SALAMANDRA **57**(1): 1–14
15 February 2021 | ISSN 0036–3375

SALAMANDRA
German Journal of Herpetology

# A new species of the genus *Stenocercus* (Iguania: Tropiduridae) from the Peruvian Pacific coast (Ica region)

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Manuscript received: 12 August 2020
Accepted: 2 January 2021 by Edgar Lehr

**Abstract.** A new species of the genus *Stenocercus* is described from the Peruvian coastal desert in the Ica region. The new species is similar in ecology and morphology to *Stenocercus modestus*, but differs from it in lacking an oblique neck fold, a distinct patch of small scales posterior to the lateral region of the neck, and bright yellow lateral dots on the head and body in males. The new species also has more subdigital lamellae on the fourth toe than *S. modestus*, and females exhibit a wide dark stripe between the subocular and antehumeral regions, as well as dark reticulations in the gular region. Distribution models of the new species and *S. modestus* suggest no geographical overlap. In conclusion, morphology and species distribution models strongly imply the new *Stenocercus* species to be an undescribed lineage and different from all other species of the genus. This new species is the most southerly distributed *Stenocercus* in the Pacific coastal desert of Peru thus far. We propose the new species be classified as 'Endangered' based on its area of occupancy and threat-defined locations.

Key words. Squamata, new species, coastal desert, distribution model, taxonomy.

**Resumen.** Se describe una nueva especie del género *Stenocercus* del desierto costero peruano en el Departamento de Ica. La nueva especie es similar en ecología y morfología a *Stenocercus modestus*, pero difiere al carecer de un pliegue oblicuo en el cuello, un parche visible de pequeñas escamas posteriores a la región lateral del cuello y puntos amarillos brillantes sobre la cabeza y el cuerpo en los machos. La nueva especie también tiene un mayor número de lamelas subdigitales en el cuarto dedo de la pata posterior que *S. modestus*, y las hembras muestran una ancha franja oscura entre la región subocular y antehumeral, así como reticulaciones oscuras en la región gular. Los modelos de distribución de la nueva especie y *S. modestus* no muestran superposición en sus distribuciones potenciales. En conclusión, la morfología y los modelos de distribución de especies sugieren fuertemente que la nueva especie de *Stenocercus* es un linaje no descrito y diferente de otras especies del género. La nueva especie es el registro más sureño de su género en el desierto costero del pacifico en Perú. Así mismo, recomendamos que se clasifique como En peligro basado en el área de ocupación y localidades con amenazas.

Palabras clave. Squamata, desierto costero, modelo de distribución, taxonomía.

## Introduction

The genus *Stenocercus* (Duméril & Bibron, 1837) currently comprises 75 described species (Uetz & Hošek 2020, Venegas et al. 2020a, 2020b) that inhabit Amazonian and desert environments of South America, but have a predominant presence in the Andes (Teixeira et al. 2016, Torres-Carvajal 2007a, 2007b). Peru harbours almost 62% (47) of the species of *Stenocercus*, the majority of which live in habitats as diverse as montane, tropical humid, and equatorial dry forest (Torres-Carvajal 2007a, Uetz & Hošek 2020, Venegas et al. 2020a, 2020b). Only one *Stenocercus* species from the Lima region (central Peru), *S. modestus* (Tschudi, 1845), has thus far been known to live in coastal desert habitats (Aguilar et al. 2007, Pérez et al. 2012). In addition, *S. modestus* is currently the most southerly distributed desert species of the genus at sea level.

Reptile diversity in the Peruvian coastal desert is higher than in the Atacama Desert in Chile (Roll et al. 2017), numbering 27 in Peru (Carrillo de Espinoza & Icochea 1995, Icochea 1998, Aguilar et al. 2007, Tello 1998, Aguilar-Puntriano et al. 2019, Villegas et al. 2020) as compared to the 20 species in the Atacama Desert (Troncoso-Palacios 2014). The Ica region is located in the centre of the Peruvian coastal desert (Morrone 2001) and hosts a considerable diversity of reptiles, with lizards of the Tropiduridae, Phyllodactylidae, Liolaemidae and Teiidae families, and snakes of the Viperidae, Leptotyphlopidae, and Colubridae families (Carrillo & Icochea 1995, Lehr 2002, Uetz & Hošek 2020, Aguilar-Puntriano et al.

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2019). Recently, new reptile records were reported for the Ica coastal desert including *Phyllodactylus* species (Venegas et al. 2017) and a new species of *Liolaemus* (Aguilar-Puntriano et al. 2019). These recent findings suggest high endemism for an ecoregion that is often underestimated and perceived as a barren land with low species diversity (Carrillo & Icochea 1995, Rosas et al. 2008).

In this paper, we describe a new species of *Stenocercus* from the the Ica region in the Pacific coastal desert, which extends the distribution of this genus by about 300 km to the south. Moreover, we developed distributional models for *S. modestus* and the new species as an additional line of evidence to support our morphological analyses and hypotheses of the new species as an independent lineage. Finally, we contemplate the conservation needs of the new species and propose a classification status based on the IUCN Species Red List criteria (Iucn 2012).

## Materials and methods

### Fieldwork

Field surveys were carried out on two visits: one in October 2018 to Arrabales and another in March 2020 to Ocucaje, both in Ica Province (Ica, Peru) where the new *Stenocercus* species occurs. Eleven specimens were collected and fixed in 10% formalin after colour photographs and tissue samples had been taken (Appendices 1, 2). Besides, to provide a broader basis to the review of lepidosis in fixed specimens of *Stenocercus modestus*, particularly in the neck where important features (folds and patch of small scales) and coloration patterns are found in life, one specimen of *S. modestus* (MUSM 38401) was collected in June 2017, and other individuals were photographed in 2018, all in the La Molina District (Lima region).

For each individual of the new species, we measured its body temperature (Tb) by placing the Omega type K thermocouple model 5SC-TT-K-30-36 of a Tenmars TM-82N thermometer in the cloaca at the time of capture. Additionally, we took the substrate temperature at the place where each individual was found. Air and ambient temperatures were recorded 1 cm above the ground at the initial site of sighting (as in Andrango et al. 2016). All specimens were deposited in the Herpetology Department of the Natural History Museum of the National University of San Marcos (MUSM).

### Morphological characters

We recorded the following measurements: snout–vent length (SVL), measured from the tip of the snout to the cloacal slit; tail length, measured from the cloacal slit to the tip of the tail; head width, measured at the widest point of the head; head length, linear distance from the tip of the snout to the anterior edge of the tympanum, head height, measured at the level of the highest point of the head; snout length, measured from the tip of the snout to the anterior edge of eye; arm length, from the point of insertion of foreleg into the body to the tip of the 4th finger; leg length, from the point of insertion of the hind leg into the body to the tip of the 4th toe; armpit-to-groin distance; and total length. All measurements were taken with digital callipers to the nearest 0.1 mm. Sexes were identified by the presence/absence of hemipenes and assessing the colour patterns of adult individuals. Oviductal egg lengths and largest widths were measured with digital callipers (to 0.1 mm), and oviductal egg weights were measured on a digital scale.

We follow the terminology of Cadle (1991) and Torres-Carvajal (2000, 2004, 2007b) for species description. We counted the following characters: scales around midbody, number of scales in a transverse line around midbody; vertebral scales from the occipital scales to the posterior edge of the thigh when extended perpendicular to body; paravertebral scales in the row laterally adjacent to the vertebral row between the same limits as for the vertebral scales; gular scales between the ventral edges of the tympani (tiny scales on the ear margin were not included); supraocular scales in a transverse line across the greatest width of the orbit; supralabials lining the upper edge of the mouth from the rostral (but excluding it) to the corner of the mouth; infralabials lining the lower edge of the mouth from the mental scale (but excluding it) to the corner of the mouth; internasals between the nasal scales; sublabials between the infralabial scales and the chin shields; posterior thigh scales (the scales covering the posterior face of the thighs can be smooth, keeled, or keeled and mucronate); subdigital lamellae on Finger IV from the point of attachment of Fingers III and IV to the terminus of Finger IV; subdigital lamellae on Toe IV from the point of attachment of Toes III and IV to the terminus of Toe IV; caudal notch; and caudal whorls per autotomic segment as the number of transverse rows of caudals between consecutive autotomic points.

The neck folds, posthumeral, postfemoral pockets and previously defined characters were characterized using the definitions of Torres-Carvajal (2000, 2007b). Likewise, morphological data such as lepidosis, measurements, state of folds, and colour pattern of the new species of *Stenocercus*, *Stenocercus modestus*, and other geographically close and similar *Stenocercus* species are summarised in Table 1.

The morphological data of Peruvian *Stenocercus* species were taken from specimens in the collection of the Herpetology Department, MUSM (see Appendix 3). Morphological and other data from the remaining *Stenocercus* species were extracted from the literature (Tschudi 1845, Girard 1858, Günther 1859, Boulenger 1885, 1900, 1911, Roux 1907, Noble 1924, Fritts 1972, 1974, Cadle 1991, 1998, 2001, Ávila-Pires 1995, Torres-Carvajal 2005, 2007a, Venegas et al. 2013, 2014, 2016, 2020, Köhler & Lehr 2015, Teixeira et al. 2016, Ávila-Pires et al. 2019).

### Species distribution models

Species distribution models (SDMs) were created to explore the potential geographic distribution of the new spe-

Table 1. Lepidoses, measurements and colour patterns of *Stenocercus ica* sp. n. and other geographically close and similar *Stenocercus* species. Average values in parentheses.

| | *S. amydrorhytus* N = 7 | *S. chrysopygus* N = 25 | *S. ica* sp. n. N = 11 | *S. johaberfellneri* N = 11 | *S. modestus* N = 17 | *S. ornatissimus* N = 21 |
|---|---|---|---|---|---|---|
| Maximum SVL males (mm) | 68 | 79 | 81.5 | 57 | 72 | 66.4 |
| Maximum SVL females (mm) | 60.5 | 76 | 62.3 | 47.5 | 59 | 57.4 |
| Scales around midbody | 42–47 (44.3) | 46–66 (57.3) | 35–38 (37.09) | 46–53 (49.2) | 35–41 (37.8) | 48–59 (53.7) |
| Vertebral scales | 44–52 (47.3) | 52–68 (59.1) | 44–48 (46.5) | 47–53 (50.0) | 39–46 (42.4) | 47–61 (53.8) |
| Gular scales | 18–21 (19.3) | 19–26 (22.8) | 15–19 (16.6) | 19–24 (21.7) | 15–18 (16.5) | 20–25 (22.5) |
| Internasals | 4 | 2–4 | 2–4 | 2–4 | 2–4 | 2–6 |
| Fourth toe subdigitals | 23–26 (24.4) | 22–32 (26.4) | 28–32 (29.6) | 23–27 (24.2) | 24–28 (26.2) | 22–26 (23.6) |
| Tail length/total length | 0.61–0.67 | 0.60–0.69 | 0.70–0.73 | 0.62–0.68 | 0.70–0.73 | 0.64–0.70 |
| oblique neck fold | Present | Present | Absent | Present | Present | Present |
| Yellow marks scattered dorsally in males | Present | Present | Absent | Present | Present | Present |
| Dark reticulations or streaks on gular regions in females | Present | Absent | Present | Present | Absent | Present |
| Dark stripe between subocular and antehumeral region in females | Absent | Absent | Present | Present | Absent | Absent |

cies relative to that of *S. modestus*. The maximum entropy model produced by the software MaxEnt version 3.4.1 (Phillips et al. 2006) was used to predict areas with a high probability of species occurrence. MaxEnt was selected due to its better performance in species distribution models even with few localities or low sample sizes (Pearson et al. 2007, Tarkesh & Jetschke 2012, Shcheglovitova & Anderson 2013). SDMs were generated based on occurrence records, and a correlation analysis (r < 0.7, Pearson et al. 2007) of the uncorrelated layers of 19 climatic and altitude variables from the WorldClim project (Hijmans et al. 2005). After this, only the altitude and six bioclimatic (BIO01, 03, 07, 12, 15, and 19) layers remained to develop the species distribution models.

For model calibration, 20% of the data were separated for random tests and the option of partitioning random samples was used. To reduce overfitting, a regularization multiplier of two (Radosavljevic & Anderson 2014), with 10,000 iterations and a minimum training value averaged by ten replicates were used. MaxEnt default convergence threshold was used, the maximum number of iterations was set to 1000, and the option "Fade by clamping" was selected as the clamping model so that probability values decrease as they move away from the native area of records. Bootstrap was used to calibrate and evaluate the model.

The "raw" output format was used, which is based on presence probabilities with the influence of climatic variables (Elith et al. 2011). We chose this output because it avoids post-processes that cause rescaling (cumulative) or data transformations. It also avoids the use of arbitrary thresholds (logistical) that might dramatically change distribution predictions without a clear biological basis (Merow et al. 2013).

To verify the model, the area under the curve (AUC) was calculated to summarize the model's ability to classify locations of presence higher than a random sample of pixels (Peterson et al. 2011). AUC values ≤ 0.5 correspond to predictions that are the same or worse than random. AUC values > 0.5 are generally classified into: (1) poor predictors (0.5–0.7); (2) reasonable predictors (0.7–0.9); and (3) very good predictors (> 0.90).

The output files were converted to a raster file with the ArcMap v10.6 application in ArcGIS v10.6 (Esri 2018). A rescaling was made in the ArcToolbox, using the "MSLarge" function to transform the values (ranging from 1 to 10) of each pixel. Values > 9 in the new scale were considered areas with a high probability of species presence.

Finally, a niche identity test was performed to measure the similarity between *Stenocercus modestus* and the new species with the Schoener's D metric, using the "ENMTools" package (Warren et al. 2019) incorporated in the R platform (R Development Core Team 2018). Here, D values range from 0 (no overlap) to 1 (identical niches) (Warren et al. 2008). We ran the data using MAXENT models and one hundred randomly resampled pseudoreplicate data sets to generate a D score distribution. We rejected the null hypothesis of niche identity when the observed D value was significantly lower than the random distribution of pseudoreplicate values.

## Conservation criteria

Our SDMs allow us to recommend a conservation status for the new species following the IUCN Red List criteria and guidelines (IUCN 2012). In this conjunction, we also employed the software GeoCAT (Bachman et al. 2011) to measure the Area of Occupancy (AOO) and the Extent of Occurrence (EOO) using grid values as suggested by the IUCN.

## Nomenclatural acts

The electronic edition of this article conforms to the requirements of the amended International Code of Zoological Nomenclature, and hence the new names contained herein are available under that Code from the electronic edition of this article. This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The LSID (Life Science Identifier) for this publication is: urn:lsid:zoobank.org:pub:C8073227-0458-4BA4-A4B8-7233C5E72521. The electronic edition of this work was published in a journal with an ISSN, has been archived, and is available from the following digital repositories: www.salamandra-journal.com, and www.zenodo.org.

## Results

### Species description

### *Stenocercus ica* sp. n.
(Figs 1–4)

ZooBank LSID: urn:lsid:zoobank.org:pub:C8073227-0458-4BA4-A4B8-7233C5E72521

Holotype: MUSM 40418, an adult male from Ocucaje District, latitude -14.350° S, longitude -75.684° W, 323 m a.s.l., Ica Province, Ica region, Peru, collected 8 March 2020 by C. Ramírez, A. Mendoza, C. Aguilar, E. Alvarado and E. Salazar. Field code AMH-352.

Paratypes. Two males (MUSM 39363, 40419), four females (MUSM 40412, 40414, 40415, 40416), one subadult (MUSM 40413), and one juvenile (MUSM 40417) from the same locality as the holotype, collected on 8 March 2020 by C. Ramírez, A. Mendoza, C. Aguilar, E. Alvarado and E. Salazar. Two males (MUSM 39364, 39365) from Arrabales, latitude -14.032° S, longitude -75.751° W, 432 m a.s.l., Subtanjalla District, Ica Province, Ica region, Peru, on 01 September 2018 by A. Mendoza and M. Mendoza.

Diagnosis: (1) Maximum SVL in males 81.5 mm (N = 5); (2) maximum SVL in females 62.3 mm (N = 4); (3) vertebrals 44–48 (N = 11); (4) paravertebrals 44–48 (N = 11); (5) scales around midbody 35–38 (N = 11); (6) supraoculars 5–6 (N = 11); (7) internasals 2–4 (N = 11); (8) postrostrals 2–5 (N = 11); (9) loreals 1–3 (N = 11); (10) gulars 15–19 (N = 11); (11) lamellae on Finger IV 20–23 (N = 11); (12) lamellae on Toe IV 28–32 (N = 11); (13) posthumeral mite pockets absent (Type I of Torres-Carvajal 2007b); (14) postfemoral mite pockets present (Type II de Torres-Carvajal 2007b); (15) parietal eye visible; (16) smooth, juxtaposed, or slightly imbricate occipital scales; (17) projecting angular temporals absent; (18) enlarged supraoculars occupying most of the supraocular region in one row absent; (19) scales in the frontonasal region smooth, weakly imbricate anteriorly or juxtaposed (20) preauricular fringe present; (21) antehumeral and longitudinal folds present; (22) lateral nuchals similar in size to dorsal nuchals; (23) posterior gulars smooth, cycloid, imbricate , with or without notches or apical pits; (24) a caudad notch on ventral scales; (25) lateral body scales similar in size to dorsal scales; (26) vertebrals similar in size to adjacent dorsals; (27) dorsolateral crests absent; (28) ventrals smooth, imbricate, sub-rhomboidal, similar in size to dorsals; (29) scales on the posterior faces of thighs granular; (30) prefemoral fold absent; (31) inguinal groove absent; (32) preanals not projected; (33) tail slightly compressed laterally in adult males; (34) tail length 70–73% of total length; (35) three caudal whorls per autotomic segment; (36) caudals not spinose; (37) dark stripe from the subocular region to superciliars absent; (38) colour pattern of dark reticulations in the gular region in adult females; (39) dark streaks that form a reticulum in the gular region in adult males absent; (40) black spot on ventral face of neck in adult males absent; (41) dark midventral stripe in adult males absent; (42) black patches on ventral faces of thighs in adult males absent; (43) background colour of dorsum olive yellowish to brown in life.

Comparisons. *Stenocercus ica* sp. n. differs from all other congeneric species except *S. amydrorhytus, S. boettgeri, S. chinchaoensis, S. chrysopygus, S. frittsi, S. haenschi, S. humeralis, S. imitator, S. ivitus, S. johaberfellneri, S. latebrosus, S. melanopygus, S. modestus, S. nigrobarbatus, S. orientalis, S. omari, S. ornatissimus, S. praeornatus, S. stigmosus, S. variabilis*, and *S. varius* by having granular scales on the posterior faces of its thighs and having three caudal whorls per autotomic segment. *Stenocercus ica* sp. n. differs from these other species (character states in parentheses) except *S. latebrosus* and *S. modestus*, by having 35–38 scales around midbody (42–125) and a tail length of 70–73% of total length (53–70%). *Stenocercus ica* sp. n. is distinguished from *S. latebrosus* and *S. modestus* by lacking an oblique neck fold and a visible patch of small scales (present in both species). *Stenocercus ica* sp. n. is most similar to *S. modestus*, with both species having long tails that account for 70–73% of the total length, a caudad notch on their ventral scales, a similar number of scales around midbody with 35–38 (average 37.09) in *S. ica* sp. n. and 35–41 (average 37.75) in *S. modestus*, similar vertebral and paravertebral scale counts (*S. ica* sp. n. with 44–48 vertebrals, 44–48 paravertebrals, and *S. modestus* with 39–46 vertebrals, 38–46 paravertebrals), and both possess strongly keeled scales on the dorsum and sides of the neck. However, *Stenocercus ica* sp. n. has 28–32 subdigital lamellae on the fourth toe (24–28 in *S. modestus*) and lacks bright yellow lateral dots or markings on the posterior head and body in males (present in *S. modestus*). In addition, females of *S. ica* sp. n. bear a wide black or dark brown stripe between the subocular scale and the antehumeral region (absent in *S. modestus*) and have dark reticulations in the gular region (absent in *S. modestus*). Table 1 shows selected qualitative morphological features, measurements, and colour patterns of *Stenocercus ica* sp. n. and geographically close S*tenocercus* species.

Description of the holotype (Figs 1, 4A): Adult male; SVL 64.18 mm; tail length 85.52 mm (incomplete); tail slightly compressed in cross section; armpit to groin distance 26.24 mm ; head length 17.06 mm, head length / SVL ratio 0.26; snout length 11.08 mm; head width 12.80 mm; head height 8.83 mm; leg length 53.15 mm , leg length / head length ratio 3.12; scales in parietal and occipital regions smooth, juxtaposed to slightly imbricate, slightly convex; visible parietal eye; supraoculars in three rows, smooth, with the two most lateral rows less than half the size of the adjacent medial row; circumorbitals present; two canthals; anterior canthal in contact with nasal; internasals two; postrostrals four, much wider than long; supralabials six; infralabials seven; loreals one (right side) and two (left side), respectively; lorilabials in one row; a single preocular; lateral temporal scales imbricate and keeled; 15 gulars between tympanic openings; gulars smooth, cycloid, imbricate, with apical pits; second sublabial in contact with two infralabials; first pair of postmentals in contact medially; mental separated from sublabials by the first pair of postmentals; dorsal and lateral scales of neck strongly keeled, imbricate and rhomboidal; lateral body scales similar in size to dorsals; scales around midbody 37; vertebrals not differentiated from adjacent scales, in 44 rows, not forming a continuous vertebral row; paravertebrals adjacent to vertebral row equal to vertebrals in size and shape, paravertebrals 44; ventrals smooth, imbricate, subrhomboidal, similar in size to dorsals; preauricular fringe present; antehumeral neck fold present, oblique neck fold absent, longitudinal fold slightly developed; ventrolateral and prefemoral folds absent; dorsal scales of forelimbs and hindlimbs keeled and imbricate; 21 subdigital lamellae on Finger IV; 30 subdigital lamellae on Toe IV; tail slightly compressed laterally, not spiny, with imbricate, mucronate and strongly keeled dorsal scales, similar in size to dorsal body scales; distal subcaudals keeled and mucronate; basal subcaudals smooth and imbricate; posthumeral mite pocket absent [Torres-Carvajal Type I (2007b)]; postfemoral mite pocket present as a cleft [Torres-Carvajal Type II (2007b)].

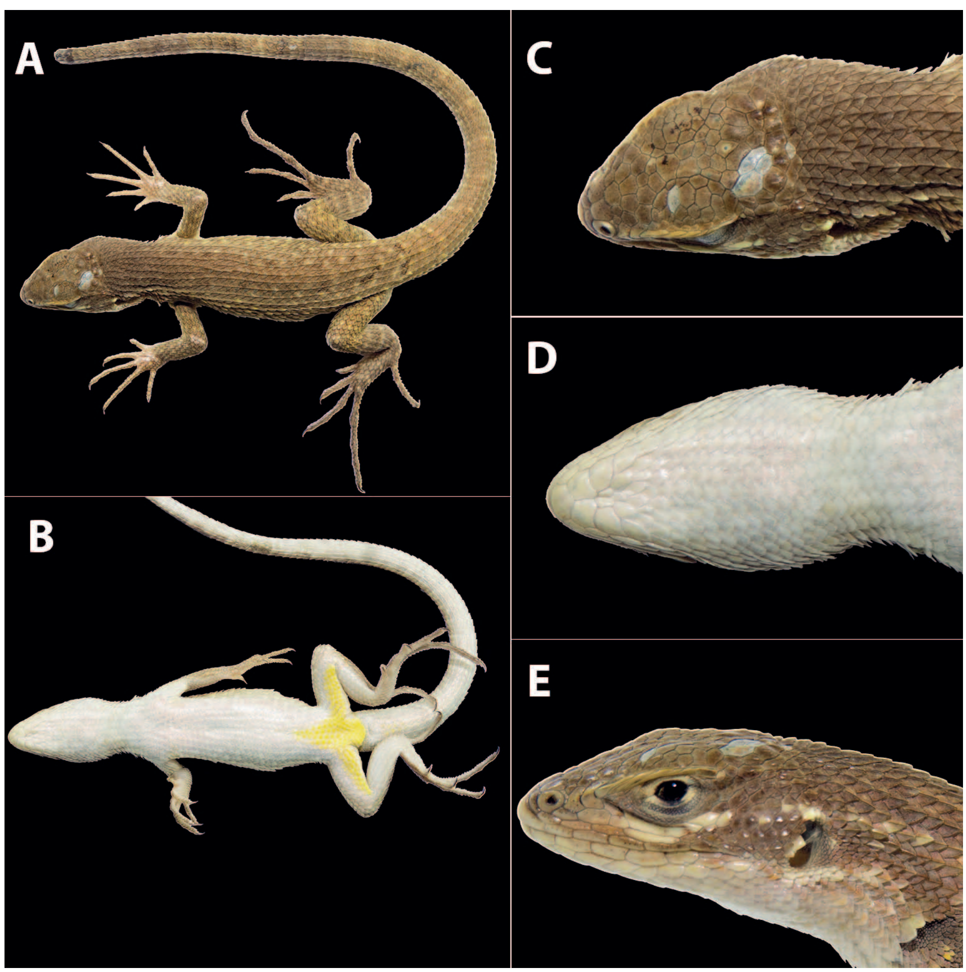


Figure 1. Male holotype of *Stenocercus ica* sp. n. (MUSM 40418, SVL 64.18 mm) in life in dorsal (A), ventral (B), head in dorsal (C), head in ventral (D), and head in lateral (E) views. Photos by A. Mendoza.

Measurements of holotype (in mm): SVL 64.18, axilla–groin distance 26.24 (40.88 % SVL), head length 17.06, head width 12.80, head height 8.83, arm length 29.44, leg length 53.15, tail length 85.52 (incomplete), snout length 11.08.

Colour in life: (Holotype, MUSM 40418, male) dorsal region including limbs, the base of the tail, and lateral body olive yellowish to light brown. Pale yellow spots on the dorsal face of limbs, dorsal side of head dark to light brown; ventrally, pinkish white to white, with a yellow patch that covers the pelvic region, thighs, and the base of the tail (Fig. 1).

Colour in 70% ethanol: (Holotype, MUSM 40418, male) dorsum and flanks of body tan, dorsal areas of head, body, arms, legs, and tail without pale yellow scales, venter whitish cream.

Variation: In both sexes, the background of the ventral body faces is pinkish white (MUSM 40415, 40419), reddish white (MUSM 40416), or whitish (MUSM 40413, 40417). Sexual dichromatism is present, i.e., in females (MUSM 40412, 40414–40416), there are a broad dark stripe from the subocular to the antehumeral region (covering the ear), and dark reticulations in the gular region; the dorsum is dark to light brown with a wide, faintly lighter dorsolateral stripe from above the ear to the pelvic area (sometimes reaching the base of tail), more evident in subadult (MUSM 40413) and young specimens (MUSM 40417); and a transverse series of 6–8 triangular or irregular dark brown spots on the dorsum (MUSM 40412–40417).

A larger male specimen (MUSM 39364, SVL 81.51 mm) from Arrabales had brick red or orange reticulations on the face, neck, gular, and ventral neck areas. In this specimen, the yellow patch in the pelvic region reaches the yellow transverse pectoral band and the ventral region of the tibia. It also has a dark brown pigmentation on the dorsal side of the head (Fig. 5B). Juvenile specimens exhibit a colour pattern that is similar to that of females, but differs by a greater number of triangular or irregular dorsal brown spots in transverse series.

Etymology. The specific epithet *ica* is a noun in apposition and refers to the Ica region of Peru where all type speci-

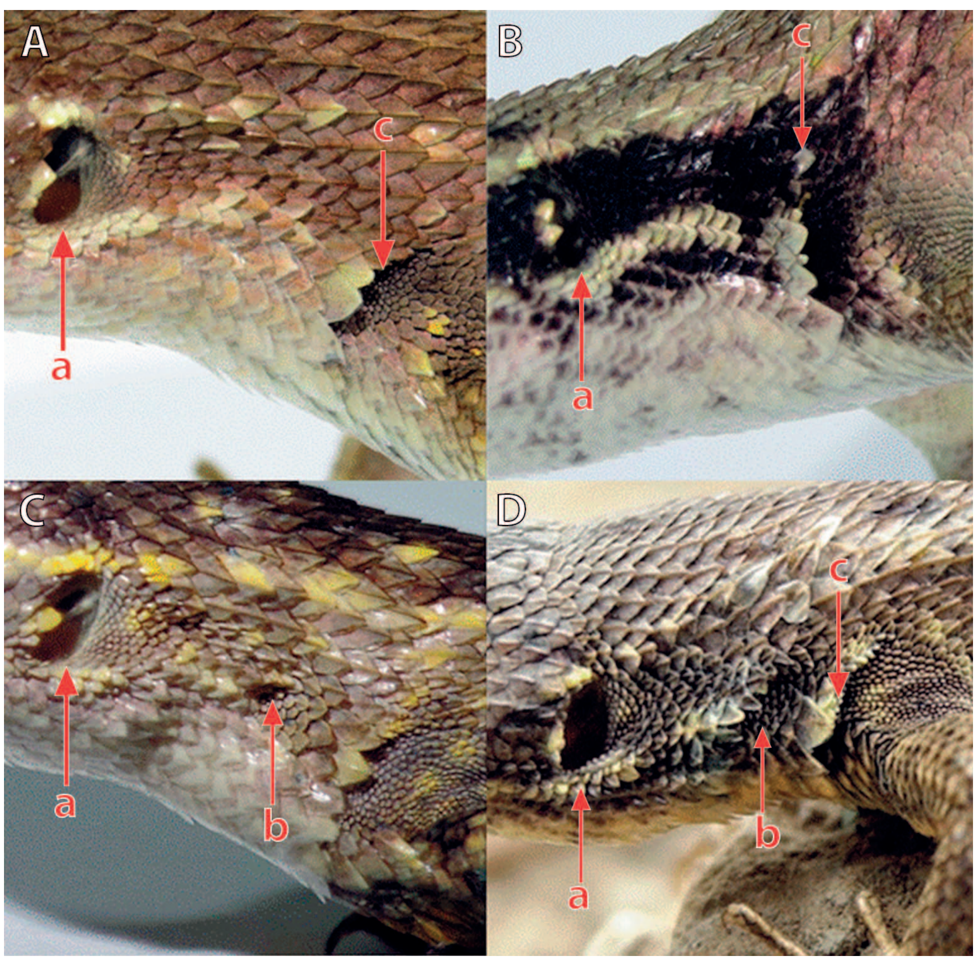


Figure 2. Lateral view of neck showing the conditions of the folds and the patch of small scales in *S. ica* sp. n. and *S. modestus*. Male of *S. ica* sp. n. (MUSM 40418) (A), *S. ica* sp. n. female (MUSM 40412) (B), *S. modestus* male (C), *S. modestus* female (D), a = eardrum, b = patch of small scales posterior to oblique fold, c = antehumeral fold. Photos by A. Mendoza.

mens were collected. It also refers to Ica as being the southernmost distribution record for the genus on the Peruvian Pacific coast.

Distribution: *Stenocercus ica* sp. n. is as yet only known from the valley of the Ica river basin, with the highest number of individuals recorded at two localities (Arrabales and Ocucaje) in the Ica region between 300 to 450 m a.s.l. on the Peruvian Pacific coast. *Stenocercus ica* sp. n. appears to be restricted to low altitudes (Figs 6–7).

Natural history: *Stenocercus ica* sp. n. has been found in dense shrub vegetation close to riverside forest and the irrigation installations in agricultural areas in the Ica river basin (Fig. 5A). Specimens were observed basking at the edge of a bushy area, mainly on dry leaf litter, fallen branches, and on the, usually in dappled or diffused sunlight. Two specimens were observed escaping into holes at the base of bushes, under accumulations of leaf litter. This species probably utilizes these cavities as burrows and nests.

Body temperatures of three specimens of *S. ica* sp. n. ranged 30.8–31.4°C (substrate temperature: 28.4–31.4°C; air temperature: 29.5–30.2°C; ambient temperature: 28.9–29.1°C).

On 8 March 2020, a gravid female with three oviductal eggs was found. The mean egg length was 13.07 ± 1.48 mm (range = 11.36–13.93 mm, N = 3), mean egg largest width was 7.41 ± 0.48 mm (range = 7.10–7.96 mm, N = 3), and mean egg weight was 0.27 ± 0.19 g (range = 0.25–0.28 g, N = 3).

## Species distribution model

The distribution model for *Stenocercus ica* sp. n. has a high AUC = 0.952, and layers with the greatest influence were BIO12 (annual precipitation, 38%) and BIO15 (seasonal precipitation, 36.2%). For its part, the *S. modestus* SDM has a high AUC = 0.985, and layers with the greatest influence were BIO07 (annual temperature range, 62.3%) and BIO03 (isothermality, 24.4%).

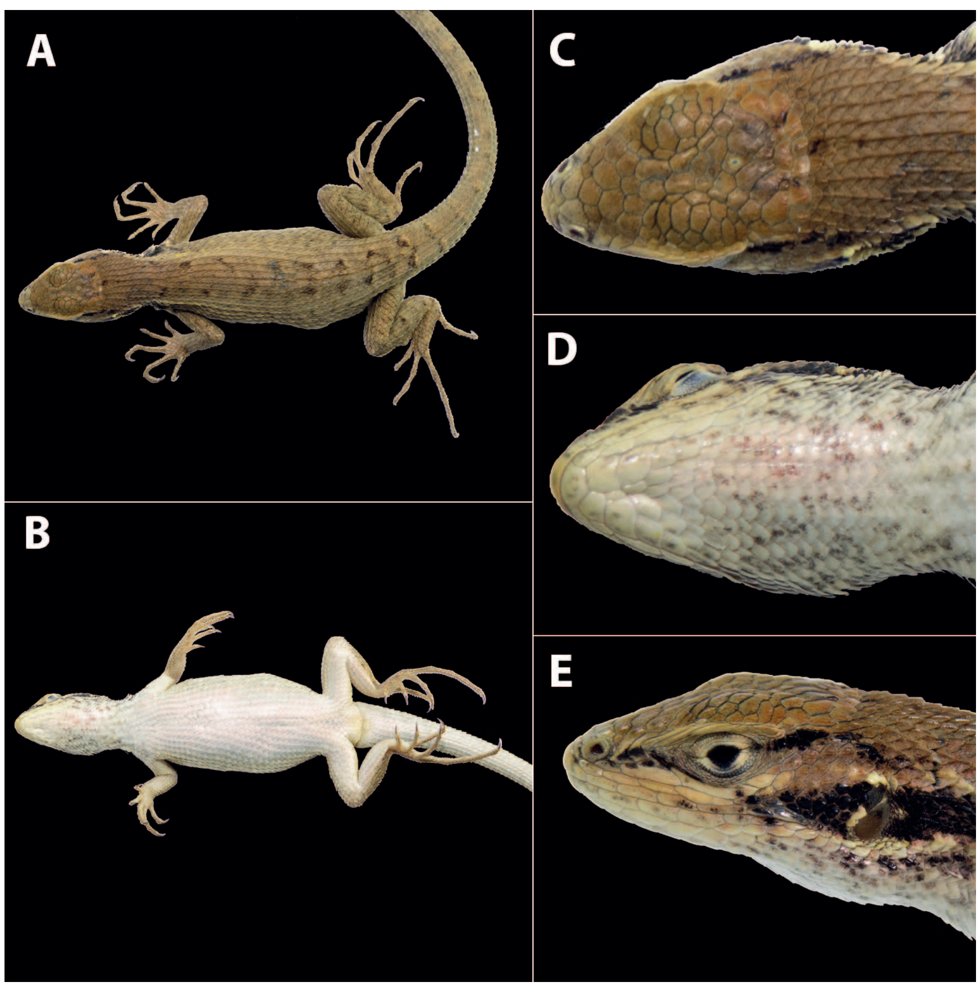


Figure 3. Female paratype of *Stenocercus ica* sp. n. (MUSM 40415, SVL 59.30 mm) in life in dorsal (A), ventral (B), head in dorsal (C), head in ventral (D), and head in lateral (E) views. Photos by A. Mendoza.

The distribution model of *S. ica* sp. n. indicates a high probability of restricted presence in valleys and the riverine vegetation of the Rio Ica basin (values > 9), at altitudes of 30–400 m a.s.l. (Fig. 6). A high probability of significant presence is also suggested for the Rio Grande valley (Palpa and Nazca province) at altitudes of 60–200 m a.s.l.. Another zone with a high probability of occurrence lies at Paracas town south of the Pisco River mouth (province of Pisco, Fig. 6).

The distribution model for *S. modestus* suggests a high probability of presence in agricultural areas near river mouths, close to the coastline in northern Lima Province. The southern area with a high probability of presence and extent coincides with agricultural areas adjacent to the mouth of the Cañete River in the Lima region (Fig. 7).

A comparison of the *S. modestus* and *S. ica* sp. n. distributional models reveals no significant overlap. *S. modestus* is predicted at lower altitudinal ranges and mainly in the Lima region. The SDM of this species also suggests areas with a high probability of presence around the Paracas District (province of Pisco, Fig. 7).

The niche identity test shows the observed Schoener's D value (0.134) of *S. ica* sp. n. vs. *S. modestus* falling outside the distribution of the pseudoreplicates (Fig. 8).

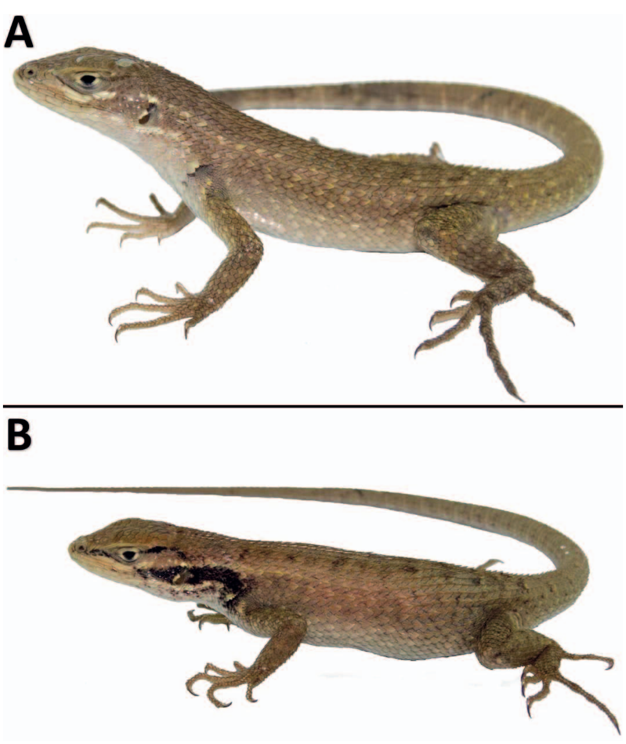


Figure 4. Coloration in life of *Stenocercus ica* sp. n.: A) dorsolateral view of adult male holotype (MUSM 40418); B) dorsolateral view of adult female paratype (MUSM 40415). Photos by A. Mendoza.

## Conservation criteria

Our analysis in GeoCAT suggests *Stenocercus ica* sp. n. possessing an Extent of Occurrence (EOO) of 85 $km^2$ and an Occupancy Area (AOO) of 16 $km^2$. Additionally, three threat-defined locations were established within its distribution.

The threats identified were loss of habitat due to urban growth, loss of habitat due to industrial agriculture (agricultural estates), and degradation of habitat and vegetation cover due to extensive agriculture.

Taking into account the current and constant pressure on its distribution range, we suggest the conservation category for the new species to be Endangered EN B1ab(iii,iv)+2ab(iii,iv) according to AOO, threat-defined locations, and the pervasive degradation of habitat quality where the new species is found (Whaley et al. 2019).

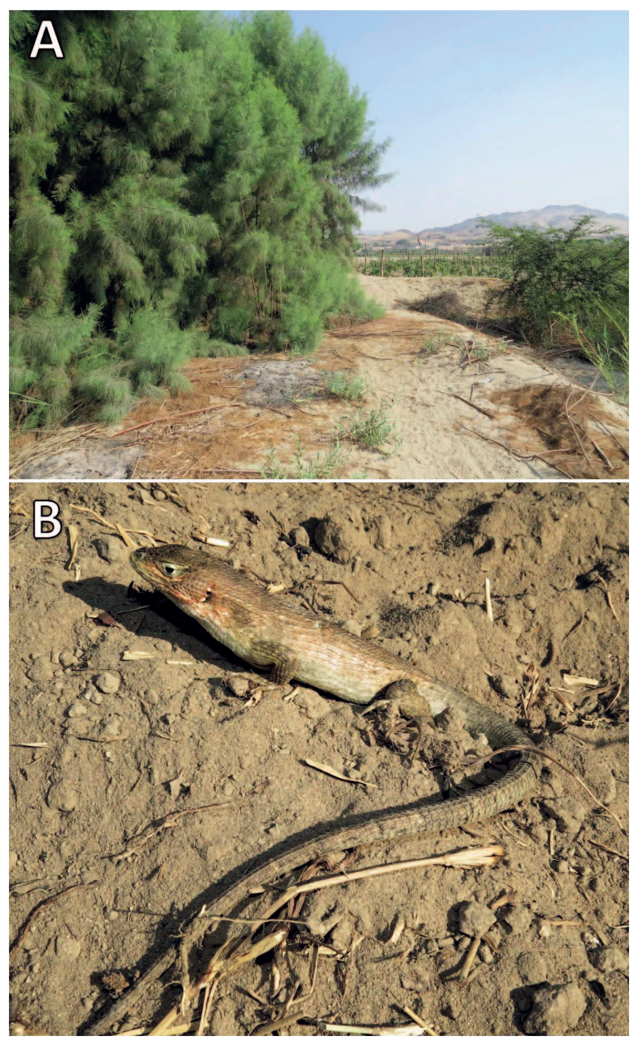


Figure 5. Habitat (A) and adult male (B) of *Stenocercus ica* sp. n. (MUSM 39364, SVL 81.5 mm) from Arrabales (Ica region). Photos by A. Mendoza.

## Discussion

The description of this new species increases the total number of *Stenocercus* species to 76, with more than half (41) of these being represented in Peru (Uetz & Hošek 2020). The phylogenetic position of *Stenocercus ica* sp. n. remains unresolved until an adequately comprehensive analysis to this effect will be carried out. However, based on the morphological similarity of some characters (granular scales on the posterior faces of thighs, three caudal whorls per autotomic segment, 35–38 scales around midbody, vertebral and paravertebral scale ranges similar, and proportion of tail length about 0.7 of total length) and the geographical proximity of *S. ica* sp. n. to both *S. modestus* and *S. ornatissimus*, we tentatively assign this new taxon to the *Saccodeira* clade sensu Torres-Carvajal et al. (2006) and Torres-Carvajal (2007a). The *Saccodeira* clade is a monophyletic group endemic to Peru, whose species all have restricted distributions in the Central Andes, specifically in northern and central Peru.

*Stenocercus modestus* was until now considered the only species of this genus known from low altitudes on the western slopes of the Central Andes (Torres-Carvajal, 2007a) and the sole species present in the coastal desert ecoregion. The description of *S. ica* sp. n. adds a second species to this ecoregion, and extends the known southern distribution of *Stenocercus* on the western slope of the Andes. Moreover, the new species follows the same distributional pattern of most Peruvian *Stenocercus* by being restricted and encompassing a narrow altitudinal range. The description of *S. ica* also highlights the fact that the Peruvian diversity of this genus (and lizards in general) is still underestimated (Köhler & Lehr 2015; Venegas et al. 2016).

Body temperatures recorded from *S. ica* sp. n. are within the range found in *S. modestus* (C. Ramírez et al. pers. comm.). These field observations indicate similarities in thermal preferences and probably in thermoregulatory strategies between these two coastal desert *Stenocercus* species. Body temperatures and habitat preferences (forest riverine vegetation) of *S. ica* sp. n. would allow the coexistence with *Microlophus thoracicus*, a species that seems to prefer open habitats with low vegetation and more exposed to solar irradiation.

Our Maxent SDM for *S. ica* sp. n. restricts the new species to the Ica River basin, Grande River, and Paracas town south of the Pisco River mouth (province of Pisco) in the Ica region (Fig. 6). However, the habitat types where the new species was found do not exist in Paracas. For this rea-

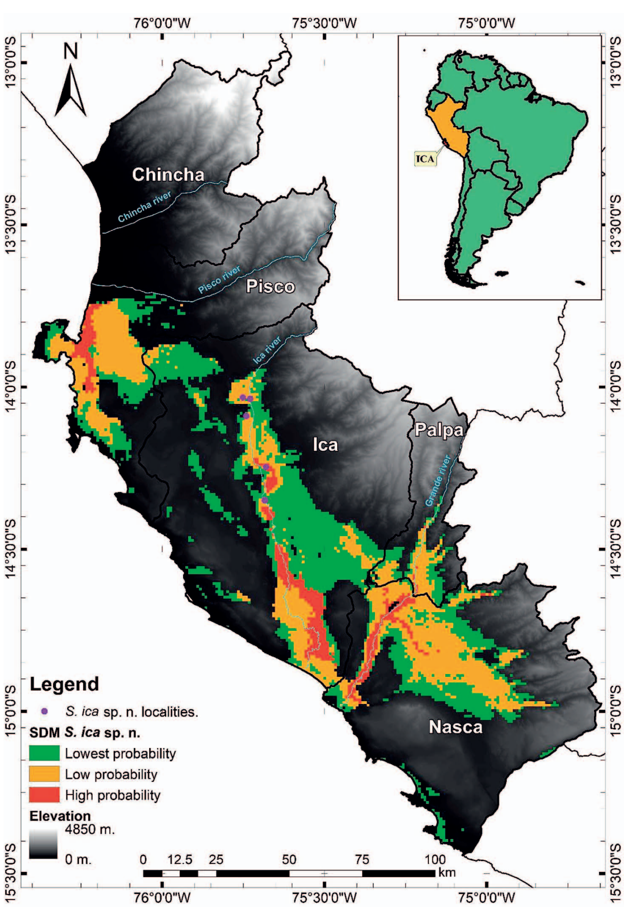


Figure 6. SDM (species distribution model) of *Stenocercus ica* sp. n. in the Ica region.

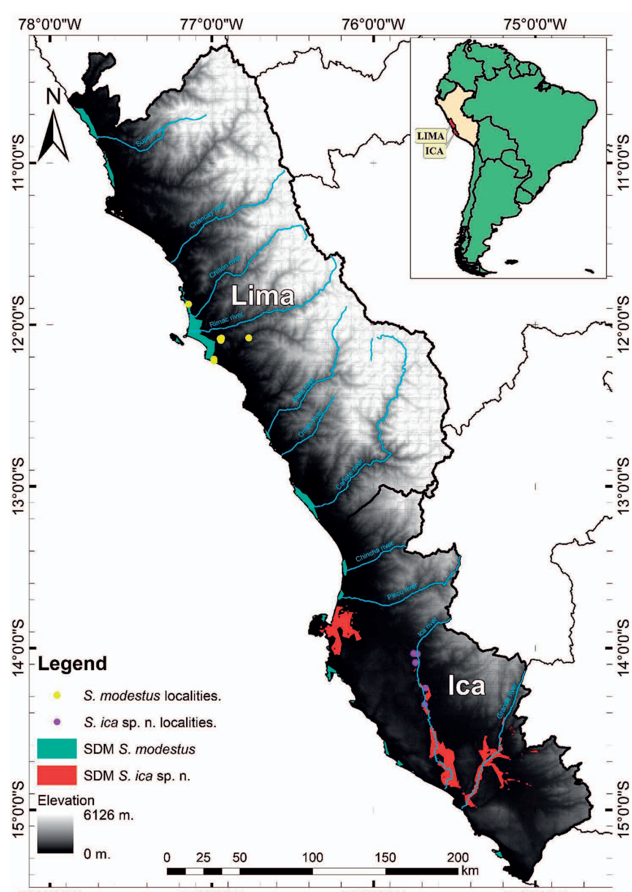


Figure 7. SDM (species distribution model)of *Stenocercus modestus* and *Stenocercus ica* sp. n. in the Lima and Ica regions.

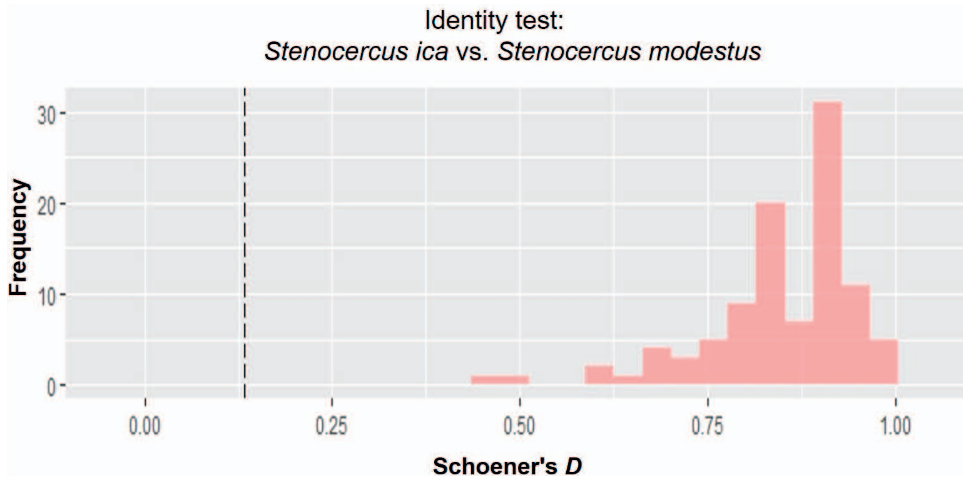


Figure 8. Histogram of the niche identity test showing the observed Schoener's D value (dashed line) and frequencies of the pseudo-replicates: *Stenocercus ica* sp. n. vs. *Stenocercus modestus*. The similarity score built for the actual occurrences of the two species (dashed line) is lower than expected based on the null hypothesis; this indicates that the environmental niches of both species are not equal.

son, we consider its occurrence in that area unlikely. Additionally, intensive herpetological surveys in Paracas did not record any *Stenocercus* species (Pérez & Balta 2007).

Our SDM for *Stenocercus ica* sp. n. suggests its potential distribution to be strongly associated with precipitation-related bioclimatic variables (BIO12 and BIO15). In contrast, the *S. modestus* SDM implies a significant relationship with temperature bioclimatic variables (BIO07 and BIO03). The difference between the bioclimatic variables associated with the potential distribution of each species critically affects their potential geographic space, limiting *S. ica* sp. n. to narrow strips of riverine vegetation in the Ica region. Likewise, the potential distribution of *S. modestus* is mainly restricted to agricultural areas close to river mouths or wetlands in Lima Province (Lima region). The *Stenocercus modestus* SDM also highlights areas with a high probability of presence around Paracas (Fig. 7), but as we have mentioned before, no *Stenocercus* species has been recorded in this area despite intensive fieldwork, and adequate habitat for *S. modestus* (riverine forest, wetland edges, and agricultural areas) is absent there.

Differences between their distributional models, including the most influential bioclimatic variables, their potential geographic space, and results from a niche identity test strongly suggest an ecological separation of both species as distinct lineages. We recommend the use of SDMs and niche identity tests of putatively related species as an additional source of evidence for lineage separation, even though taking into account their limitations (Aguilar et al. 2013, 2017).

We here preferred to use distribution models rather than the insufficient geographic information that exists on both species. Records of *S. ica* sp n. and *S. modestus* are scarce, and those of *S. ica* sp n. are even recent. Moreover, new herpetological surveys in areas with a high probability of presence of the new species in Ica (between Lat. 14°35'36.25" S / Long. 75°36'42.75" W, 250 m a.s.l., and Lat. 14°49'34.39" S / Long. 75°33'15.58" W, 20 m a.s.l.) and the Rio Grande (Lat. 14°52'39.03" S / Long. 75°22'35.24" W, 60 m a.s.l.) basin yielded no records of *S. ica* sp. n.

*Stenocercus ica* sp n. has been found in a reduced fringe (25 meters approximately) of fragmented riparian vegetation, limited by field crops in disturbed zones similar to those inhabited by *S. modestus* (Pérez et al. 2012). However, the former species was only found in riparian vegetation next to dried-up riverbeds.

The presence of *Stenocercus ica* sp. n. close to agricultural areas and small patches of riverine vegetation suggests that at least a partial transformation of its natural habitat has occurred. To make things worse, the nearby city of Ica has grown exponentially in the last decade and former agricultural areas have by now also been transformed into urban areas (Whaley et al. 2019). If this trend continues in the near future, we may expect a total eradication of the existing riparian vegetation and remaining populations of *S. ica* sp. n. with it. Therefore, we highly recommend the new species be classified as Endangered EN B1ab(iii,iv)+2ab(iii,iv) based on our GeoCat analysis, threat-defined locations, habitat degradation, and risk of extinction (Iucn, 2012).

## Acknowledgements

We thank the Vicerrectorado de Investigación y Postgrado (VRIP) of the UNMSM for funding this study (Código B20100151) and the following people who helped us in different parts of the project: A. Wong, A. Jerí, A. Meza, D. Tataje, E. Salazar, M. Silva, M. Mendoza, and O. Machuca. We thank J. Pérez for his suggestions in the SMD analysis, E. Alvarado for data collection, and K. Siu-Ting for her English revision of our manuscript. We also thank the Servicio Nacional Forestal y de Fauna Silvestre (SERFOR) for issuing a research permit (RDG N° 286-2017-SERFOR/DGGSPFFS, RDG N° 152-2020-MINAGRI-SERFOR-DGGSPFFS).

## References


Aguilar-Puntriano, C., C. Ramírez, C., E. Castillo, A. Mendoza, V. J. Vargas, & J. W. Sites Jr (2019): Three new lizard species of the *Liolaemus montanus* group from Peru. – Diversity, **11**: 161.

Aguilar, C., P. L. Wood Jr, M. Duff, M. Belk & J. W. Sites Jr (2017): Different roads lead to Rome: Integrative taxonomic approaches lead to the discovery of two new lizard lineages in the *Liolaemus montanus* group (Squamata: Liolaemidae). – Biological Journal of the Linnean Society, **120**: 448–467.

Aguilar, C., P. L. Wood Jr, J. C. Cusi, A. Guzman, F. Huari, M. Lundberg, E. Mortensen, C. Ramírez, D. Robles, J. Suárez, A. Ticona, V. J. Vargas, P. J. Venegas & J. W. Sites Jr (2013): Integrative taxonomy and preliminary assessment of species limits in the *Liolaemus walkeri* complex (Squamata, Liolaemidae) with descriptions of three new species from Peru. – ZooKeys, **364**: 47–91.

Aguilar, C., M. Lundberg, K. Siu-Ting & M. E. Jiménez (2007): Nuevos registros para la herpetofauna del departamento de Lima, descripción del renacuajo de *Telmatobius rimac* Schmidt, 1954 (Anura: Ceratophrydae) y una clave de los anfibios. – Revista Peruana de Biología, **14**: 209–216.

Andrango, Mb, C. Sette, O. Torres-Carvajal (2016): Short-term predicted extinction of Andean populations of the lizard *Stenocercus guentheri* (Iguanidae: Tropidurinae). – Journal of Thermal Biology, **62**:30–36.

Ávila-Pires T. C. (1995). Lizards of Brazilian Amazonia (Reptilia: Squamata). Zoologische Verhandelingen Leiden, **299**: 1–706.

Ávila-Pires T. C., C. De C. Nogueira & M. Martins (2019): A new "horned" *Stenocercus* from the highlands of southeastern Brazil, and redescription of *Stenocercus tricristatus* (Reptilia: Tropiduridae). – Zoologia, **36**, 1–16.

Bachman, S., J. Moat, A. W. Hill, J. De La Torre & B. Scott (2011): Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. – ZooKeys, **150**: 117–127.

Boulenger, G. A. (1900): Descriptions of new batrachians and reptiles collected by Mr. PO Simons in Peru. – Annals and Magazine of Natural History, **6**:181–186.

Boulenger, G. A. (1911): Descriptions of new Reptiles from the Andes of South America, preserved in the British Museum. – Annals and Magazine of Natural History, **7**: 19–25.

Boulenger, G. A. (1885): Catalogue of the lizards in the British Museum (Natural History). British Natural History Museum, 497 pp.

Cadle, J. E. (1991): Systematics of lizards of the genus *Stenocercus* (Iguania: Tropiduridae) from northern Peru: new species and comments on relationships and distribution patterns. – Proceedings of the Academy of Natural Sciences of Philadelphia, **143**: 1–96.

Cadle, J. E. (1998): New species of lizards, genus *Stenocercus* (Iguania: Tropiduridae) from western Ecuador and Peru. – Bulletin of the Museum of Comparative Zoology, **155**: 257–297.

Cadle, J. E. (2001): A new species of lizard related to *Stenocercus caducus* (Cope) (Squamata: Iguanidae) from Peru and Bolivia, with a key to the" Ophryoessoides Group": – Bulletin of the Museum of Comparative Zoology.

Carrillo, N. & J. Icochea (1995): Lista Taxonómica preliminar de los Reptiles Vivientes del Perú. – Publicaciones del Museo de Historia Natural de la Universidad Nacional Mayor se San Marcos, **49**:1–27.

Duméril, A. M. & G. Bibron (1837): Erpétologie Générale ou Histoire Naturelle Complete des Reptiles. – Librairie Encyclopedique de Roret, 570 pp.

Elith, J., S. J. Phillips, T. Hastie, M. Dudík, Y. E. Chee, & C. J. Yates (2011): A statistical explanation of MaxEnt for ecologists. – Diversity and distributions, **17**: 43–57.

ESRI (Environmental Systems Resource Institute) (2018): ArcMap 10.6. – ESRI, Redlands, California.

Fritts, T. H. (1972): New species of lizards of the genus *Stenocercus* from Peru: (Sauria: Iguanidae). – Ocassional Papers University of Kansas Museum of Natural History, **10**: 1–21.

Fritts, T. H. (1974). A multivariate and evolutionary analysis of the Andean iguanid lizards of the genus *Stenocercus*. – San Diego Society of Natural History Memoir, **7**: 1–89.

Girard, C. (1858): Descriptions of some new Reptiles, collected by the US. Exploring Expedition under the command of Capt. Charles Wilkes, U. S. M. Fourth part including the species of saurians exotic to North America. – Proceedings of the Academy of Natural Sciences of Philadelphia, **1857**: 195–198.

Günther, A. (1859): List of cold-blooded vertebrata collected by Mr. Fraser in the Andes of Western Ecuador. Proceedings of the Zoological Society of London, **1859**: 89–93.

Hijmans, R. J., S. E. Cameron, J. L. Parra, P. G. Jones & A. Jarvis (2005): Very high resolution interpolated climate surfaces for global land areas. – International Journal of Climatology, **25**: 1965–1978.

Icochea, J. (1998): Lista roja preliminar de los anfibios y reptiles amenazados del departamento de Lima. – pp. 217–229 in: Cano, A. & K. R. Young (eds): Los Pantanos de Villa. Biología y Conservación. – Serie de Divulgación Museo de Historia Natural-UNMSM, Lima.

IUCN (2012): IUCN Red List Categories and Criteria: Version 3.1. Second edition. – Gland, Switzerland and Cambridge, UK: IUCN. iv + 32 pp. – http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf

Köhler, G. & E. Lehr (2015): Two new species of lizards of the genus *Stenocercus* (Iguania, Tropiduridae) from central Peru. – Zootaxa, **3956**: 413–427.

Lehr, E. (2002): Amphibien und Reptilien in Peru. – Natur und Tier-Verlag, Münster, 208 pp.

Merow, C., M. J. Smith & J. A. Silander Jr. (2013): A practical guide to MaxEnt for modeling species' distributions: what it does, and why inputs and settings matter. – Ecography, **36**: 1058–1069.

Morrone, J. J. (2001): Biogeografía de América latina y el Caribe. – Manuales y Tesis de la Sociedad Entomológica Aragonesa.

Noble, G. K. (1924): New lizards from northwestern Peru. – Occasional Papers of the Boston Society of Natural History, **5**: 107–113.

Pearson, R. G., C. J. Raxworthy, M. Nakamura & A. T. Peterson (2007): Predicting species distributions from small numbers of occurrence records: a test case using cryptic geckos in Madagascar. – Journal of Biogeography, **34**: 102–117.

Pérez, J. & K. Balta (2007): Ecología de la comunidad de saurios diurnos de la Reserva Nacional de Paracas, Ica, Perú. – Revista Peruana de Biología, **13**: 169–176.

Pérez, J., L. Y. Echevarría, S. C. Álvarez, A. Vera, J. G. Alarcón & M. Andía (2012): Ecología trófica de la lagartija *Stenocercus modestus* (Squamata: Tropiduridae) en una zona urbana, Lima, Perú. – Revista Peruana de Biología, **19**: 323–326.

Peterson, A. T., J. Soberón, R. G. Pearson, R. P. Anderson, E. Martínez-Meyer, M. Nakamura & M. B. Araújo (2011): Ecological niches and geographic distributions. – Princeton University Press.

Phillips, S. J., R. P. Anderson & R. E. Schapire (2006): Maximum entropy modeling of species geographic distributions. – Ecological modelling, **190**: 231–259.

R Development Core Team (2018): R: A Language and Environment for Statistical Computing. – The R Foundation for Statistical Computing, Vienna, Austria. – Retrieved from https://www.r-project.org/.

Radosavljevic, A. & R. P. Anderson (2014): Making better Maxent models of species distributions: complexity, overfitting and evaluation. – Journal of biogeography, **41**: 629–643.

Roll, U., A.Feldman, M. Novosolov, A. Allison, A. M. Bauer, R. Bernard, M. Böhm, F. Castro-Herrera, L. Chirio, B. Collen, G. Colli, L. Dabool, I. Das, T. M. Doan, L. L. Grismer, M. Hoogmoed, Y. Itescu, F. Kraus, M. Lebreton, A. Lewin, M. Martins, E. Maza, D. Meirte, Z. T. Nagy, C. Nogueira, O. S. G. Pauwels, D. Pincheira-Donoso, G. D. Powney, R. Sindaco, O. J. S. Tallowin, O. Torres-Carvajal, J. Trape, E. Vidan, P. Uetz, P. Wagner, Y. Wang, C. D. L. Orme, R. Grenyer & S. Meiri (2017): The global distribution of tetrapods reveals a need for targeted reptile conservation. Nature Ecology & Evolution, **1**: 1677–1682.

Rosas, C. V., L. A. T. Navaez, C. T. Ingar, F. R. Gastelumendi & P. V. Ruesta (2008): ¿Qué áreas conservar en nuestras Zonas Áridas? Seleccionando sitios prioritarios para la conservación en la Ecorregión Desierto de Sechura-Perú. – Zonas Áridas, **12**: 36–59.

Roux, J. (1907): Revisión de quelques espèces de reptiles et amphibiens du Péru' descrites par Tschudi en 1844–1846. – Revue Suisse de Zoologie, **15**: 293–303.

Shcheglovitova, M. & R. P. Anderson (2013): Estimating optimal complexity for ecological niche models: A jackknife approach for species with small sample size. – Ecological Modelling, **269**: 9–17.

Tarkesh, M. & G. Jetschke (2012): Comparison of six correlative models in predictive vegetation mapping on a local scale. – Environmental and Ecological Statistics, **19**: 437–457.

Tello, G. (1998): Lagartijas del Departamento de Lima, Perú. – Biotempo, **3**: 59–63.

Teixeira M. Jr, I. Prates, C. Nisa, N. S. C. Silva-Martins, C. Strüssmann & M. T. Rodrigues (2016): Molecular data reveal spatial and temporal patterns of diversification and a cryptic new species of lowland *Stenocercus* Duméril & Bibron (1837). (Squamata: Tropiduridae). – Molecular Phylogenetics and Evolution, **94**: 410–423.

Torres-Carvajal, O. (2000): Ecuadorian lizards of the genus *Stenocercus* (Squamata: Tropiduridae). – Scientific Papers University of Kansas Museum of Natural History, **15**: 1–38.

Torres-Carvajal, O. (2005): A new species of iguanian lizard (*Stenocercus*) from the western lowlands of southern Ecuador and northern Peru. – Herpetologica, **61**: 78–85.

Torres-Carvajal, O. (2007a): Phylogeny and biogeography of a large radiation of Andean lizards (Iguania, *Stenocercus*). – Zoologica Scripta, **36**: 311–326.

Torres-Carvajal, O. (2007b): A taxonomic revision of South American *Stenocercus* (Squamata: iguania) lizards. – Herpetological monographs, **21**: 76–178.

Torres-Carvajal, O., J. A. Schulte II & J. E. Cadle (2006): Phylogenetic relationships of South American lizards of the genus *Stenocercus* (Squamata: Iguania): a new approach using a general mixture model for gene sequence data. – Molecular Phylogenetics and Evolution, **39**: 171–185.

Troncoso-Palacios, J. (2014): Nueva lista actualizada de los reptiles terrestres de la Región de Atacama, Chile. – Boletín Chileno de Herpetología, **1**: 1–4.

Tschudi, J. V. (1845): Reptilium conspectum quae in republica Peruana reperiuntur er pleraque observata vel collecta sunt in itenere. – Archiv für Naturgeschichte **11**: 150–170

Uetz, P., P. Freed & J. Hošek (2020): The Reptile Database. – http://www.reptile-database.org, accessed 12 June 2020.

Venegas, P. J., L. Y. Echevarria, K. Garcia-Burneo & C. Koch (2016): A new species of iguanid lizard, genus *Stenocercus* (Squamata, Iguania), from the Central Andes in Peru. Zootaxa, **4205**: 52–64.

Venegas, P. J., V. Duran & K. Garcia-Burneo (2013): A new species of arboreal iguanid lizard, genus *Stenocercus* (Squamata: Iguania), from central Peru. – Zootaxa **3609**: 291–301

Venegas, P., L. Echevarria & S. Alvarez (2014): A new species of spiny-tailed iguanid lizard (Iguania: *Stenocercus*) from northwestern Peru. – Zootaxa, **3753**: 47–58.

Venegas, P. J., R. Pradel, H. Ortiz & L. Ríos (2017): Geographic range extension for the critically endangered leaf-toed gecko *Phyllodactylus sentosus* Dixon and Huey, 1970 and notes on its natural history and conservation status. – Herpetology Notes, **10**: 499–505.

Venegas, P. J., L. Y. Echevarría, L. A. García-Ayachi & C. Z. Landauro (2020): Two new sympatric species of *Stenocercus* (Squamata: Iguania) from the inter-Andean valley of the Mantaro River, Peru. – Zootaxa, **4858**: 555–575.

Venegas, P. J., L. A. García-Ayachi, J. C. Chávez-Arribasplata, G. Chávez, I. Wong & A. García-Bravo (2020): Four new species of *Stenocercus* Duméril & Bibron, 1837 (Squamata, Iguania) from the Department of Amazonas in northeastern Peru. – Evolutionary Systematics, **4**: 79–108.

Warren, D.L., R.E. Glor & M. Turelli (2008): Environmental niche identity versus conservatism: quantitative approaches to niche evolution. – Evolution, **62**: 2868–2883.

Warren, D.L., N. Matzke, M. Cardillo, J. Baumgartner, L. Beaumont, N. Huron, M. Simões, T. L. Iglesias & R. Dinnage (2019): ENMTools (Software Package). – Retrieved from https://github.com/danlwarren/ENMTools.

Whaley, O. Q., A. Orellana-Garcia & J. O. Pecho-Quispe (2019): An Annotated Checklist to Vascular Flora of the Ica Region, Peru – with notes on endemic species, habitat, climate and agrobiodiversity. – Phytotaxa, **389**: 1–125.

**Appendix 1**

*Stenocercus ica* sp. n. specimens from the Ica region of Peru examined. * Holotype.

| Code | Age class | Sex | Location | Long. W | Lat. S | Altitude (m) |
|---|---|---|---|---|---|---|
| MUSM-39363 | Adult | Male | Ocucaje | -75.687 | -14.347 | 331 |
| MUSM-39364 | Adult | Male | Arrabales | -75.751 | -14.032 | 432 |
| MUSM-39365 | Adult | Male | Arrabales | -75.751 | -14.032 | 432 |
| MUSM-40412 | Adult | Female | Ocucaje | -75.684 | -14.349 | 323 |
| MUSM-40413 | Subadult | – | Ocucaje | -75.684 | -14.349 | 323 |
| MUSM-40414 | Subadult | Female | Ocucaje | -75.684 | -14.349 | 323 |
| MUSM-40415 | Adult | Female | Ocucaje | -75.684 | -14.349 | 323 |
| MUSM-40416 | Adult | Female | Ocucaje | -75.684 | -14.349 | 323 |
| MUSM-40417 | Young | – | Ocucaje | -75.684 | -14.349 | 323 |
| MUSM-40418* | Adult | Male | Ocucaje | -75.684 | -14.35 | 323 |
| MUSM-40419 | Adult | Male | Ocucaje | -75.684 | -14.349 | 323 |

**Appendix 2**

Coordinates of localities of *Stenocercus modestus* and *Stenocercus ica* sp. n. used in SD Modelling. * Type locality.

| Species | Lat. S | Long. W | Altitude (m) | Locality | Region | Habitat |
|---|---|---|---|---|---|---|
| *Stenocercus ica* | -14.090 | -75.740 | 400 | Cachiche | Ica | Agricultural-Urban |
| *Stenocercus ica* | -14.032 | -75.751 | 432 | Arrabales | Ica | Agricultural zone |
| *Stenocercus ica* | -14.247 | -75.680 | 377 | La Venta | Ica | Agricultural zone |
| *Stenocercus ica* | -14.037 | -75.729 | 414 | La Tinguiña | Ica | Riverbank with Agricultural Zone |
| *Stenocercus ica* | -14.349 | -75.684 | 323 | Ocucaje* | Ica | Riverbank with Agricultural Zone |
| *Stenocercus modestus* | -12.082 | -76.771 | 404 | Cieneguilla | Lima | River bank |
| *Stenocercus modestus* | -12.224 | -76.986 | 2 | Villa swamps | Lima | Wild vegetation |
| *Stenocercus modestus* | -12.214 | -76.986 | 4 | Villa swamps | Lima | Wild vegetation |
| *Stenocercus modestus* | -11.874 | -77.144 | 4 | Ventanilla Wetlands | Lima | Wild-Urban |
| *Stenocercus modestus* | -12.097 | -76.943 | 239 | Tree nursery-La Molina | Lima | Agroforestry area |
| *Stenocercus modestus* | -12.083 | -76.939 | 245 | UNALM university campus | Lima | Agricultural zone |
| *Stenocercus modestus* | -12.087 | -76.948 | 240 | UNALM university campus | Lima | Agroforestry area |

**Appendix 3**

Specimens examined from the MUSM's Herpetology Department.

*Stenocercus amydrorhytus* (4): Peru: Ancash Department: Aija Province: MUSM 20221; Ancash Department: Huarmey Province: MUSM 20222–20224. *Stenocercus apurimacus* (4): Apurímac Department: Puente Pachachaca: MUSM 8667–8670. *Stenocercus arndti* (9): Cajamarca Department: Chota Province: MUSM 28359, 28360, 28362, 28364; Cajamarca Department: Chota Province: Querocoto District MUSM 31209; Cajamarca Department: Chota Province: Quebrada Iraca locality MUSM 28314–28316, 28319. *Stenocercus boettgeri* (6): Pasco Department: Oxapampa Province: Oxapampa District: Alto Peru Town: MUSM 23610; Pasco Department: Oxapampa Province: Chontabamba District; Maria Teresa Town: MUSM 23611, 23627, 23632; Pasco Department: Oxapampa Province: Chontabamba District: Yaupi Town: MUSM 23639; Pasco Department: Oxapampa Province: Villa Rica District: MUSM 23666. *Stenocercus chlorostictus* (6): Cajamarca Department: San Miguel Province: La Florida District: Agua Azul Town: MUSM 25821; Piura Department: Huancabamba Province: Canchaque District: MUSM 33824–33828. *Stenocercus chrysopygus* (25): Ancash Department: Yungay Province: Ranrahirca District: MUSM 1818–1819, 8624, 8627; Ancash Department: Huaylas Province: Caraz District: MUSM 4918–4919, 4921, 4923; Ancash Department: Yungay Province: Llanganuco locality: MUSM 4942–4943; Ancash Department: Huaraz Province: Huaraz District: MUSM 8857–8862, 35200–35201; Ancash Department: Recuay Province: MUSM 20184, 20188, 25320, 25341, 39296; Ancash Department: Huaraz Province: Jangas District: MUSM 35199, 39304. *Stenocercus crassicaudatus* (5): Cusco Department: La Convencion Province: Inkawasi District: Amaybamba Town: MUSM 1862–1863; Cusco Department: Urubamba Province: Macchupicchu District: Ruinas de Macchupicchu locality: MUSM 8691; Cusco Department: Calca Province: Yanatile District: Quebrada Honda locality: MUSM 36514; Cusco Department: Urubamba Province: Macchupicchu District: Aguas calientes Town: MUSM 38565. *Stenocercus cupreus* (13): Huánuco Department: Huánuco Province: Huánuco District: Kotosh locality: MUSM 19171, 19178; Huánuco Department: Huánuco Province: Quisqui District: MUSM 20208; Huánuco Department: Ambo Province: MUSM 20212, 20220; Pasco Department: Pasco Province: Huariaca District: MUSM 25325, 25329, 25332; Huánuco Department: Pachitea Province: Chaglla District: MUSM 20214, 20216–20219. *Stenocercus empetrus* (6): La Libertad Department: Sánchez Carrión Province: Huamachuco District: MUSM 8675, 38554–38557, 38559. *Stenocercus eunetopsis* (1): Cajamarca Department: Río Zaña locality: MUSM 13970. *Stenocercus fimbriatus* (1): Madre de Dios Department: Tambopata Province: MUSM 22321. *Stenocercus formosus* (6): Junín Department: Chanchamayo Province: San Ramón District: MUSM 8682–8685, 8688–8689. *Stenocercus frittsi* (1): Huancavelica Department: Angaraes Province: Congalla District: MUSM 40185. *Stenocercus huancabambae* (6): Amazonas Department: Bagua Province: San José: MUSM 8827, 8833, 8829, 8828, 8830, 8832. *Stenocercus imitator* (9): Cajamarca Department: Hualgayoc Province: Monte Seco: MUSM 4017, 4019, 4027, 4031, 4032; Cajamarca Department: Hualgayoc Province: Rio Zaña: El Chorro: MUSM 1855, 1859; Cajamarca Department: San Miguel Province: La Florida District: Agua Azul: MUSM 26752, 26754. *Stenocercus iridescens* (7): Tumbes Department: Parque Nacional Cerros de Amotape: MUSM 35418, 35426, 35433, 35434, 35427, 35428, 35430. *Stenocercus johaberfellneri* (6): Ancash Department: Huarmey Province: MUSM 20225–20230. *Stenocercus latebrosus* (4): La Libertad Department: MUSM 17103, 17105, 17109, 17111. *Stenocercus limitaris* (5): Tumbes Department: Parque Nacional Cerros de Amotape: MUSM 35415, 35417, 35432, 35436; Tumbes Department: Tumbes Province: Pampas de Hospital District: Cochas: MUSM 33835. *Stenocercus melanopygus* (4): Cajamarca Department: Cajamarca Province: MUSM 4912; La Libertad Department: Sánchez Carrión Province: Huamachuco District: MUSM 8666; La Libertad Department: Sánchez Carrión Province: Huamachuco District: Sausacocha: MUSM 38552, 38553. *Stenocercus modestus* (17): Lima Department: Lima Province: Lurín District: MUSM 4954–4956, 4959, 4961–4962; Lima Department: Lima Province: Chosica District: La Cantuta: MUSM 4978; Lima Department: Huarochirí Province: Antioquía District: Hacienda Chontay: MUSM 4979; Lima Department: Lima Province: Chaclacayo District: MUSM 16521; Lima Department: Lima Province: Cieneguilla District: MUSM 25405, 25408, 25410, 25416, 25421; Lima Department: Lima Province: Carabayllo District: Río Rímac MUSM 30842; Lima Department: Lima Province: La Molina District: Campus UNALM MUSM 38401, 38849. *Stenocercus nigromaculatus* (1): Cajamarca Department: Chota Province: MUSM 8837. *Stenocercus ochoai* (3): Cusco Department: Urubamba Province: Ollantaytambo District: 10km Chilca: MUSM 8664, 8665; Cusco Department: Calca Province: Lamay District: MUSM 38564. *Stenocercus orientalis* (2): Amazonas Department: Chachapoyas Province: MUSM 8662, 8663. *Stenocercus ornatissimus* (21): Lima Department: Huarochirí Province: Bosque de Zárate: MUSM 4945, 4969, 4971–4973; Lima Department: Huarochirí Province: Matucana District: MUSM 4938–4939, 4941, 4968; Lima Department: Canta Province: Canta locality: MUSM 16039, 16127–16128, 1820–1824, 1826–1828, Lima Department: Huarochirí Province: San Jerónimo de Surco District: MUSM 4980. *Stenocercus percultus* (5): Cajamarca Department: Hualgayoc Province: Rio Zaña: El Chorro: MUSM 1843, 1846; Cajamarca Department: Hualgayoc Province: Monte Seco: MUSM 4020, 4033; Lambayeque Department: MUSM 21886. *Stenocercus praeornatus* (1): Junin Department: Comas locality: MUSM 8674. *Stenocercus prionatus* (1): Huánuco Department: Pachitea Province: Panguana: MUSM 38640. *Stenocercus puyango* (11): Tumbes Department: Parque Nacional Cerros de Amotape: MUSM 33548, 33549, 33563, 35304, 35321, 35389, 35391, 35438, 35439, 35441, 37990. *Stenocercus roseiventris* (10): Huánuco Department: Rio Negro: MUSM 7005; Huánuco Department: Rio Llullapichis: MUSM 7006; Madre de Dios Department: Tambopata Province: Las Piedras District: Cusco Amazónico – Río Madre de Dios: MUSM 7174, 7175, 14711, 14712; Cusco Department: Camisea: MUSM 33886; Cusco Department: La Convención Province: Echarate District: MUSM 4982, 26523, 29434. *Stenocercus scapularis* (1): Pasco Department: Oxapampa Province: Chontabamba District: Maria Teresa: MUSM 24824. *Stenocercus stigmosus* (13): Cajamarca Department: Cajamarca Province: Cajamarca District: MUSM 34746–34749, 36699, 36702; Cajamarca Department: Hualgayoc Province: Bambamarca District: Quengorio Alto: Jadibamba: MUSM 37926, 37927; Cajamarca Department: Celendin Province: Huasmin District: Santa Rosa de Huasmin: Tragadero: MUSM 37928; Lambayeque Department: Ferreñafe Province: Cañaris District: MUSM 40162–40165. *Stenocercus torquatus* (9): Pasco Department: Oxapampa Province: Chontabamba District: Maria Teresa: MUSM 23640–23644; Pasco Department: Pasco Province: Paucartambo District: 24452–24454; Junín Department: Alto Yurinaki Town: MUSM 8618. *Stenocercus variabilis* (4): Ayacucho Department: Huamanga Province: Chiara District: MUSM 18493–18495; Huancavelica Department: Huancavelica Province: Conayca District: MUSM 8694.