31517, 31519; BYU 50466-68, 50470.

*Liolaemus insolitus* (4): Arequipa Department: Islay Province: Mollendo: MUSM 31489-90; BYU 50500, 50462.

*Liolaemus poconchilensis* (5): Tacna Department: Tacna Province: MUSM 31542-45; BYU 50176.

*Liolaemus evaristoi* (4): Huancavelica Department: Castrovirreyna Province: Sinto: MUSM 31454-55, BYU 50434, 50630

*Liolaemus melanogaster* (10): Ayacucho Department: Lucanas Province: MUSM 31472-76, BYU 50151-55.

*Liolaemus polystictus* (95): Huancavelica Department: Huancavelica Province: Santa Ines: (Holotype: MCZ 45845; Paratypes: MCZ R-161157, 43782, 45844, 45847, 45849, FMNH 81453-61); Huancavelica Department: Huaytará Province: Santa Ines: (MUSM 31446, 31449-52, 31456; BYU 50346, 50435, 50441, 50443, 50565); Huancavelica Department: Huancavelica Province: Huando: MUSM 29594; Huancavelica Department: Huaytará Province: Pilpichaca (MUSM 28632-38, 28641-56, 28658-77, 28679-701; BYU 50439-40).

*Liolaemus robustus* (65): Junín Department: (Holotype: FMNH 34242; Paratypes: FMNH 34242/1-15, 34242/19-21, 34242-23, MCZ 45811-12, R-161155-56, 157226); Junín Department: Junín Province: MUSM 13427, 13467-68, 13476-77, 31504, 30822; BYU 50485; Junín Department: Jauja Province: MUSM 13470-71, 13478; Pasco Department: Cerro de Pasco Province: MUSM 18056-58, 18197, 18401, 18403; Lima Department: Yauyos Province: (Paratype: MCZ 45830; MUSM 23633-36, 31505-08; BYU 50480-84); Huancavelica Department: Huancavelica Province: (MUSM 29591-93, 29595-96, 31439, 31458, BYU 50438, 50442).

*Liolaemus victormoralesii* (10): FMNH 81435-42, 81446-47. Without locality data.

*Liolaemus williamsi* (23): Ayacucho Department: Lucanas Province: Pampas Galeras: (Paratypes: MCZ R-100435, R-145335-37, R-145340, R-157223); Ayacucho Department: Lucanas Province: Pampas Galeras: MUSM 1968, 1972, 1974, 21880-82; Ayacucho Department: Lucanas Province: Chaviña: MUSM 29690, Ayacucho Department: Lucanas Province: Lucanas: (MUSM 31483-87; BYU 50143-44, 50463-65).

*Liolaemus annectens* (4): Arequipa Department: Caylloma Province: MUSM 31499-500, 31503; BYU 50491.

*Liolaemus etheridgei* (9): Arequipa Department: Arequipa Province: Pocsi: MUSM 31491-93, 31496-97, BYU 50494-95; Arequipa Department: Arequipa Province: Chiguata: MUSM 31494-95.

*Liolaemus signifier* (2): Puno Department: Lampa Province: Lampa: Muruhuanca: MUSM 31433; Puno Department: Amantani Island: MUSM 31434.

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