Article

Two new sympatric species of *Stenocercus* (Squamata: Iguania) from the inter-Andean valley of the Mantaro River, Peru

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Abstract

We describe two new sympatric species of *Stenocercus* from the seasonally dry forest of the inter-Andean valley of the Mantaro River (Huancavelica department) in the Central Andes of central-southern Peru, at elevations of 1,693 to 2,920 m asl. *Stenocercus diploauris* **sp. nov.** is similar to *S. formosus* and *S. ochoai*, but differs in having a longitudinal neck fold and C-shaped nuchal mite pocket around the oblique fold and posteriorly limited by the antehumeral fold. *Stenocercus nigrobarbatus* **sp. nov.** is similar to *S. frittsi* and *S. variabilis*, however it can be distinguished by having a postfemoral mite pocket with one or more vertical folds or ridges and by the presence, in adult males, of a continuous black patch covering the infralabials, throat, chest, ventral surfaces of forelimbs, belly (as a midventral line), ventral surfaces of hind limbs, and pelvic region.

Key words: Andes, Huancavelica department, lizard, mite pocket, morphology, seasonally dry forest

Resumen

Describimos dos especies simpátricas de *Stenocercus* de los bosques estacionalmente secos del valle interandino del Río Mantaro (Departamento de Huancavelica) en los Andes Centrales del centro-sur de Perú, a altitudes entre 1,693 y 2,920 msnm. *Stenocercus diploauris* **sp. nov.** es parecido a *S. formosus* y *S. ochoai* pero, a diferencia de estas especies, posee el pliegue longitudinal del cuello y una depresión debajo del pliegue oblicuo del cuello. *Stenocercus nigrobarbatus* **sp. nov.** es similar a *S. frittsi* y *S. variabilis*, sin embargo, se diferencia de estas especies por poseer un bolsillo acárido postfemoral con uno o más pliegues verticales o crestas y por la presencia, en machos adultos, de un parche negro que cubre las escamas infralabiales, la garganta, el pecho, la superficie ventral de los miembros superiores e inferiores, el vientre (línea central) y la región pélvica.

Palabras clave: Andes, bolsillo acárido, bosque estacionalmente seco, Departamento de Huancavelica, lagartija, morfología

Introduction

Peru is one of the most biodiverse countries in the world (Mittermeier *et al*. 1997). This is mostly related to the complex topography of the Andes, which cover almost one-third of the Peruvian territory (Peñaherrera del Aguila 1989), running north to south through the entire country with an average height of 4,000 m asl. This mountain range

influences the climate of most of the country resulting in a wide variety of habitats, including deserts, scrubs, dry forests, puna grasslands, humid montane forests, cloud forests, and humid lowland forests (Brack 1986; Duellman & Lehr 2009).

Dry forests are one of the most interesting habitats in the Andes, and are known to harbor numerous endemic species of plants, birds and reptiles (Statterfield *et al*. 1998; Bridgewater *et al*. 2003; Särkinen *et al*. 2011; Koch *et al*. 2018). Their arid environment may limit the displacement of organisms, favoring endemism within this habitat (Linares-Palomino 2004; Reynel *et al*. 2013). The dry forests along the Andes, commonly known as seasonally dry forests (SDFs) (Linares-Palomino 2004), are isolated at deep inter-Andean valleys and remain as the least known environments of Peru in biological terms (Reynel *et al*. 2013; Koch *et al*. 2018). The most important SDFs along the Peruvian Andes are isolated within the inter-Andean valleys of the Marañón, Mantaro and Apurímac Rivers in northern, central and southern Peru, respectively (Linares-Palomino 2004).

The SDF of the inter-Andean valley of the Mantaro River (Huancavelica Department) occurs between 1,800-2,400 m asl. Its vegetation has a similar physiognomy to SDFs from coastal regions of northern Peru, including xerophytic plants like *Prosopis sp., Eriotheca ruizii* and *Acacia macracantha* (Linares-Palomino 2004). The herpetofauna of the inter-Andean valley of the Mantaro River is still poorly studied, thus herpetological surveys carried out in the last decade have resulted in the discovery of new species: one water frog, *Telmatobius mantaro* (Ttito *et al*. 2016), and a lizard *Ameiva reticulata* (Landauro *et al*. 2015).

Stenocercus is a diverse South American lizard genus with 69 valid taxa (Uetz & Hošek 2020). Within the last three decades, around of one-fourth of species of *Stenocercus* have been described, indicating that the diversity of the genus is still underestimated (e.g. Torres-Carvajal 2000, 2005, 2007a; Torres-Carvajal & Mafla-Endara 2013; Köhler & Lehr 2015; Venegas *et al*. 2013, 2014, 2016; Texeira *et al*. 2016; Avila-Pires *et al*. 2019). One of the main causes of this dramatic rate of species discovery is the herpetological exploration of previously unsurveyed areas throughout the Andes. Also, the careful examination of specimens from collections has revealed several undescribed species previously confused with morphologically similar ones (Torres-Carvajal 2007a). Although most morphological diagnostic characters of *Stenocercus* are osteological, the absence of an enlarged interparietal scale and of femoral and preanal pores, and the presence of gular scales imbricate posteriorly and a gular fold incomplete medially are among the external morphological characters diagnosing the genus (Torres-Carvajal 2000, 2007a). Among the external morphological characters useful for species diagnosis are: scale counts, presence or absence of keeled scales, size of dorsal head scales, shape and length of the tail, dermal folds and mite pockets (Cadle 1991; Torres-Carvajal 2005; Torres-Carvajal 2007a). Furthermore, this clade of lizards is one of the most geographically and ecologically widespread reptile taxa currently ranked as a genus in South America (Torres-Carvajal 2007b). Members of this genus are particularly diverse along the Andes, reaching up to 4,000 m asl (Torres-Carvajal 2007a). However, a number of species are also found in the wet Amazonian lowlands, and in the drier, open settings of southern, central and northeastern Brazil (Nogueira & Rodrigues 2006; Torres-Carvajal 2007a; Texeira *et al*. 2016).

To contribute to the knowledge of the particular herpetofauna of Andean SDFs, herein, we describe two new species of *Stenocercus*. Specimens of the new species were collected during several herpetological surveys conducted in the SDF of the inter-Andean valley of the Mantaro River. This discovery increases the number of *Stenocercus* species known from Peru to 43 and highlights the importance of the Mantaro SDF as a hotspot of endemism.

Materials and methods

Lizards were captured by hand; coordinates (presented in degrees, minutes and seconds) and elevation were taken with a GPS (Garmin, WGS84). All collected specimens were fixed in 10% formalin for 24 hours and permanently stored in 70% ethanol. Type specimens are deposited at Centro de Ornitología y Biodiversidad (CORBIDI) in Lima, Peru. Measurements of snout-vent length (SVL) and tail length (TL) were taken with a ruler and recorded to the nearest 1 mm. All other measurements were made with digital calipers and recorded to the nearest 0.1 mm. Sex was determined by dissection or by noting the presence of hemipenes. Data on scutellation of all species of *Stenocercus* used for comparisons were taken from Torres-Carvajal (2007a). All specimens reviewed for comparison purposes are deposited at the herpetological collection of CORBIDI, Lima, Peru; and are listed in Appendix I. Osteological characters were examined by dissection of two adult paratypes (a pair) for each new species: CORBIDI 9915 and CORBIDI 9916 for *S. diploauris*, and for *S. nigrobarbatus,* CORBIDI 13718 and 13729. We follow the terminology of Cadle (1991) and Torres-Carvajal (2000, 2004, 2007a) for characters included in the description.

Species concept. We consider a species as the single lineage segment of ancestor-descendant populations or metapopulations evolving separately from other lineages (Simpson 1951; Wiley 1978; de Queiroz 1998; Wiley & Lieberman 2011). In this study, we used observed morphological features and color pattern as evidence to infer the existence of species (Frost & Kluge 1994; de Queiroz 1998, 2007).

Results

Stenocercus diploauris sp. nov.
Figures 1–4, Table 1.

Holotype. CORBIDI 13643, adult male from Limonal (12°13'55.097'' S, 74°41'27.487'' W), at 1,678 m asl, Surcubamba District, Tayacaja Province, Huancavelica Department, Peru, collected on September 1, 2013 by A. Escobar.

Paratypes. Peru: Huancavelica Department: Tayacaja Province: CORBIDI 9913 (adult female), CORBIDI 9914 (juvenile male), CORBIDI 9915 (adult female), CORBIDI 9916 (adult male) from Jatuspata (12°15'1.2'' S, 74°41'33.6'' W), at 2,609 m asl, collected on April 7, 2011 by D. Amaya; CORBIDI 14672 adult female from Chupto (12°18'42.56'' S, 74°39'13.23'' W) at 2,328 m asl, collected on July 2, 2014 by L. Y. Echevarría; CORBIDI 14901 adult female from Jatuspata (12°15'28.83'' S, 74°41'28.74'' W) at 2,816 m asl, collected on July 2, 2014 by C. Landauro; CORBIDI 14902 and CORBIDI 14903 adult females from Jatuspata (12°15'35.31'' S, 74°41'31.74'' W) at 2,835 m asl, collected on July 3, 2014 by C. Landauro; CORBIDI 14904 adult male from Jatuspata (12°15'34.23'' S, 74°41'25.12'' W) at 2,920 m asl, collected on July 3, 2014 by C. Landauro; CORBIDI 14906 adult male from Limonal (12°13'58.82'' S, 74°41'23.09'' W) at 1,753 m asl, collected on July 8, 2014 by C. Landauro; CORBIDI 16036 adult female from Pichiu (12°19'50'' S, 74°39'13.07'' W) at 2090 m asl, collected on July 12, 2015 by J. Malqui.

Diagnosis. Adult specimens of *Stenocercus diploauris* can be easily distinguished from all known species of *Stenocercus* by having a C-shaped nuchal mite pocket around the oblique fold, posteriorly limited by the antehumeral fold (Fig. 4). However, among the 69 currently known species of *Stenocercus, S. diploauris* resembles *S. formosus* Tschudi, 1845, and *S. ochoai* Fritts, 1972, by the combination of the following characters: (1) imbricate scales on the posterior surface of thighs, (2) well developed postfemoral mite pocket, (3) antehumeral and oblique neck folds, and (4) absence of posthumeral mite pocket.

The new species can be distinguished from *S. ochoai* and *S. formosus* by having dorsal and lateral nuchals similar in size and the presence of longitudinal neck fold, in the former species lateral nuchals are smaller than dorsal nuchals and the longitudinal neck fold is absent. Furthermore, *S. diploauris* differs from *S. formosus* (character state of latter in parenthesis) by having three whorls per autotomic segment (four), smooth dorsal head scales (keeled), and fewer scales, 50–61, around midbody (74–82).

Characterization. (1) Maximum SVL in males 94.82 mm (n = 5); (2) maximum SVL in females 76.06 mm (n = 5); (3) vertebrals 40–50; (4) paravertebrals 63–78; (5) scales around midbody 50–61; (6) supraoculars 5–7; (7) internasals 3–4; (8) postrostrals 2–4; 9) loreals 4–8; (10) gulars 17–24; (11) lamellae on Finger IV 17–21; (12) lamellae on Toe IV 24–30; (13) posthumeral pocket absent; (14) postfemoral pocket distinct with slit-like opening, Type 2 of Torres-Carvajal (2007a); (15) parietal eye not visible; (16) occipital scales large, smooth, imbricate; (17) projecting angulate temporals absent; (18) enlarged supraoculars occupying most of supraocular region in one row; (19) scales on frontonasal region weakly imbricate anteriorly; (20) preauricular fringe present; (21) antehumeral, longitudinal and oblique neck folds present; (22) C-shaped nuchal mite pocket around the oblique neck fold, posteriorly limited by the antehumeral neck fold; (23) lateral nuchals slightly smaller than dorsal nuchals; (24) posterior gulars in adults smooth, imbricate, not mucronate, not notched; (25) lateral and dorsal body scales similar in size; (26) vertebral crest prominent; (27) dorsolateral crest absent; (28) ventrals in adults smooth, imbricate, mucronate; (29) scales on posterior surfaces of thighs keeled, imbricate, mucronate; (30) prefemoral fold absent; (31) inguinal groove absent; (32) preanals projected; (33) tail not strongly compressed laterally in adult males; (34) tail length 50–70% of total length; (35) three caudal whorls per autotomic segment; (36) caudals not spinose; (37) dark stripe extending anterodorsally from subocular region to supraciliaries present in most specimens; (38) gular region of adult females black or densely pigmented; (39) gular region of adult males gray or reddish; (40) black blotch on ventral surface of

neck in adult males absent; (41) light gray or cream midventral line present; (42) black patch on ventral surface of thighs absent; (43) background color of dorsum, in females and males, brown; (44) two xiphisternal, and two long postxiphisternal pairs of inscriptional ribs that do not articulate midventrally (Pattern 1A of Torres-Carvajal 2004).

Description of holotype. Male; SVL 94.82 mm; TL 217.5 mm; maximum head width 19.18 mm; head length 21.99 mm; head height 13.69 mm; occipitals, parietals, interparietal, and postparietals large, smooth, slightly imbricate (Fig. 2); parietal eye not visible; supraoculars in six rows, smooth, slightly imbricate, with one row two times larger than adjacent rows; anterior and posterior circumorbitals smooth, imbricate; canthals two; anteriormost canthal in contact with nasal; scales in frontonasal region not imbricate; internasals four; postrostrals four, wider than long, median ones smaller; supralabials six; infralabials six; loreals eight; lorilabials in one row; preocular not divided, in contact with posterior canthal; lateral temporals imbricate, keeled; gulars in 22 rows between tympanic openings; all gulars smooth, imbricate; second infralabial in contact with first three sublabials; mental in contact with first pair of infralabials and first pair of postmentals; dorsal and lateral scales of body and neck keeled, imbricate; scales around midbody 53; vertebrals large, in 48 rows, forming a distinct serrate vertebral crest; paravertebrals 77; ventrals smooth, imbricate; preauricular fringe short, composed of two enlarged scales, of similar size; antehumeral, longitudinal and oblique neck folds present; a C-shaped nuchal mite pocket around the oblique fold, posteriorly limited by the antehumeral fold (Fig. 4); limb scales keeled, imbricate; ventral scales of hind limbs smooth; lamellae on Finger IV 20; lamellae on Toe IV 30; tail slightly compressed laterally; caudals keeled, imbricate; basal subcaudals keeled, imbricate; vertebral crest extending two thirds of tail length; tail length 2.3 times SVL; posthumeral pocket absent; postfemoral pocket shallow with slit-like opening (Type 2 of Torres-Carvajal 2007a).

Color in life of the holotype. Dorsal surface dusty brown with light cream chevrons over the vertebral line, irregular light cream transversal bars on limbs and a reddish hue on tail; flanks cinnamon, dotted with yellowish cream scales; dorsal surface of head darker than dorsum and with some scattered cream dots; temporal surface of head dark brown, with scattered reddish pigmentation and white dots; loreal region and canthus rostralis dark brown and subocular region, supralabials and infralabials bright cream; sublabials forming a thin black stripe along the lower jaw; superciliaries cream with transversal brown bars; dark brown stripe from postocular region to supratemporals; sides of neck dusty brown with reddish pigmentation; a black blotch covers the nuchal mite pocket; black line below antehumeral fold. Gular region and throat cream with reddish pigmentation on the sides and a faint pink blotch over the throat; chest and ventral surfaces of forelimbs dirty cream; first portion of venter, immediately after forelimb insertion, yellow; belly dirty cream flanked by pink pigmentation; pelvic region and ventral surfaces of thighs yellow; tail pale pink, with yellow pigmentation on the base (Fig. 11B). Irises light brown.

Color of the holotype in ethanol 70%. Similar to coloration in life. However, flanks turned dusty brown as dorsum and the reddish coloration to the sides of gular region and ventral surface of neck turned brown (Fig. 1).

Variation. Scale counts and measurements for *Stenocercus diploauris* are presented in Table 1. Loreals 4–8; supralabials 5–6; infralabials 5–6; postrostrals 2–4; second infralabial not in contact with third sublabial in 91% of specimens; first pair of postmentals in contact in 91% of specimens (n = 11).

The nuchal mite pocket is conspicuous only in adult specimens, after preservation it becomes less defined. The type series of *S. diploauris* contains three adult males (CORBIDI 9916, 14904 and 14906) of 68.0 mm to 78.0 mm of SVL, and one juvenile male (CORBIDI 9914) with 61.0 mm of SVL. Two adult males (CORBIDI 9916 and 14906) are identical in dorsal coloration to the holotype. However, ventrally both specimens differ from the holotype by having the posterior portion of the gular region and ventral surface of neck gray and a gray midventral line on the belly. The dorsal coloration of one adult male (CORBIDI 14904) is similar to the holotype differing only by having the flanks dusty brown as the dorsum and not cinnamon as the holotype (Fig. 3A). Ventrally this specimen differs from the holotype by having the gular region cream and the ventral surface of neck gray, the chest and belly are cream with an indistinct light gray midventral line and a dark cream patch covering the pelvic region and the ventral surface of thighs (Fig. 3B). A juvenile male (CORBIDI 9914), has the dorsum grayish and the flanks dusty brown (Fig. 3C). Ventrally this specimen has the gular region, ventral surfaces of neck and chest cream with gray reticulations, and the belly cream with a faint gray midventral line (Fig. 3D).

Sexual dimorphism is conspicuous with respect to size (maximum SVL in males 94.82 mm versus 76.0 mm in females) and coloration. Females have brown dorsal surfaces with a gray dorsolateral stripe, and pairs of dark brown triangular blotches along the vertebral line becoming chevrons on the tail (Fig. 3E); flanks are brown as dorsum or cinnamon (CORBIDI 14901) without marks; sides of head brown with a dark brown subocular stripe; jaw,
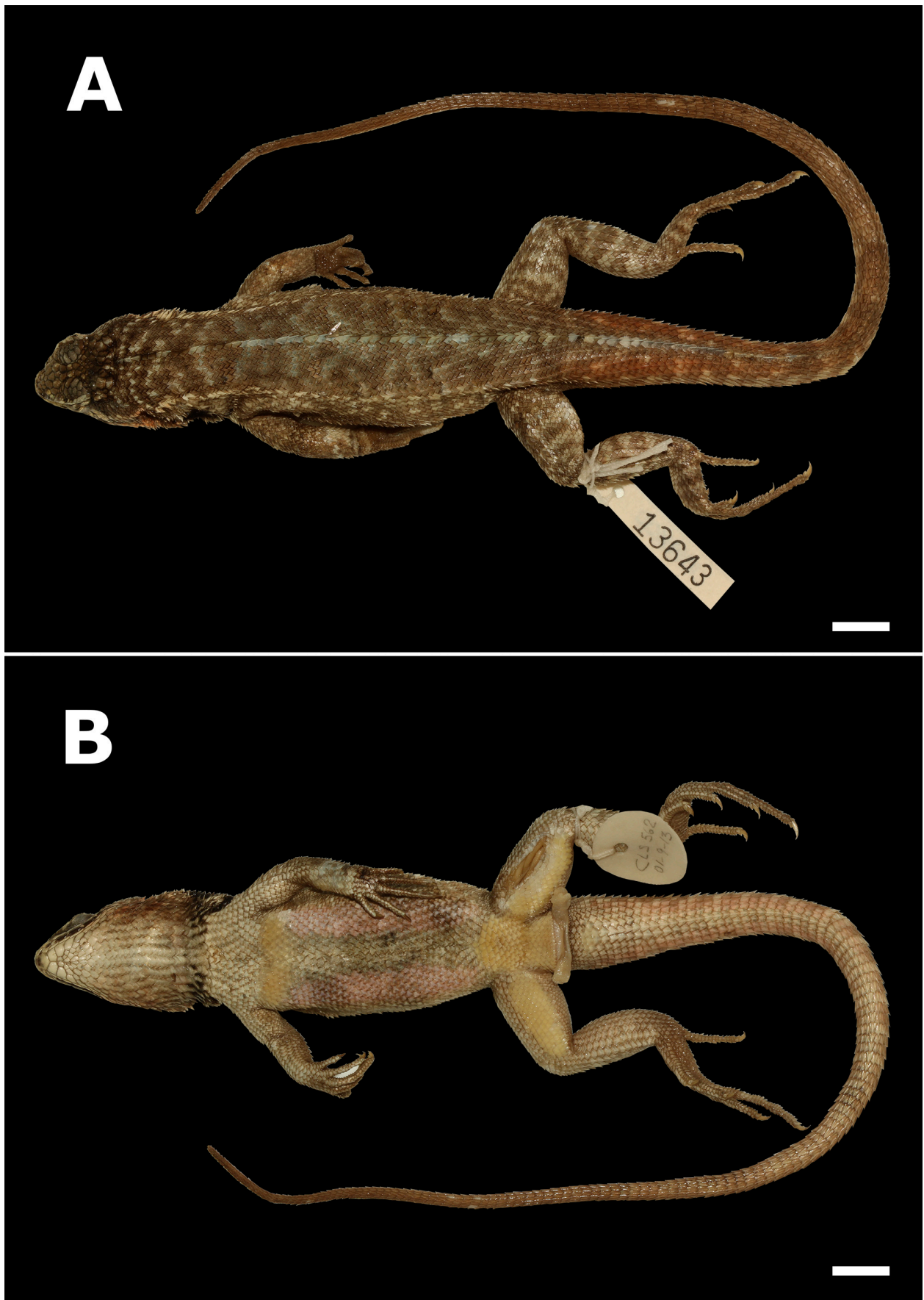
FIGURE 1. *Stenocercus diploauris* **sp. nov.**, holotype CORBIDI 13643, male, 94.82 mm SVL. Dorsal (A) and ventral (B) views. Photographs by P.J. Venegas. Scale bar = 10 mm.
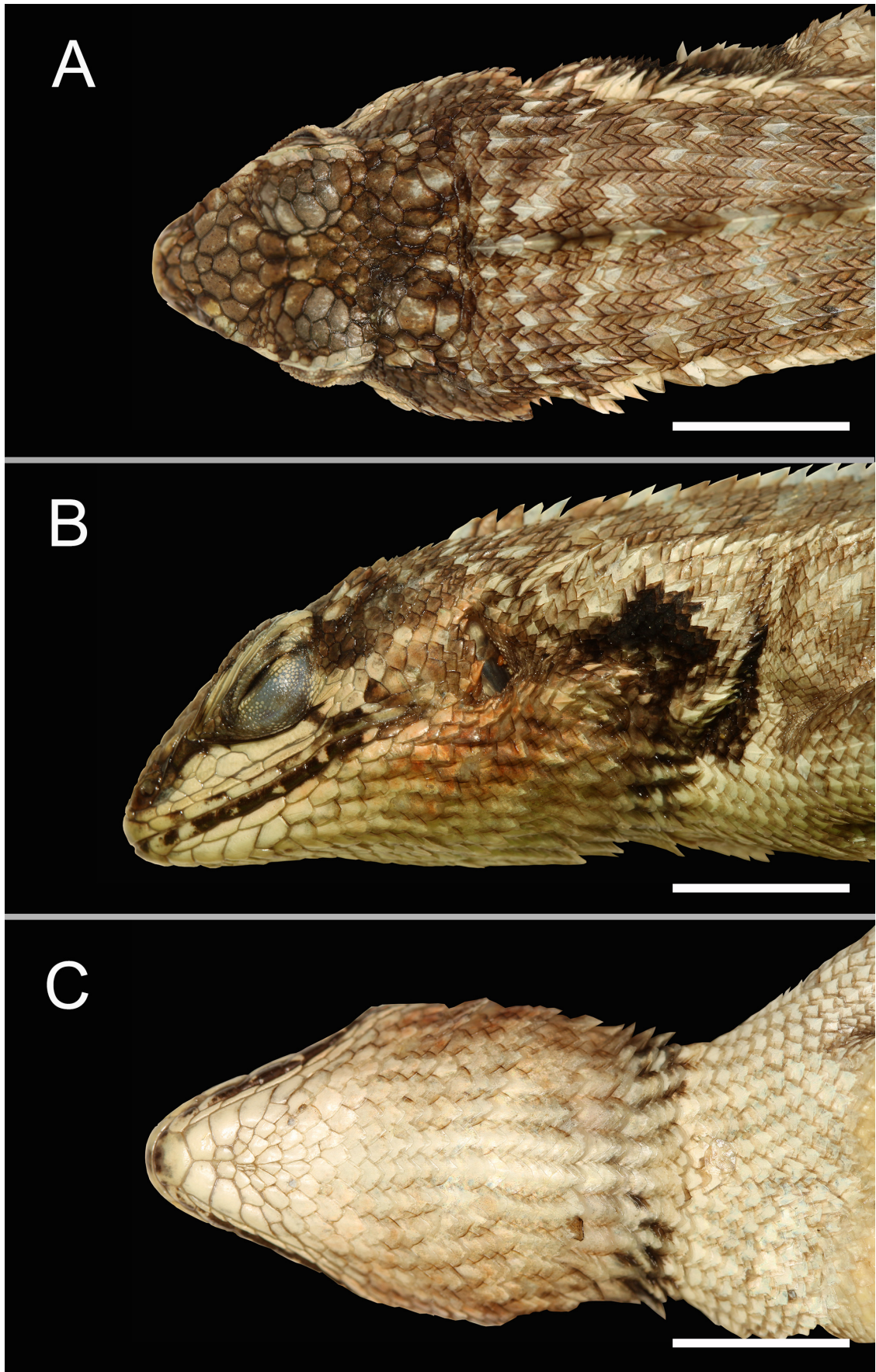
FIGURE 2. Dorsal (A), lateral (B), and ventral (C) views of the head of *Stenocercus diploauris* **sp. nov.** holotype, CORBIDI 13643, male. Photographs by P.J. Venegas. Scale bar = 10 mm.

ventrolateral region of head and sides of neck black (Fig. 3E). Ventral surfaces in adult females are brownish cream with a black patch covering the gular region and ventral surface of neck (Fig. 3F). One specimen (CORBIDI 14902) has the gular region and ventral surface of neck black with a cream blotch on the middle. One of the five female paratypes (CORBIDI 14672) has a dusty brown dorsum with dark brown chevrons along the vertebral line and the loreal and subocular regions bright cream like adult males. One juvenile female (CORBIDI 9913) differs from the adult females by having a light cream dorsolateral stripe (gray in adult females).
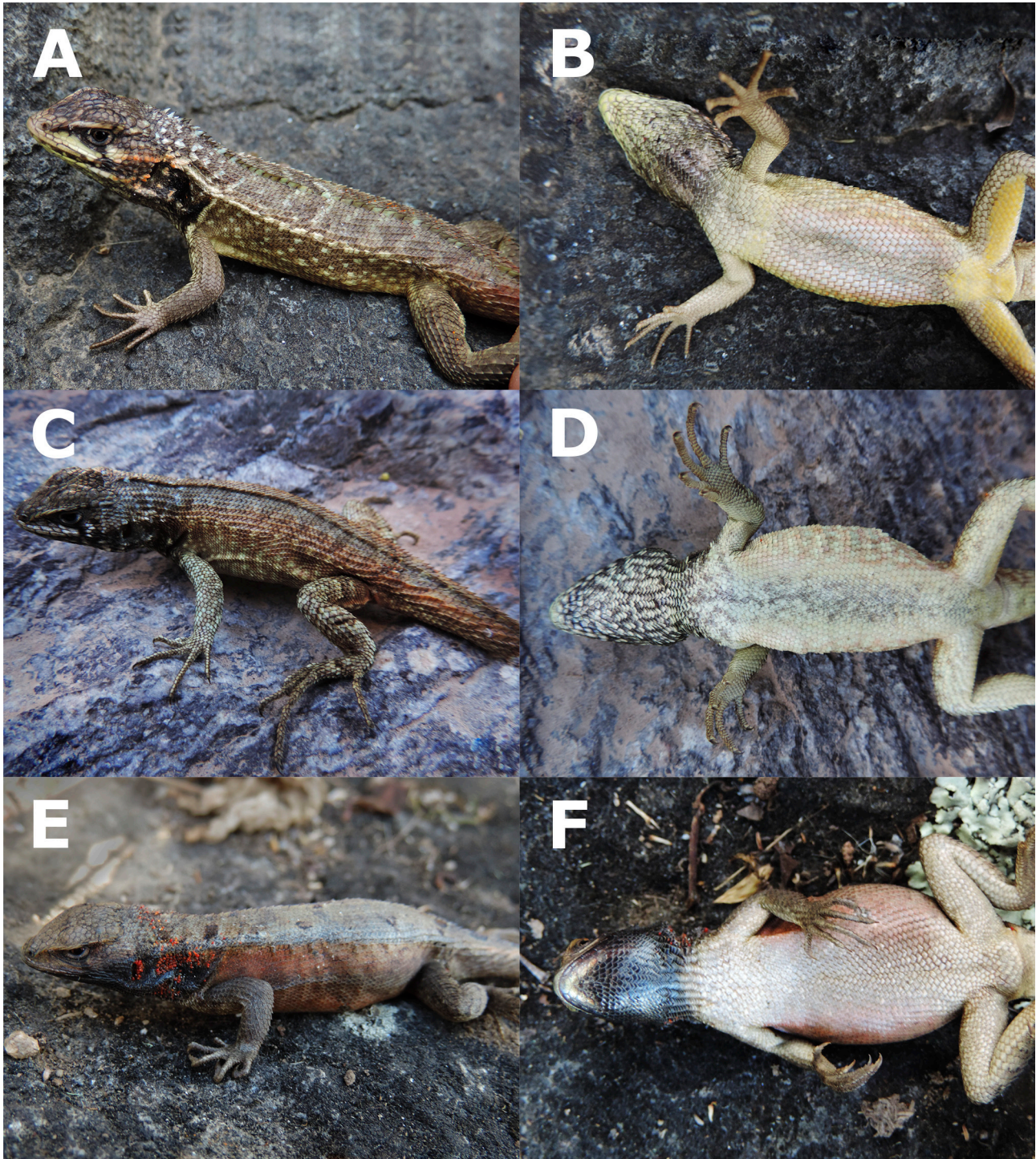

FIGURE 3. Paratypes of *Stenocercus diploauris* **sp. nov.**: (A, B) Dorsolateral and ventral view of an adult male paratype (CORBIDI 14904); (C, D) Dorsolateral and ventral views of a subadult male (CORBIDI 9914); (E, F) Dorsolateral and ventral views of an adult female (CORBIDI 14901). Photographs by C.Z. Landauro.
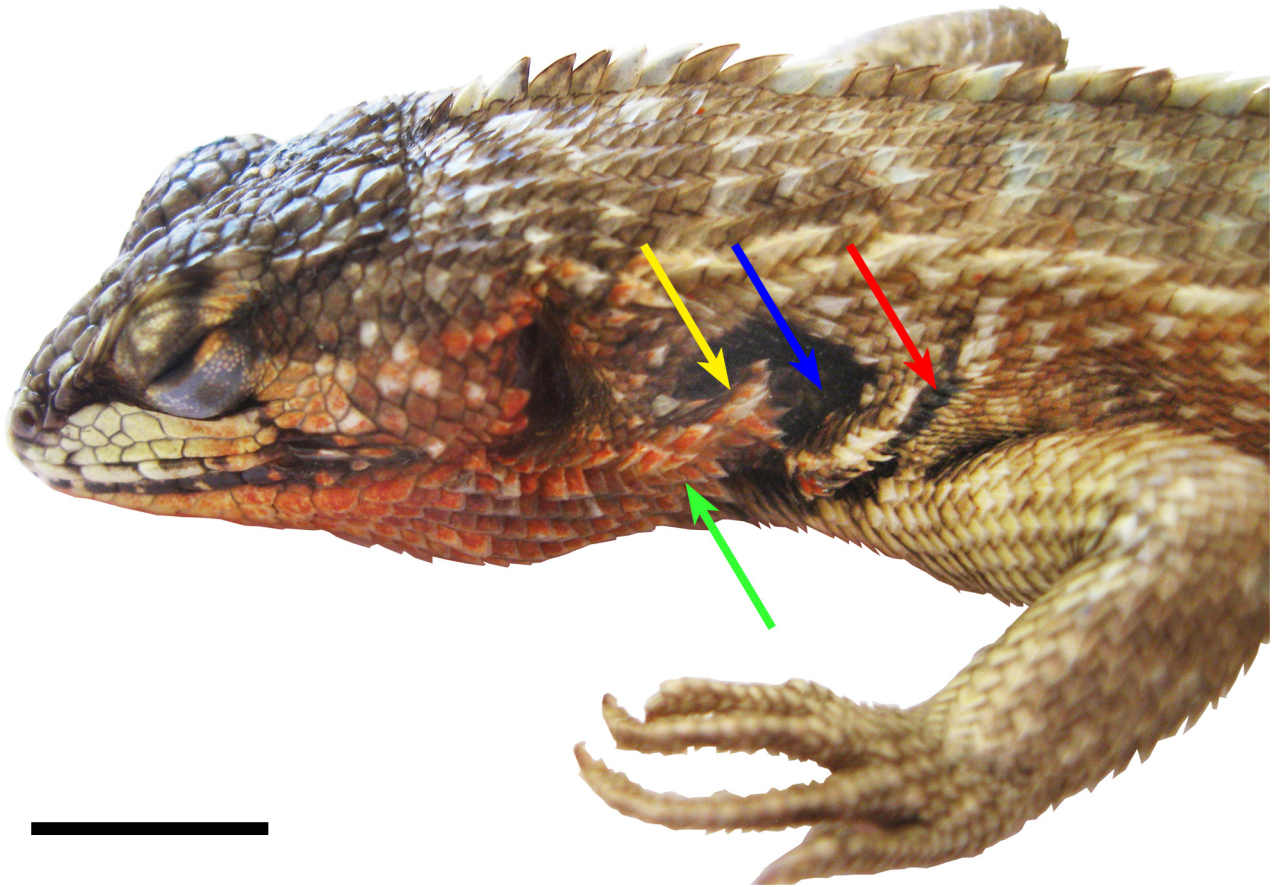
FIGURE 4. Lateral view of the nuchal mite pocket of freshly dead holotype of *S. diploauris* **sp. nov.** (CORBIDI 13643). Yellow arrow: oblique neck fold; blue arrow: nuchal mite pocket as a C-shaped depression around the oblique neck fold; red arrow: antehumeral fold; green arrow: longitudinal neck fold. Scale bar = 10 mm.

Distribution and natural history observations. *Stenocercus diploauris* is known from four localities in the SDF of the Mantaro River Valley at elevations between 1,678 to 2,920 m asl, Huancavelica Department, Peru (Fig. 5). *Stenocercus diploauris* inhabits a seasonal dry forest, according to Linares-Palomino (2004) classification, and Central Andean Yungas according to Olson *et al*. (2001). Limonal (1,678 m asl), corresponds to the locality with the lowest elevation record of *S. diploauris,* its general landscape is that of a typical dry forest but with scattered crop lands with plantations of corn *Zea mays*, avocado pear *Persea* sp., citrus fruit trees and several other species of fruit trees. The agriculture is more intensive in the surrounding areas of Pichiu village (2,090 m asl); however, the remnants of native vegetation are dominated by shrubs, *Opuntia* and other cacti species. Chupto, at 2,328 m asl, is a very steep area dominated by shrubs and grasses. The locality of Jatuspata is located within an evergreen forest at elevations between 2,609 m and 2,920 m asl.

The holotype of *Stenocercus diploauris* was collected by chance, it was found dead but not decomposed in a Sherman trap. Most paratypes were collected inactive under rocks, among cacti and shrubs, during cloudy days. Only CORBIDI 14672 was collected while active and moving among shrubs. *Stenocercus diploauris* and *S. nigrobarbatus* are known to co-occur at Chupto and Pichiu. Other species of Squamate reptiles collected at the same localities of *S. diploauris* include *Ameiva reticulata*, *Mastigodryas boddaerti*, *Micrurus* sp., and *Wilsonosaura josyi*.

Etymology. The specific epithet "*diploauris*" is a noun (in apposition) in the nominative singular and derives from the Greek word *diploos* (= double) and the Latin word *auris* (= ear). It refers to the depression on both sides of the neck of the new species, appearing like a second tympanic opening.
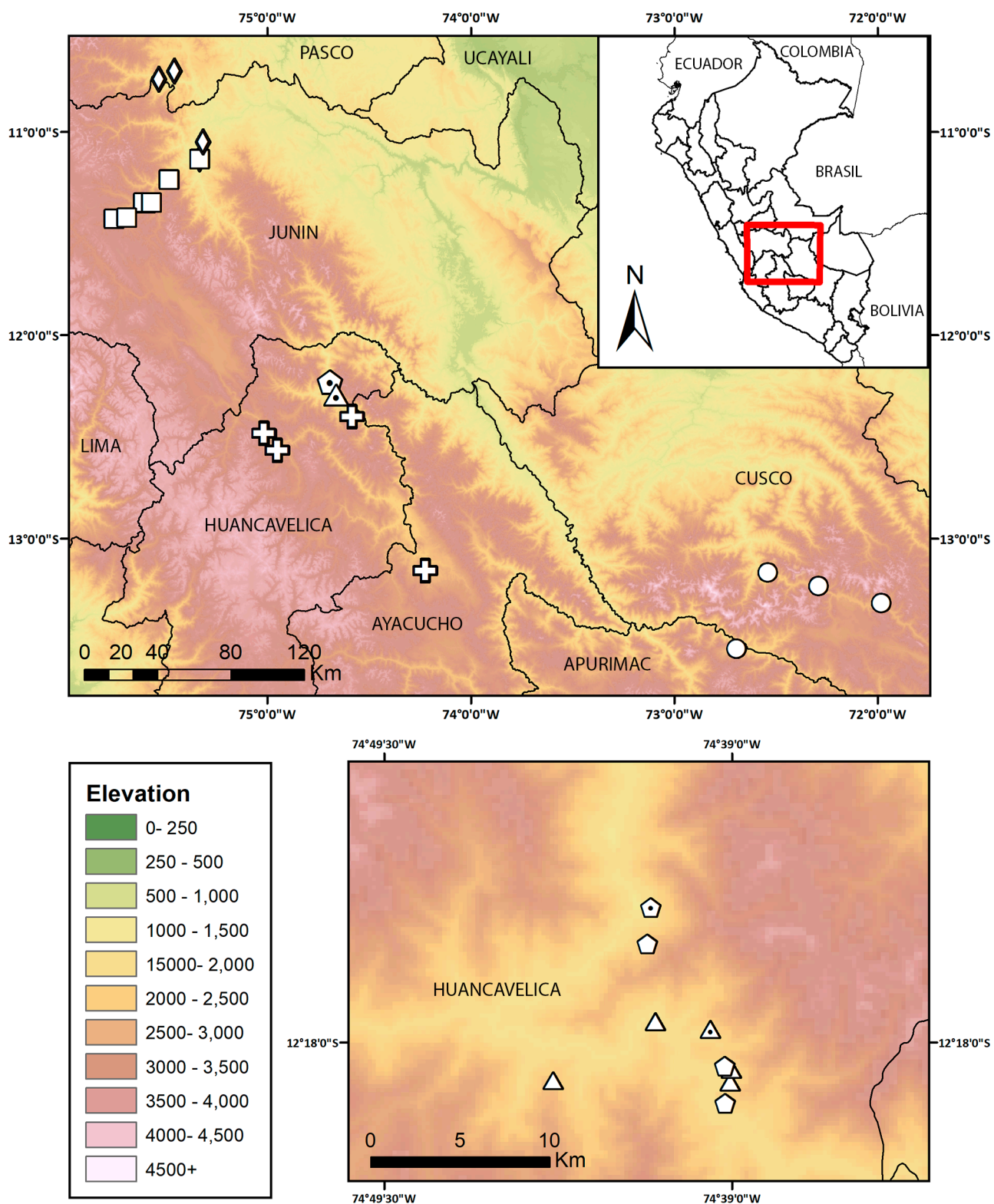
FIGURE 5. Distribution map of six species of *Stenocercus* from Peru. *S. diploauris* **sp. nov.** (pentagons), *S. formosus* (squares), *S. frittsi* (crosses), *S. nigrobarbatus* **sp. nov.** (triangles), *S. ochoai* (circles), and *S. variabilis* (diamonds). Symbols with a dot in the middle correspond to type localities.

***Stenocercus nigrobarbatus* sp. nov.**
Figures 6–10, Table 1.

Holotype. CORBIDI 13725, adult male from Fundición (12°17'36.41"S, 74°39'39.67" W) at 2,158 m asl, Tayacaja Province, Huancavelica Region, Peru, collected on January 31, 2014 by L. Y. Echevarría.

Paratypes. Peru: Huancavelica Department: Tayacaja Province: CORBIDI 13637 a juvenile female from Jatuspata (12°15'14.617" S, 74°41' 16.93" W) at 2,972 m asl, collected on September 3, 2013 by C. Landauro; CORBIDI 13638 a juvenile female from Pichiu (12°19'11.815" S, 74°39'3.588" W) at 2,036 m asl, collected on September 13, 2013 by C. Landauro; CORBIDI 13640 juvenile female from Pichiu, collected on September 12, 2013 by C. Landauro; CORBIDI 13641 adult female from Barropata (12°17'21.943" S, 74°41'19.035" W) at 1,725 m asl, collected on October 2, 2013 by C. Landauro; CORBIDI 13639 and CORBIDI 13642 female juveniles from Fundición (12°17'32.347" S, 74°39'45.433" W), at 2,169 m asl, collected on September 28, 2013 by C. Landauro; CORBIDI 13718 adult male from Chupto (12°19'52.96" S, 74°39'13" W) at 2,058 m asl, collected on January 23, 2014 by L. Y. Echevarría; CORBIDI 13719 adult male from Chupto (12°18'22.19" S, 74°39'18.42" W) at 2,314 m asl, on January 24, 2014 by L. Y. Echevarría; CORBIDI 13722 adult female from Chupto (12°19'52.96" S, 74°39'13" W) at 2,058 m asl, collected on January 21, 2014 by L. Y. Echevarría; CORBIDI 13728 adult female from Barropata (12°17'34.95" S, 74°41'34.08" W) at 1,704 m asl, collected on February 2, 2014 by L. Y. Echevarría; CORBIDI 13729 adult female from Barropata (12°17'22.11" S, 74°41'19.07" W) at 1,783 m asl, collected on February 3, 2014 by L. Y. Echevarría; CORBIDI 14669 adult female from Chupto (12°18'48.18" S, 74°39'1.83" W) at 2,345 m asl, collected on July, 1 2014 by L. Y. Echevarría; CORBIDI 14674 adult female from type locality, collected on July 6, 2014 by L. Y. Echevarría; CORBIDI 14676 juvenile female and CORBIDI 14677 adult male from Barropata (12°17'37.66" S, 74°41'39.18" W) at 1,693 m asl, collected on July 7, 2014 by L. Y. Echevarría; CORBIDI 15765–66 (adult male and female, respectively) and CORBIDI 15767 (juvenile male) from Pichiu (12°15'31.57" S, 75°6'3.6" W) at 2,206 m asl, collected on January 14, 2015 by L. Lujan; CORBIDI 16033 adult male from Pichiu (12°19'50" S, 74°39'13.07" W) at 2,090 m asl, collected on July 9, 2015 by J. Malqui; CORBIDI 20546–47 two adult males from San Luis de Estanque (12º19'8.62" S, 74º44'24.19" W) at 2,636 m asl., collected on Jun 17, 2019 by L.A. García-Ayachi.

Diagnosis. Adult males of *Stenocercus nigrobarbatus* can be easily distinguished from all species of *Stenocercus* by having a continuous black patch covering the infralabials, throat, chest, ventral surfaces of forelimbs, belly (as a black midventral line), ventral surfaces of hind limbs, and pelvic region (Figs. 6B, 8B, 9B and 9C).

However, among the 69 currently described species of *Stenocercus*, *S. nigrobarbatus* resembles *S. frittsi* Torres-Carvajal, 2005, and *S. variabilis* Boulenger, 1901, by the following combinations of characters: (1) granular scales on the posterior surface of thighs, (2) imbricate and keeled lateral body scales, (3) a distinct row of enlarged vertebral scales, (4) unnotched gular scales, (5) three caudal whorls per autotomic segment, (6) brown dorsal ground color, and (7) distinct oblique neck fold, and antegular fold not continuous medially.

Stenocercus nigrobarbatus differs from the geographically close *S. frittsi* (character state of latter in parenthesis) by having a postfemoral mite pocket composed by one or more vertical folds or ridges, Type 1 of Torres-Carvajal (2007a) (postfemoral pocket absent in *S. frittsi*), 2–4 postrostrals (5–7), and two pairs of postxiphisternal inscriptional ribs, long, not in contact midventrally, pattern 1A of Torres-Carvajal (2004) (three pairs of postxiphisternal inscriptional ribs, two pairs long and the last pair short, not in contact midventrally; pattern 2B of Torres-Carvajal 2004).

Stenocercus nigrobarbatus can be distinguished from *S. variabilis* (character state in parenthesis) by having 2–4 postrostrals (6), postfemoral pocket composed by one or more vertical folds or ridges, Type 1 of Torres-Carvajal (2007a) (slit-like opening, Type 2 of Torres-Carvajal 2007a), and inguinal groove absent (present). In addition, lateral body scales in *S. nigrobarbatus* are slightly smaller than dorsals, while *S. frittsi* and *S. variabilis* have lateral body scales approximately half the size of dorsals.

Characterization. (1) Maximum SVL in males 67.73 mm (n = 4); (2) maximum SVL in females 62.29 mm (n = 5); (3) vertebrals 47–73; (4) paravertebrals 69–87; (5) scales around midbody 57–74; (6) supraoculars 5–7; (7) internasals 3–5; (8) postrostrals 2–4; (9) loreals 3–7; (10) gulars 19–30; (11) lamellae on Finger IV 18–23; (12) lamellae on Toe IV 27–34; (13) posthumeral pocket as one or more vertical folds or ridges, Type 1 of Torres-Carvajal (2007a); (14) postfemoral pocket composed of one or more vertical folds or ridges, Type 1 of Torres-Carvajal (2007a); (15) parietal eye not visible; (16) occipital scales small, smooth, juxtaposed; (17) no projecting angulate

temporals; (18) supraoculars of varying sizes; (19) scales in frontonasal region slightly imbricate anteriorly; (20) short preauricular fringe present; (21) antehumeral, antegular, gular, oblique, suprauricular and postauricular neck folds present; (22) nuchal mite pocket absent; (23) lateral nuchals less than half size of dorsal nuchals; (24) posterior gulars in adults smooth, imbricate, not mucronate; (25) lateral scales slightly smaller than dorsal body scales; (26) vertebrals larger than adjacent paravertebrals; (27) dorsolateral crest absent; (28) ventrals in adults smooth, imbricate, not mucronate; (29) scales on posterior surfaces of thighs granular; (30) inguinal granular pocket absent; (31) inguinal groove absent; (32) preanals not projecting; (33) tail not compressed laterally in adult males; (34) tail length 62–70% of total length; (35) three caudal whorls per autotomic segment; (36) caudals not spinose; (37) dark stripe extending anterodorsally from subocular region to supraciliaries present; (38) gular region of adult females dark or densely pigmented in all specimens; (39) gular region of adult males dark or densely pigmented in all specimens; (40) black blotch on ventral surface of neck in adult males absent; (41) bold black midventral line present in males; (42) black patch on ventral surface of thighs present in males; (43) dorsal ground color brown, in females and males; and (44) postxiphisternal inscriptional ribs not articulating midventrally, both pairs long, Pattern 1A of Torres-Carvajal (2004).

Description of holotype. Male (Fig. 6-8); SVL= 66.02 mm; TL = 130.0 mm; maximum head width = 12.24; head length = 15.87; head height = 8.63; scales on parietal and occipital regions small, smooth, juxtaposed; parietal eye not visible; supraoculars in six rows, smooth, slightly imbricate, of varying sizes; canthals two; anterior most canthal separated from nasal by one minute scale; scales in frontonasal region slightly imbricate; internasals four; postrostrals three, subequal in size, wider than long; supralabials seven; infralabials seven; loreals six; lorilabials in one row; preocular not divided, in contact with posterior canthal; lateral temporals imbricate, weakly keeled; gulars in 29 rows between tympanic openings; all gulars smooth, imbricate; second infralabial in contact with first two sublabials; mental in contact with first pair of infralabials and first pair of postmentals; lateral and dorsal scales of body and dorsal scales of neck keeled, imbricate; lateral scales of neck granular; scales around midbody 63; vertebrals large, in 68 rows, not forming a prominent serrate vertebral crest; paravertebrals 86; ventrals smooth, imbricate; preauricular fringe short, composed of two enlarged scales, both same size; antehumeral, antegular, gular, oblique, suprauricular, postauricular neck folds and ventrolateral body fold present; limb scales keeled, imbricate; ventral scales of hind limbs and upper arms smooth; lamellae on Finger IV 23; lamellae on Toe IV 31; tail not compressed laterally; caudals keeled, imbricate; basal subcaudals smooth, imbricate; vertebral crest extending more than half length of tail; tail length 1.9 times SVL; posthumeral pocket shallow (Type 1 Torres-Carvajal 2007a) with vertically oriented fold approximately 2.57 mm long; postfemoral pocket composed by one vertical fold (type 1 of Torres-Carvajal 2007a); postfemoral region composed of imbricate, smooth scales, becoming smaller toward insertion of hind limbs (Fig. 10A).

Color in life of the holotype. Dorsal surfaces of head and neck cinnamon brown with yellow spots, denser on neck; lorilabials and supralabials yellow; infralabials black; ventrolateral regions of head and neck black; dorsal surfaces of body, limbs and tail dusty brown with pale yellow spots; flanks light blue, densely covered with cream spots; limbs and tail with thin dark brown marks on dorsal surfaces (Fig. 8A). Ventral surface of head, throat, chest black; ventral surfaces of forelimbs black, although pigmentation is faint at elbow joint; a bold black midventral line, continuous with chest pigmentation, flanked by pink; ventral surfaces of hind limbs, and pelvic region black, except by the cloaca; posterior surfaces of thighs pink; pre-cloacal region dark yellow and post post-cloacal region pink; ventral surface of tail pink, with a yellow blotch and blackish speckles at the base (Fig. 8B). All black pigmentation on ventral surfaces constitutes a continuous patch, except black pigmentation on tail.

Coloration of holotype in ethanol 70%. Dorsally, all yellow spots turned to pale yellow. Dorsal surfaces of head and neck turned brown. Ventrally, pink and yellow pigmentation turned to a less vivid (pale) shade, almost vanished on cloaca.

Variation. Scale counts and measurements for *Stenocercus nigrobarbatus* are presented in Table 1. Loreals 3–7; supralabials 6–8; infralabials 5–8; postrostrals 2–4; second infralabial not in contact third sublabial in all specimens; first pair of postmentals in contact in all specimens.

Dorsal coloration in adult males of *Stenocercus nigrobarbatus* is the same in all adult male paratypes (n = 5) (Fig. 9A). The black coloration on ventral surfaces as a continuous patch is exclusive to adult males (Fig. 9B–C). The juvenile specimen CORBIDI 13718 has a faint black midventral line on the belly (Fig. 9D–E). Another juvenile specimen (CORBIDI 13719) has the gular region and ventral surface of neck covered by a dark gray patch and the midventral region of the belly has scattered dark gray dots (Fig. 9F–G). These immature males
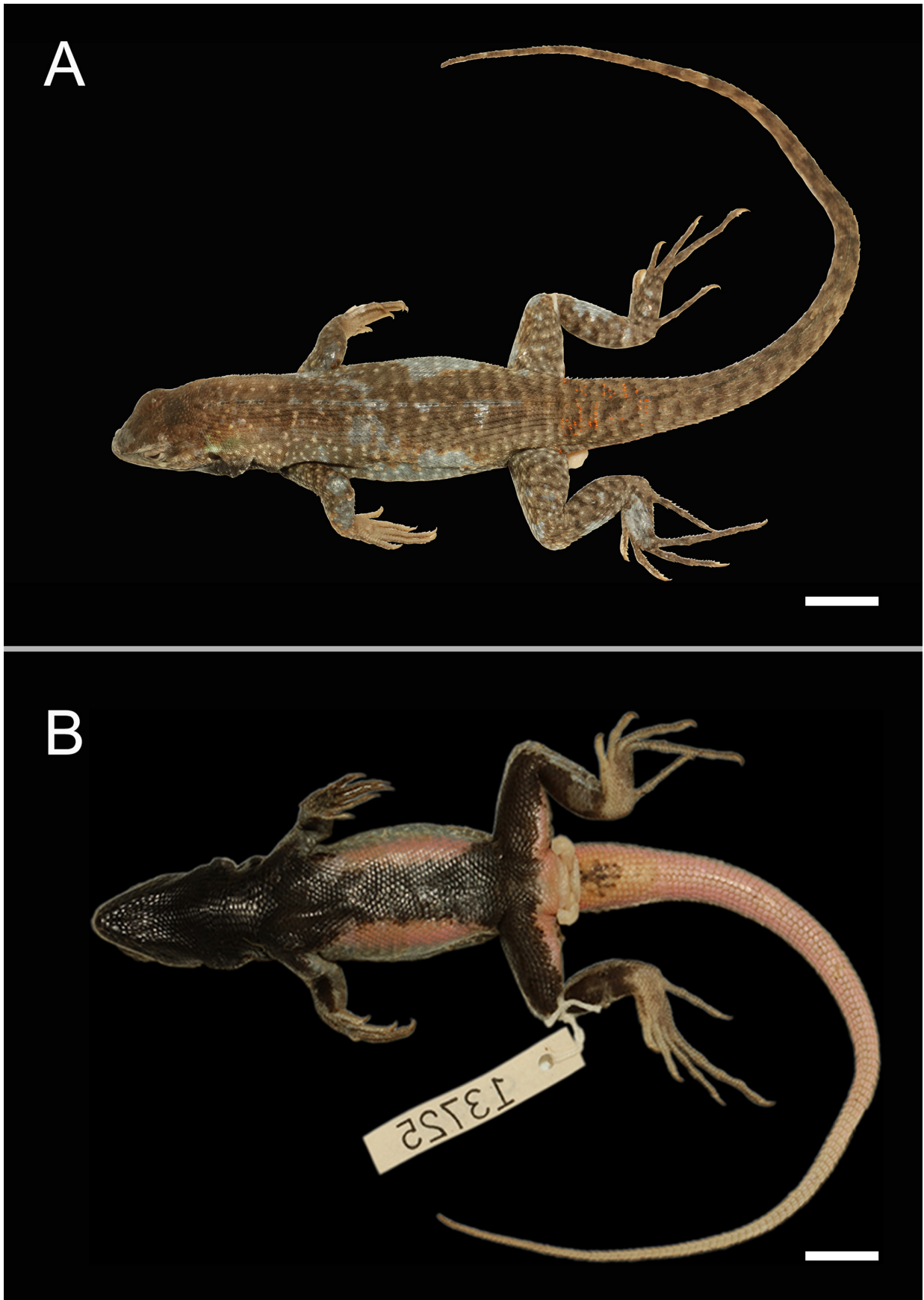
FIGURE 6. *Stenocercus nigrobarbatus* **sp. nov.**, holotype CORBIDI 13725, male, 66.02 mm SVL. Dorsal (A) and ventral (B) views. Photographs by P.J. Venegas. Scale bar = 10 mm.
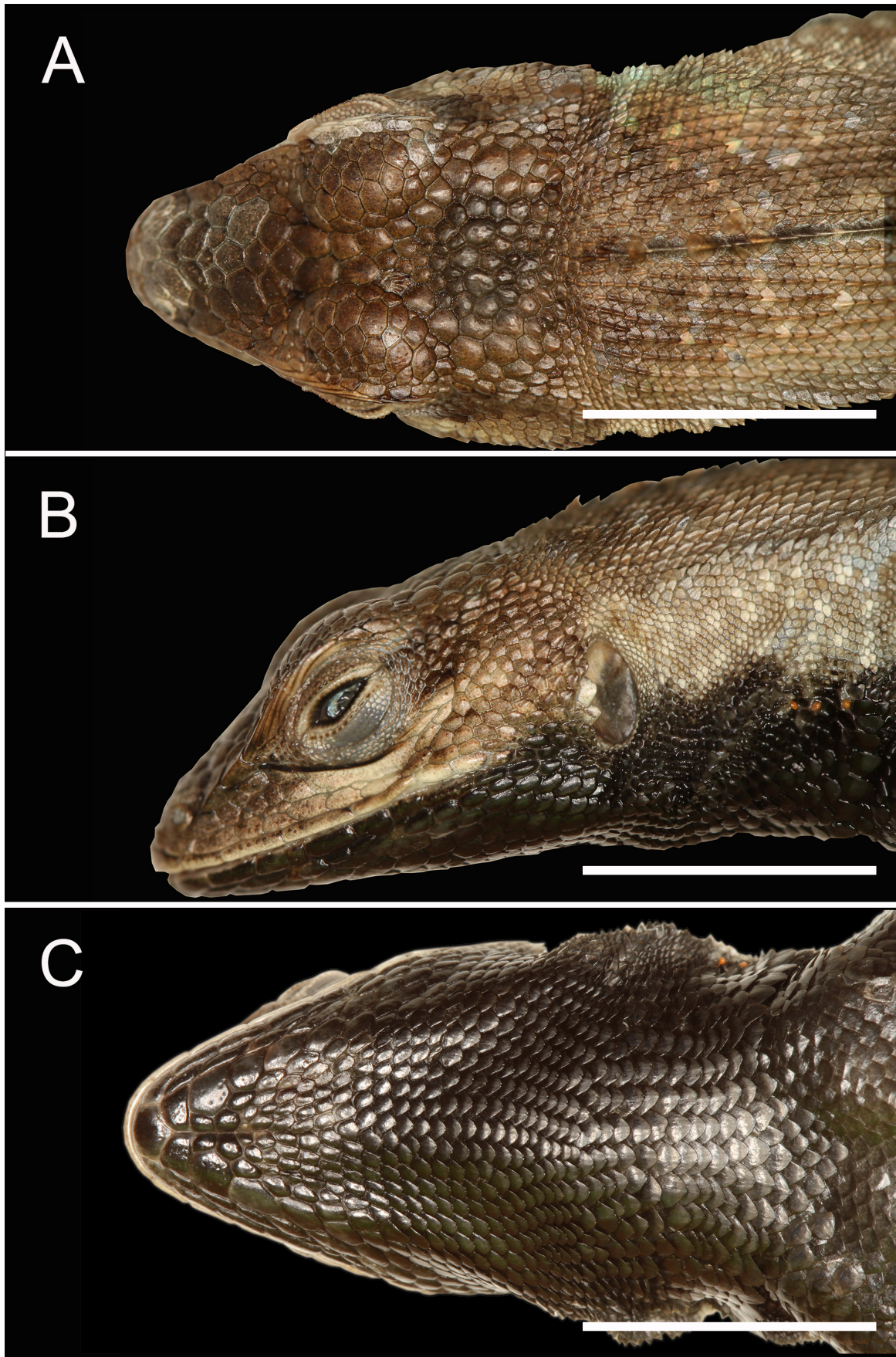
VENEGAS *ET AL.*

FIGURE 7. Dorsal (A), lateral (B), and ventral (C) views of the head of *Stenocercus nigrobarbatus* **sp. nov.** holotype, COR-BIDI 13725, male. Photographs by P.J. Venegas. Scale bar = 10 mm.
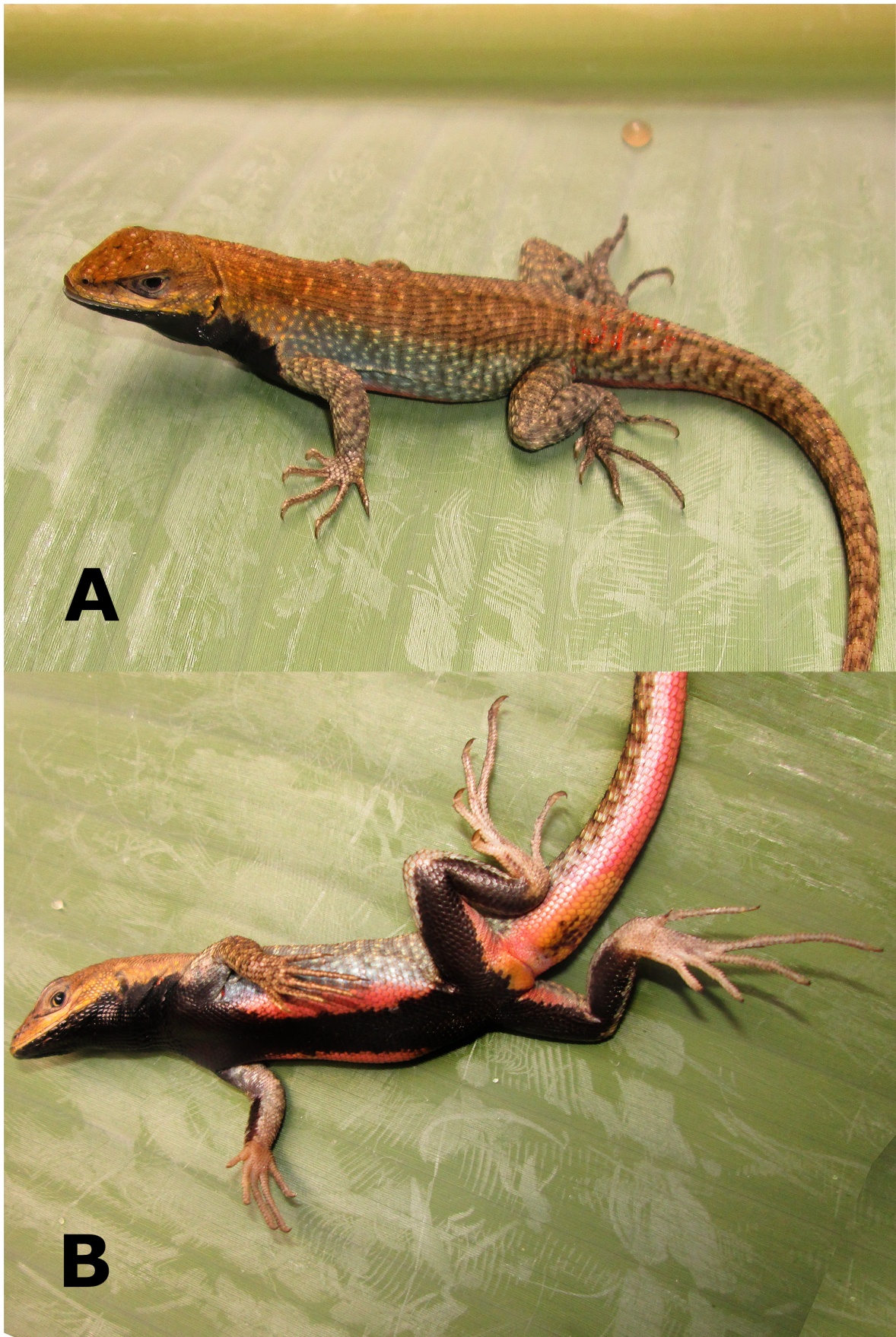
FIGURE 8. (A) Dorsolateral and (B) ventral views of the holotype of *Stenocercus nigrobarbatus* **sp. nov.** (CORBIDI 13725) in life. Photographs by L.Y. Echevarría.

(CORBIDI 13718 and 13719) have the pelvic region and the base of tail yellow and the ventral surface of forelimbs cream (Fig. 9D–G). In both specimens the pink coloration on the flanks of the belly is also less intense than in the holotype. In the adult male paratype (CORBIDI 20547) the base of the tail has a black blotch and the pre-cloacal region is yellow with black speckles (Fig. 9C).
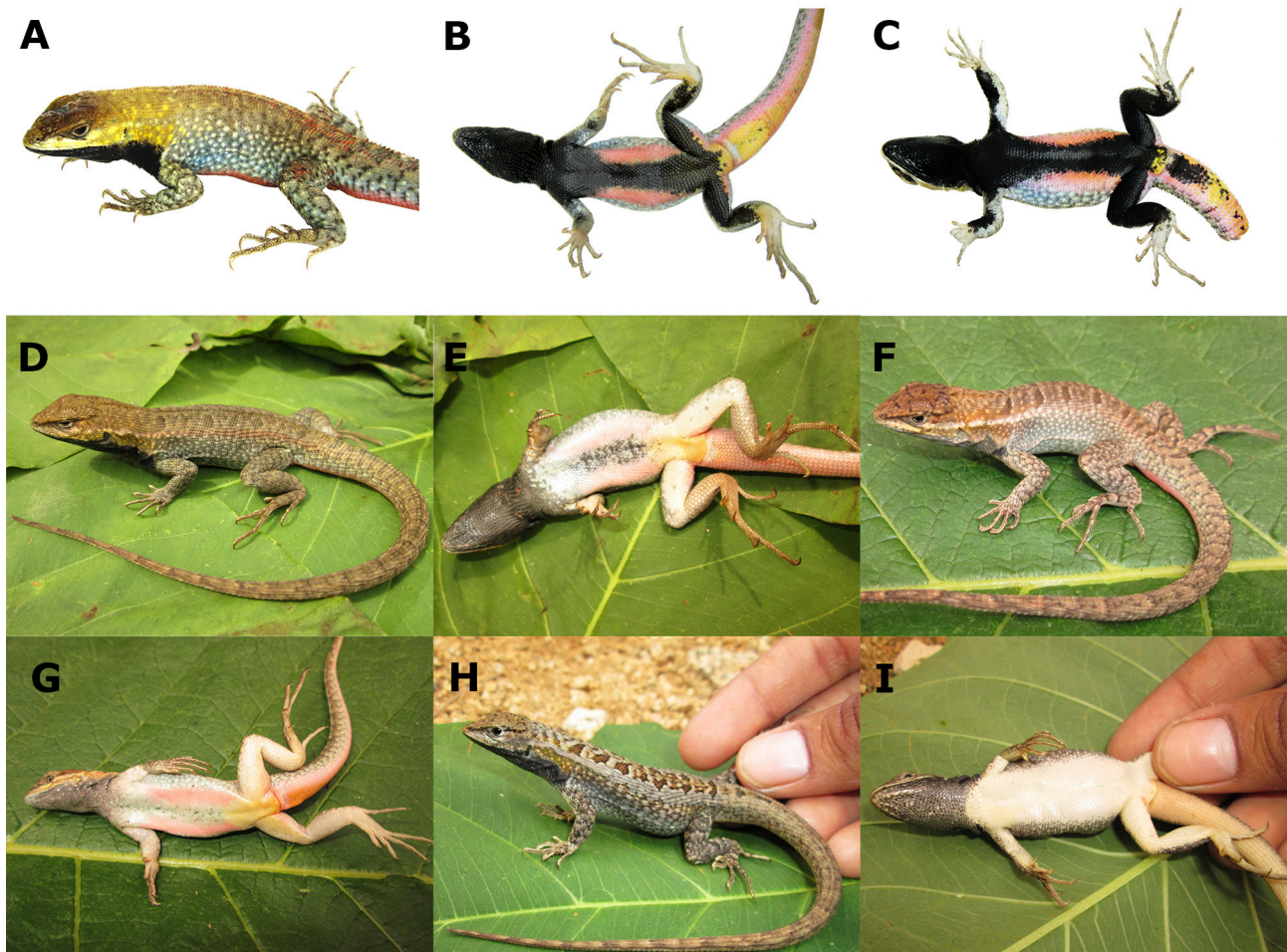

FIGURE 9. Paratypes of *Stenocercus nigrobarbatus* **sp. nov.**: (A, B) dorsolateral and ventral views of an adult male (CORBIDI 20546); (C) ventral view of an adult male (CORBIDI 20547); (D, E) dorsolateral and ventral views of an immature male (COR-BIDI 13718); (F, G) dorsolateral and ventral views of an immature male (CORBIDI 13719); (H, I) dorsolateral and ventral views of an adult female (CORBIDI 13729). Photographs A-C by L.A. García-Ayachi and D-I by L.Y. Echevarría.

Sexual dimorphism is evident in coloration and size (maximum SVL in males 67.0 mm versus 62.0 mm in females). Dorsal coloration in adult females can be gray or brown with irregular dark brown blotches over the ver-tebral line and a light brown dorsolateral stripe from the temporal region to the base of tail (Fig. 9H); dorsal surface of limbs has dark brown or gray transversal bars; sides of head brown or gray with a thin postocular stripe and some scattered dark brown dots; sides of neck yellowish brown with light yellow flecks; jaw and ventrolateral region of neck black or dark gray; body flanks covered by a dark brown reticulation. Ventrally all adult females have the gular region and neck dark gray, belly and limbs are light cream, and the tail is light orange (Fig. 9I).

Juvenile females, between 43.0–51.0 mm of SVL, have the same dorsal and ventral pattern than adult females, only two specimens (CORBIDI 13637 and 13642) have the gular region gray with dark gray speckles, and chest and belly light cream with gray speckles. The smallest juvenile female (CORBIDI 14676) has the gular region covered by gray flecks. The juvenile male CORBIDI 13640 (SVL = 43.0 mm) has the dorsum with dark brown dorsal marks as adult and juvenile females, however, the gular region and chest are gray and the belly is grayish cream. The juve-nile male CORBIDI 15767 (SVL = 53.0 mm) has the same dorsal coloration as adult males but ventrally the gular region and chest are gray, and has a faint gray midventral line on belly flanked by a weak pink hue; pelvic region, ventral surface of hindlimbs and tail are light cream.
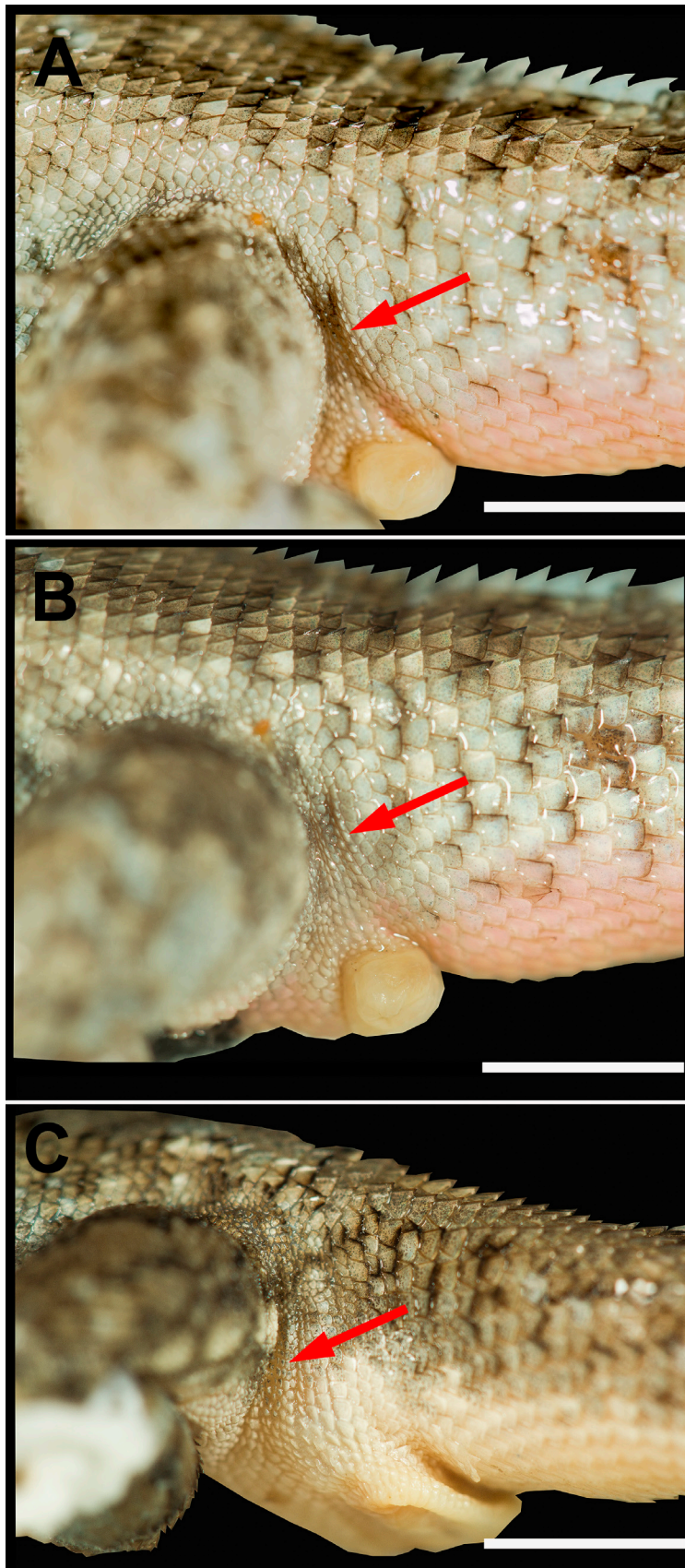
FIGURE 10. Variation of the postfemoral mite pocket in *Stenocercus nigrobarbatus* **sp. nov.**, right views of (A) holotype (COR-BIDI 13725), (B) adult male (CORBIDI 14677), and (C) adult female (CORBIDI 14669). Photographs by P.J. Venegas. Scale bar = 5 mm.
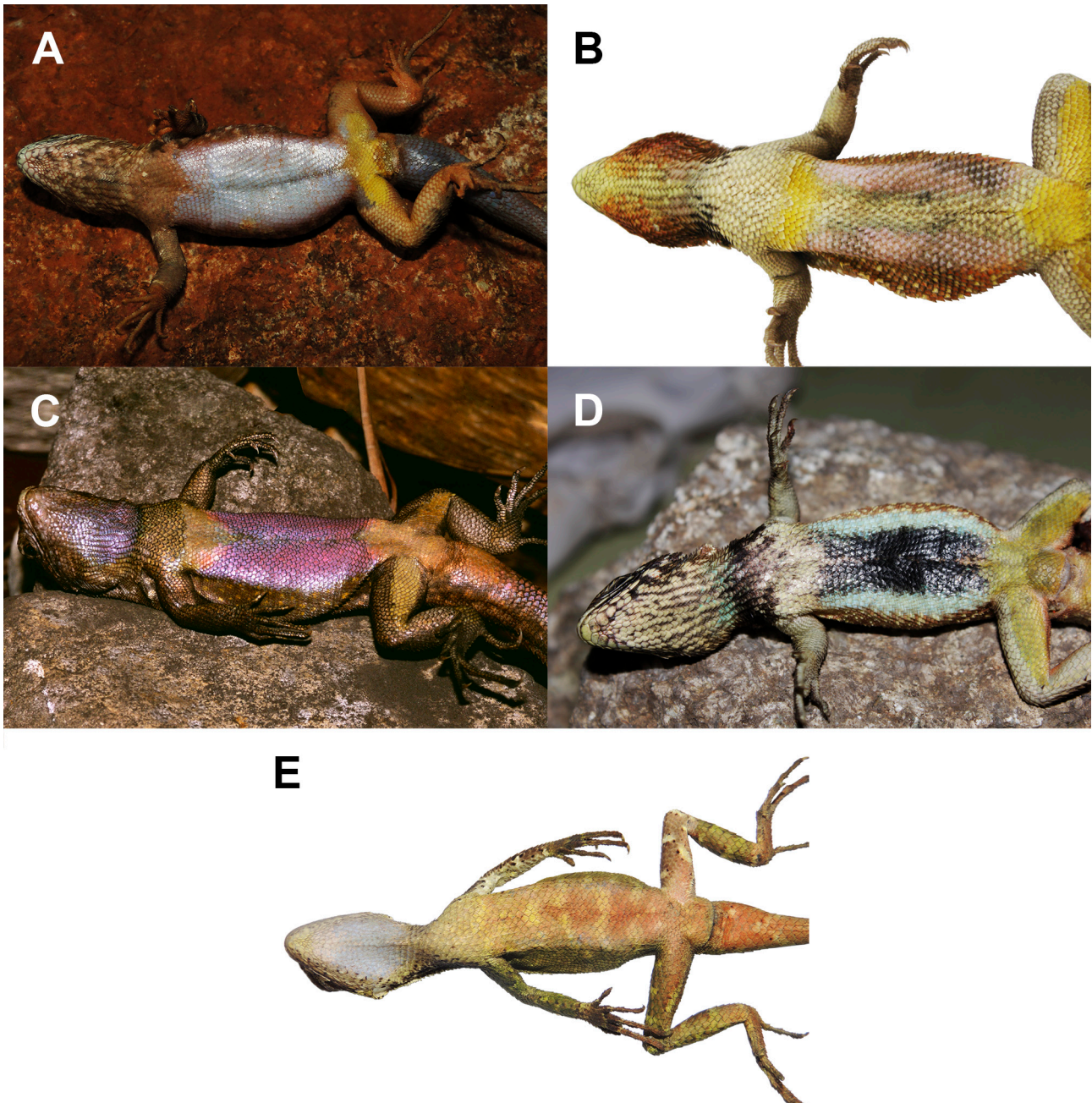
FIGURE 11. Ventral views of adult males of *Stenocercus* from the Anatomegalepis clade in life: (A) *S. apurimacus*, (B) *S. diploauris* **sp. nov.** (holotype), (C) *S. formosus* (MTD 44698), (D) *S. ochoai*, and (E) *S. scapularis* (CORBIBI 17739). Photographs by: (A) P.J. Venegas, (B) C.Z. Landauro, (C) M. Lundberg, (D) L. Mamani; and (E) L. Luján.

Distribution and natural history observations. *Stenocercus nigrobarbatus* is known from four localities in SDF of the Mantaro River Valley at elevations between 1,693 and 2,345 m asl, Huancavelica Department, Peru (Fig. 5). *Stenocercus nigrobarbatus* inhabits a seasonal dry forest, according to classification of Linares-Palomino (2004), and Central Andean Yungas according to Olson *et al.* (2001). In most localities the habitat has been modified by crops of *Zea mays, Opuntia*, and *Persea* sp., roads and the construction of a hydroelectric plant. However, this species is very conspicuous in most localities.

Specimens of *Stenocercus nigrobarbatus* were found inactive under rocks during cloudy days and active, basking or running, during warm days, among rocks, cacti or shrubs. Other species of Squamate reptiles collected at the same localities of *S. nigrobarbatus* include *Ameiva reticulata*, *Epictia* sp., *Mastigodryas boddaerti*, *Micrurus* sp., and *Oxyrhopus* cf. *erdisii*, and *Stenocercus diploauris*.

Etymology. The specific epithet "*nigrobarbatus*" is a noun derived from the Latin words "*nigro*" (= black) and

"*barbatus*" (= bearded). It refers to the black patch covering the gular region and ventral surface of neck, including the jaw angle, of adult males which resembles a black beard.

TABLE 1. Variation in scutellation and sexual dimorphism in snout–vent length (mm) of *Stenocercus diploauris* and *S. nigrobarbatus*. Range followed by mean ± standard deviation is given for quantitative characters if applicable.

Characters	*Stenocercus diploauris* (*n* = 11)	*Stenocercus nigrobarbatus* (*n* = 16)
Scales around midbody	50–61	57–74
	54.91 ± 3.73	64.56 ± 4.24
Vertebrals	40–50	47–73
	45.45 ± 2.98	63.88 ± 6.6
Paravertebrals	63–78	69–87
	70.55 ± 4.34	80.63 ± 4.84
Gulars	17–24	19–30
	21 ± 1.84	25.69 ± 3.03
Supraoculars	5–7	5–7
	5.91 ± 0.94	5.88 ± 0.62
Internasals	3–4	3–5
	3.55 ± 0.52	3.88 ± 0.5
Subdigitals Finger IV	17–21	18–23
	18.82 ± 1.17	20.38 ± 1.63
Subdigitals Toe IV	24–30	27–34
	27.55 ± 163	29.19 ± 2.1
Tail length/Total length	0.5–0.7	0.6–0.7
	0.66 ± 0.07 (n = 8)	0.67 ± 0.05 (n = 13)
Maximum SVL males	94.82	67.73
Maximum SVL females	76.06	62.29

Discussion

We tentatively assigned *Stenocercus diploauris* to the supraspecific clade Anatomegalepis (Torres-Carvajal *et al.* 2006), due to its resemblance with *S. ochoai* (e.g. well-developed postfemoral mite pocket, antehumeral and oblique neck folds, absence of posthumeral mite pocket), from which is efficiently distinguished by the presence of a C-shaped nuchal mite pocket around the oblique neck fold. The supraspecific clade Anatomegalepis stems from the most recent common ancestor of *S. apurimacus, S. formosus, S. ochoai*, and *S. scapularis* (Torres-Carvajal *et al.* 2006). All the species of this clade occur in central and southern Peru and adult males of three of them (*S. apurimacus, S. formosus,* and *S. ochoai*) share a similar ventral pattern, as in *S. diploauris*, characterized by a pink, sky blue or lavender belly, a distinctive pale patch on the chest, and a cream or yellow patch on the pelvic region including the ventral surface of the thighs and base of the tail.

Currently, there is not enough available data to assign *Stenocercus nigrobarbatus* to any supraspecific clade, as the species that are most similar morphologically and closest geographically, *S. frittsi* and *S. variabilis*, have not yet been included in any phylogeny.

Mite pockets are modifications of the skin, usually containing feeding trumbiculid mite larvae, present on the axillary, nuchal, post-axillary, inguinal and post-femoral regions of many species of lizards (Arnold 1986). The concentration of mite larvae in these modified patches of skin has raised hypotheses about a possible function of mite pockets (Arnold 1986), although it remains a controversial issue (Bauer *et al.* 1993; Salvador *et al.* 1999). Mite pockets are important characters to diagnose *Stenocercus* species (Cadle 1991; Torres-Carvajal 2005; Torres-Carvajal 2007a). There is a classification for posthumeral and postfemoral mite pockets in *Stenocercus* (Cadle 1991; Torres-Carvajal 2007a), and the presence of nuchal mite pockets, although without a standard classification,

distinguishes a set of *Stenocercus* species. *Stenocercus chrysopygus, S. cupreus, S. johaberfellneri, S. latebrosus, S. modestus, S. orientalis* and *S. ornatissimus* have mite pockets under the oblique neck fold and a shallow mite pocket under the oblique neck fold is sometimes present in *S. amydrorhytus* (Cadle 1998; Torres-Carvajal 2007a; Köhler & Lehr 2015; Venegas *et al.* 2016).

The nuchal mite pocket present in *S. diploauris* is of a novel type. It does not lie under any neck fold but borders the oblique neck fold, as a distinct depression, and is posteriorly delimited by the antehumeral neck fold (Fig. 4). Moreover, scales on the mite pocket region are not reduced in size compared to other neck scales, unlike scales on the mite pockets of all the aforementioned species, so the pocket is a conspicuous depression of the skin instead of an invagination. We recognize two types of nuchal mite pockets in adult *Stenocercus*. A nuchal mite pocket can be present as (1) deep or shallow invagination under the oblique neck fold, with scales over pocket region reduced in size, or (2) as a C-shaped depression around the oblique neck fold, posteriorly delimited by the antehumeral neck fold, with scales over pocket region not reduced in size.

According to Venegas *et al.* (2016), neck and ventrolateral folds, as well as mite pockets, can be modified and become indistinguishable after fixation. Excessive injection of 10% formalin intraperitoneally and in the chest or neck alters the height and shape of folds, obscuring the presence of mite pockets related to them. Field notes and photographs in life of collected specimens are crucial to accurately record these characters.

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APPENDIX I. Examined specimens for comparison

Stenocercus frittsi: PERÚ: Huancavelica: Mariscal Cáceres, 3966 m, KU 134181 (holotype).

Stenocercus ochoai: PERÚ: Cusco: La Convención: Santa Teresa: Sahuayaco, 2,956 m, CORBIDI 17466–77; Calca: Calca: Chimpacalca, 3235 m, CORBIDI 15909.