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An updated diagnosis of the rare *Amphisbaena slateri* Boulenger, 1907, based on additional specimens (Squamata, Amphisbaenia, Amphisbaenidae)

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Abstract

Amphisbaena slateri is a rare species of worm lizard from Peru and Bolivia, known only from three specimens. We found two additional specimens of this taxon, housed at the herpetological collections of the Zoological Museum (Cenak), Universität Hamburg, and the University of Kansas Biodiversity Institute, updating its known geographic distribution and morphological variation. We also discovered an unpublished manuscript by late Carl Gans reporting the finding of the Hamburg specimen, which we reproduce here with the permission of his family. *Amphisbaena slateri* can be identified by a combination of characters including counts of annuli, segments, and pores, the shape of head scales and color pattern. Basic morphological data is given for all species of Amphisbaenia known for Bolivia and Peru to aid in the identification of specimens from those countries.

Introduction

Amphisbaena slateri was described more than a century ago based on a single specimen from southern Peru, deposited in the British Museum, London, UK (BM) (Boulenger 1907). Six decades later, the species was redescribed after the discovery of two specimens from Bolivia, housed in the Zoological Museum, Universität Hamburg (ZMH), and the Museum für Naturkunde, Berlin, Germany (ZMB) (Gans 1967). Since then, no relevant information on *A. slateri* has been published.

While searching for data of the three known specimens of *Amphisbaena slateri*, the senior author was informed about the existence of another specimen housed at the ZMH, and a specimen at the University of Kansas Biodiversity Institute (KUH). The Hamburg specimen (ZMH R01282) was first identified as *Amphisbaena* sp. in the collection catalog. In 1980, the prominent herpetologist and amphisbaenian expert Carl Gans (1923–2009) re-identified it as *A. slateri*. Gans planned to disclose his finding and typed a short note, which was not published (see Discussion). Later, ZMH R01282 was cited as *A. slateri* in a checklist of amphibians and reptiles of the lower Llullapichis River (Schlüter et al. 2004) without further information. The Kansas specimen (KUH 135171) was identified as *A. slateri* in the collection database, but apparently, no one had noticed its importance to the knowledge on the taxonomy and distribution of the species, and it was never cited in the published literature.

Knowledge on the systematics of South American amphisbaenians has rapidly advanced in recent years, with the description of many new species and the proposals of phylogenetic relationships (Mott and Vieites 2009, Colli et al. 2016). These advances, however, are mostly related to Brazilian species, and little has been published in this decade on the taxonomy of species from other South American countries (Perez et al. 2012, Ribeiro et al. 2015, Montero 2016, Costa et al. 2018). Given the apparent rarity of *A. slateri* and the scarce information on its morphology, it is important to unveil the existence of the above-cited specimens and to provide an updated description for this taxon, comparing it with other species from Bolivia and Peru.

Material and methods

The two specimens housed in the Zoologisches Museum, Universität Hamburg (ZMH R01282 and R05908) and the specimen housed at the University of Kansas (KUH 135171) were personally examined and photographed by JH and LJW, respectively. Data from the holotype housed in the British Museum, London, UK (BM 1946.8.31.82, former 1907.5.2-RR) and the specimen in the Museum für Naturkunde, Berlin, Germany (ZMB 10888) was based on the species redescription (Gans 1967) and on the examination of photographs. We also searched for information on specimens identified as *Amphisbaena slateri* in VertNet (http://portal.vertnet.org).

For comparisons with other species we used information from preserved specimens (see appendix in Costa et al. (2018), and Appendix 1) in addition to data from taxonomic studies, especially those on Bolivian and Peruvian taxa (Werner 1901, Gans 1961, 1962a, 1962b, 1963, 1964d, 1966, Gans and Amdur 1966, Gans and Diefenbach 1972, Montero 1996, 2001, Vanzolini 1999, 2002, Ribeiro et al. 2015), although not restricted to them (Gans and Alexander 1962, Gans 1964a, 1966, Perez et al. 2012). We further examined a series of photographs of three paratypes of *Amphisbaena pericensis* from the Field Museum of Natural History (FMNH 16106, 16107, and 73371). Nomenclature for head scales follows Gans and Alexander (1962). Measurements were taken with a ruler and a caliper to the nearest 1.0 mm and 0.01 mm, respectively.

Biomes and ecoregions follow Dinerstein et al. (2017). Geographical coordinates were assessed with the aid of Google Earth Pro software and pertinent literature (Evans 1903, Stephens and Traylor 1983, Dirksen and Riva 1999, United States Government 2001). Maps were prepared using QGis 2.14.3 (https://qgis.org/en/site/).

Results

The specimen ZMH R01282 was collected by Hans-Wilhelm Koepcke in June 1973 at Panguana Private Conservation Area (9°37’S, 74°56’W), left margin of the Llullapichis (Yuyapichis) River, a tributary of the right margin of the Pachitea River, Departamento de Huánuco, 260 m elevation. It was found when the collector was digging in a garden inside the forest (Suppl. material 1). Specimen KUH 135171 (field number THF 1796) was collected by Thomas H. Fritts in January 1968 at Misión Coribeni (12°36’S, 72°48’W), Departamento de Cuzco, Peru.

Morphology of ZMH R01282 and KUH 135171 is within the range described for most characters of *Amphisbaena slateri*, but slightly increases the maximum values of snout-vent length (from 139 to 163 mm), number of body annuli (from 206 to 213), and caudal annuli (from 21 to 24) (Table 1). The tail of ZMH R01282 is separate from the body. Regarding color, KUH 135171 has the typical pattern described for *A. slateri*, i.e., uniform dark brown (although without a white tail tip). Comparatively, ZMH R01282 has a uniform light brown color.

Our search on VertNet returned only three results: KUH 135171 and two specimens from ‘Peru’ housed in the Louisiana State University Museum of Natural Science, Baton Rouge, USA (LSUMZ 27189 and 27190). We received photographs and morphological data of these two specimens provided by the LSUMZ staff (Jackson Roberts, e-mail to HC on 27 March 2018). The specimens are probably juveniles, with only ~50 mm total length. Based on the available data we confirmed they cannot be assigned to *A. slateri* or any other Peruvian species – further discussions on their identification are outside the scope of the present paper.

Systematics

Squamata Oppel, 1811
Amphisbaenia Gray, 1844
Amphisbaenidae Gray, 1825
Amphisbaeninae Gray, 1825

***Amphisbaena* Linnaeus, 1758**

Amphisbaena slateri Boulenger, 1907: 487.

Heterochresonymy. *Amphisbaena darwinii*: (Werner 1910) – erroneous identification of ZMH R05908.

Type material. Holotype, BM 1946.8.31.82 (former 1907.5.2-RR), undetermined sex, collected sometime prior to 2 May 1907 by Thomas Slater and presented by him to the British Museum through Prof. G. S. Boulger (Boulenger 1907) (Figure 1).

Type-locality. San Gaban river valley, Provincia de Carabaya, Departamento de Puno, Peru, between 2000–3000 feet (~600–900 m) above sea level. Originally cited as “Peru, obtained in the Rio San Gaban Valley, Prov. Carabaya, altitude 2000-3000 feet” (Boulenger 1907).

Definition. *Amphisbaena slateri* is defined by the following combination of characters: (1) rounded head, not compressed or depressed; (2) length of frontal suture > < prefrontal > nasal sutures; (3) four precloacal pores with-

Table 1. Morphological data of the five known specimens of *Amphisbaena slateri*.

Characters / Specimens	BM 1946.8.31.82 (holotype)	ZMB 10888	ZMH R05908 (former 3434)	ZMH R01282	KUH 135171
Snout-vent + tail length	138+x mm	139+20 mm	112+16 mm	148+18 mm	163+22 mm
Body annuli	206	176	183	213	202
Lateral annuli	3	3	4	3	3
Caudal annuli	9+ (broken)	21	20	22	24
Autotomic caudal annulus	9	7	8	9	10
Midbody dorsal segments	10	14	12	10	12
Midbody ventral segments	14	16	16	14	14
Head shields sutures	F > PF > N	PF > N*	F > PF > N	F = PF > N	PF > F > N
Supralabials	3	3	3	3	3
Infralabials	3	3	3	3	3
Postgenials	2+3	3	3	3	2+2
Postmalars	0	0	0	0	7
Precloacal scales	8	6	6	7	8
Postcloacal scales	10	11	12	12	11

* ZMB 1088 has only the left frontal.

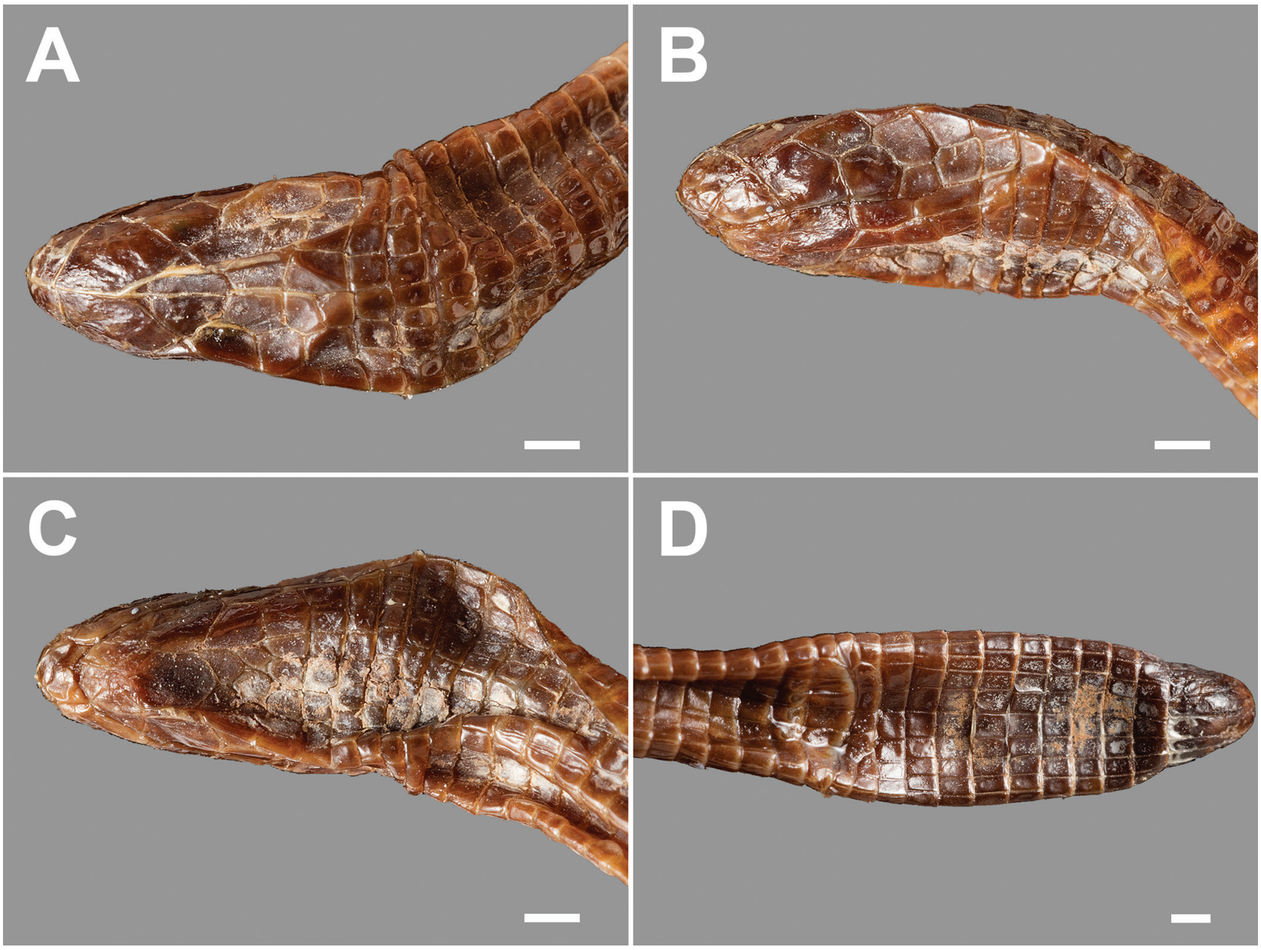

Figure 1. Holotype of *Amphisbaena slateri* (BM 1946.8.31.82), from the San Gaban river valley, Peru. Note the specimen's poor condition. **A)** head in dorsal view; **B)** head in lateral view; **C)** head in ventral view; **D)** cloacal region and tail (autotomized) in ventral view. Scale bars: 1 mm. Photos: Natural History Museum, UK.

out a median hiatus; (4) lateral sulcus present, dorsal and ventral sulci absent; (5) 176–213 body annuli; (6) three or four lateral annuli; (7) 20–24 caudal annuli; (8) autotomy constriction on caudal annulus 7–10; (9) tail round in cross-section, with similar width along its length; (10) dorsal surface of tail with non-tuberculate segments; (11) tail tip round, segmented, not compressed; (12) 10–14 dorsal and 14–16 ventral segments on a midbody annulus

Figure 2. General view of the dorsum and venter of the body of ZMB 10888 (Pelechuco, Bolivia) (**A, B**) and ZMH R01282 (Panguana Private Conservation Area, Peru) (**C, D**). Note the difference in color pattern. Tail tip of ZMH R01282 is broken and not shown. Scale bars: 10 mm. Photos: Frank Tillack (**A, B**) and Jakob Hallermann (**C, D**).

(24–30 total midbody segments); (13) three supralabials; (14) three infralabials; (15) a pair of enlarged pentagonal parietals; (16) one postocular; (17) one temporal; (18) postmental distinctly longer than mental; (19) one or two rows of postgenials; (20) postmalar row present or absent; (21) dorsum and venter uniformly dark brown or light brown in preservative, with a white or a brown tail tip. Basic morphological data are present in Table 1, and photographs of the five known specimens are shown in Figures 1–4.

Diagnosis. Among the Bolivian and Peruvian amphisbaenians (characters inside parenthesis) the round head distinguishes *Amphisbaena slateri* from *A. kingii* Bell, 1833, (keel-headed) and *Leposternon microcephalum* Wagler, 1824 (shovel-headed). The four precloacal pores distinguish it from *A. silvestrii* Boulenger, 1902 (two pores) and *A. fuliginosa* Linnaeus, 1758 (6–10 pores). The presence of 176–213 body annuli distinguishes *A. slateri* from *A. borelli* Peracca, 1897 (239–261), *A. occidentalis* Cope, 1876 (262–275), *A. polygrammica* Werner, 1900 (270), *A. steindachneri* Strauch, 1881 (255–266), and *A. townsendi* Stejneger, 1911 (261–279). By having 10–14 dorsal segments at midbody, *A. slateri* differs from *A. alba* (30–42), *A. angustifrons* Cope, 1861 (20–31), *A. bolivica* Mertens, 1929 (27–38), *A. camura* Cope, 1862 (28–42), *A. cegei* Montero, Sáfadez & Álvarez, 1997 (17–22), and *A. vermicularis* Wagler, 1824 (18–26). *Amphisbaena slateri* differs from *A. heterozonata* Burmeister, 1861 – sometimes considered a subspecies of *A. darwinii* Duméril & Bibron, 1839 (Montero 2016) – by the having 20–24 caudal annuli (vs. 13–18), enlarged parietals (vs. rarely enlarged), and a uniform body coloration (vs. dorsum brown, venter cream). Despite a small overlap in midbody dorsal/ventral segment counts between *A. slateri* (10–14/14–16) and *A. heterozonata* (14–24/15–28), specimens of the later most commonly have 16/18 segments. Finally, *A. slateri* differs from *A. pericensis* Noble, 1921 by lacking a compressed tail tip (vs. slightly laterally compressed), by having a postmental longer than the mental (vs. postmental faintly longer than mental) and having a uniform body coloration (vs. dorsum brown, venter cream). A summary of morphological characters useful to identify Peruvian and Bolivian amphisbaenids is present in Table 2.

Expanding comparisons to all Neotropical amphisbaenians, we find an overlap of most morphological character states between *A. slateri* and *A. albocingulata* Boettger, 1885, *A. darwinii* Duméril & Bibron, 1839, *A. hogei* Vanzolini, 1950, *A. manni* Barbour, 1914, *A. mensae* Castro-Mello, 2000, *A. munoai* Klappenbach, 1960, *A nigricauda* Gans, 1966, *A. prunicolor* (Cope, 1885), *A. schmidti* Gans, 1964, and *A. talisiae* Vanzolini, 1995. The uniform color pattern of *A. slateri* distinguishes it from *A. albocingulata*, *A. darwinii*, *A. hogei*, *A. mensae*,

Figure 3. *Amphisbaena slateri*. Head in dorsal, lateral, and ventral view of ZMB 10888 (left), from Pelechuco, and ZMH R05908 (right), from San Antonio, Bolivia. Scale bars: 1 mm. Photos: Frank Tillack (left) and Jakob Hallermann (right).

A. munoai, *A. nigricauda*, *A. schmidti*, and *A. talisiae* (countershading pattern), and from *A. prunicolor* (venter with a checkerboard pattern). By presenting a modal number of 14 midbody ventral segments, *Amphisbaena slateri* differs from *A. hogei*, *A. manni*, *A. munoai*, *A. nigricauda*, *A. prunicolor*, and *A. schmidti* (16), *A. albocingulata* (18), and *A. darwinii* (20). While all known specimens of *A. slateri* have four precloacal pores, most specimens of *A. manni* have six pores – females of *A. nigricauda* and *A. prunicolor* lack pores, but this trait is unknown in *A. slateri*, since no specimen was sexed. Postmental is distinctly longer than wide in *A. slateri*, while it is almost long as wide in *A. darwinii*, *A. mensae*, *A. munoai*, *A. nigricauda*, *A. prunicolor*, and *A. talisiae*. Parietals are enlarged in *A. slateri*, but not in *A. manni* and are irregular in *A. darwinii*. Finally, while the tail tip is rounded in *A. slateri*, it is conical in *A. manni* and has a slight lateral constriction in *A. darwinii*, *A. hogei*, and *A. nigricauda*.

Distribution and habitat. *Amphisbaena slateri* is known from southeastern Peru (Departamento Huánuco) to western Bolivia (Departamento La Paz) (Figure 5; Table 3). Locality records are in the Tropical and Subtropical Moist Broadleaf Forests biome (Ucayali Moist Forests, Southwest Amazon Moist Forests, and Bolivian Yungas ecoregions). The main soil types of the localities where the species is known are cambisol and regosol, with coarse (loamy sand or sandy loam) to medium textures (loam or silt loam).

Discussion

In this article, we update the diagnostic characters and the known distribution of *Amphisbaena slateri* based on an additional specimen housed at the Zoologisches Museum, Universität Hamburg (ZMH R01282), and another from the University of Kansas (KUH 135171). These rep-

Figure 4. *Amphisbaena slateri*. Head in dorsal, lateral, and ventral view of ZMH R1282 (left), from Panguana Private Conservation Area, and KUH 135171 (right), from Misión Coribeni, Peru. Scale bars: 1 mm. Photos: Jakob Hallermann (left) and Luke J. Welton (right).

resent only the fourth and fifth specimens known for the species. ZMH R01282 was first identified by the late Carl Gans, who prepared a manuscript reporting his finding, which should have been published at the *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut* (former name of this journal). The unpublished draft manuscript was recently found by JH, and its reproduction (Suppl. material 1) was permitted by the Gans Collections and Charitable Fund Trustees (Eva Lynn Gans, e-mail to JH on 14 December 2017). Our study is the first to give detailed information on the place of origin and morphology (including photographs) of ZMH R01282, and, to the best of our knowledge, the first to report the existence of KUH 135171.

In the redescription of *Amphisbaena slateri* (Gans 1967) the three specimens examined were considered to have two rows of 'chin-segments', i.e., postgenials (Gans and Alexander 1962) – some authors call them 'median genials'(Vanzolini 1991, Pinna et al. 2010). The holotype of *A. slateri* clearly has two rows of postgenials, the first with two and the second with three scales (Figure 1). Specimen ZMB 10888 was said to have 3+6 postgenials (Gans 1967). It has, in fact, three scales between the malars (postgenials), but the following row of six scales should not be considered postgenials (*sensu* Gans and Alexander 1962) since they are posterior to the malars (Figure 3). One could argue this is a postmalar row, as the scales are between the last infralabial on each side. However, this row lies posterior to the *angulus oris* (mouth commissure), and should be counted as the first body annulus (Gans 1962b, 1964a, 1964b, 1964c, 1966); the same is observed in BM 1946.8.31.82 and ZMH R01282 (Figures 1 and 4). Gans (1967) also cites four infralabials and 2+4 postgenials for ZMH R05908, but this specimen has three infralabials (Gans's fourth infralabial is beyond the *angulus oris*) and three

Table 2. Morphological characters useful for the identification of Peruvian and Bolivian Amphisbaenia (*A.* = *Amphisbaena*; *L.* = *Leposternon*). BA = body annuli; CA = caudal annuli; AA = autotomic annulus; HS = head shape: R (round), K (keel), or S (shovel); TT = tail tip: R (round), LC (slightly laterally compressed), VK (vertical keel); DS = dorsal segments (modal value in parenthesis); VS = ventral segments (modal value in parenthesis); EP = enlarged parietals (larger than adjacent body segments); SL = supralabials; IL = infralabials; PG = postgenial rows; PM = postmalar row; PP = precloacal pores (modal value in parenthesis).

Species	BA	CA	AA	HS	TT	DS	VS	EP	SL	IL	PG	PM	PP
A. alba	198–248	13–21	no	R	R	30–42 (36)	35–46 (38, 40)	irregular	3–4 (4)	3	1–2	yes	4–12
A. angustifrons	190–218	12–19	no	R	LC	20–31 (24)	21–36 (28)	no	3–4 (4)	3	2	yes	3–6 (4)
A. bolivica	200–231	18–26	5–6	R	R	27–38 (30)	26–36 (28)	no	4	3	2	yes	2–6 (4, 6)
A. borelli	239–261	17–19	6–8	R	VK	14–18 (16)	16–20 (16)	no	3	3	2	no	4
A. camura	188–206	14–19	4–6	R	R	28–42 (39)	29–46 (43)	no	4	3	2	yes	2–6 (4, 6)
A. cegei	179–199	21–24	6–8	R	R	17–22 (19)	20–24 (23)**	no	3	3	2	no	0(♀), 4(♂)
A. fuliginosa	180–220	20–30	5–7	R	R	20–28	18–28	no	3	3–4	2	yes	6–10
A. heterozonata	189–207	13–18	5–8	R	LC	14–24 (16)	15–28 (18)	irregular	3	3	1–2	yes	2–6 (4)
A. kingii	214–244	15–23	7	K	R	12–19 (16)	14–22 (18)	no	3	3	2	no/yes	0–4 (0, 4)
A. occidentalis	262–275	17–20	no	R	R	16–20 (18)	24–28 (26)	no	3	3	2–3	yes	4
A. pericensis	196–218	16–19	6–8	R	LC	12–16 (14)	16–20 (18)	yes	3	3	2	no	4–6 (4)
A. polygrammica	270	22	?	R	?	18	26	no	3	3	1	yes	4
A. silvestrii	173–190	20–23	4–7	R	R	10–12 (10)	10–14 (10)	yes	3	3	2	yes	2
A. slateri	176–213	20–24	7–10	R	R	10–14 (10, 12)	14–16 (14)	yes	3	3	1–2	no/yes	4
A. steindachneri	255–266	17–19	7	R	VK	12–16 (14)	12–16 (14)	no	3	3	1–2	no	4
A. townsendi	261–279	22–26	7–9	R	R	16–18 (18)	24–28 (26)	no	3	3	2–3	yes	4
L. microcephalum	*192–229	8–14	no	S	R	17–31(21)	17–31 (22)	yes	2	2	0	yes	0

* number of post-pectoral ventral annuli.
** Ricardo Montero, pers. comm.

Table 3. Voucher, geographical coordinates, elevation, ecoregion (Dinerstein et al. 2017), and soil type (IUSS Working Group WRB 2015) of the collection localities of known specimens of *Amphisbaena slateri*. UMF: Ucayali Moist Forests; SAMF: Southwest Amazon Moist Forests; BY: Bolivian Yungas.

Voucher	Country	Department	Locality	Latitude	Longitude	Elevation	Ecoregion	Soil type
ZMH R1282	Peru	Huánuco	Panguana Private Conservation Area	-09.616°	-74.933°	260 m	UMF	Cambisol
KUH 135171	Peru	Cuzco	Misión Coribeni	-12.600°	-72.800°	900 m	SAMF	Regosol
BM 1946.8.31.82[H]	Peru	Puno	Carabaya, San Gaban river valley	-13.437°	-70.403°	600–900 m	SAMF	Regosol
ZMH R5908	Bolivia	La Paz	San Antonio	-14.566°	-68.383°	1700 m	BY	Cambisol
ZMB 10888	Bolivia	La Paz	Pelechuco	-14.820°	-69.071°	3600 m	BY	Regosol

H = Holotype.

postgenials, followed by a row of six scales (the first body annulus), the outermost on each side larger than the rest (Figure 3). KUH 135171, however, has a postmalar row with seven scales (Figure 4). This variation regarding the postmalar row is not a common feature. It was also described for *A. metallurga*, from southeastern Brazil, and is linked with a polymorphism in the shape of the malars (Costa et al. 2015). The only specimen of *A. slateri* with a postmalar row (KUH 135171) has small malars that do not touch the third infralabials, contrary to the other four specimens.

In the ‘Key to the American Amphisbaenia’(Gans and Mathers 1977), *A. slateri* is considered to have a postmalar row (step 40), which usually is not the case, as commented above. If the option ‘without postmalar row’ is chosen at step 40, the reader would follow to step 41b (‘four or more precloacal pores’), step 45a (‘postmental shield markedly longer and of larger area than mental’), and finally step 46, where both possible options refers to species with more body annuli than *A. slateri* (*A. xera* with 225–234 and *A. carvalhoi* with 231–245 body annuli). The key is certainly outdated, and its use should be avoided.

Amphisbaena slateri can be distinguished from most Bolivian and Peruvian amphisbaenians by the number of body and caudal annuli, segments, and precloacal pores, and the size of parietals. The only exception is *A. pericensis*, from which it differs by the shape of the caudal tip, the relative size of the postmental scale, and color pattern. Ten Neotropical species (*A. albocingulata*, *A. darwinii*, *A. hogei*, *A. manni*, *A. mensae*, *A. munoai*, *A. nigricauda*, *A. prunicolor*, *A. schmidti*, and *A. talisiae*), from Argentina, Brazil, Hispaniola, Paraguay, and Puerto Rico (Gans 2005), share many morphological similarities with *A. slateri*. The phylogenetic relationships of most of them – *A. slateri* included – is not known (Dal Vechio et al. 2016), but it would be of no surprise if later it is found that such similarities are due to convergent evolution, as had been recently discovered for some taxonomically important morphological characters like the head shape (Kearney and Stuart 2004, Mott and Vieites 2009).

The identification of ZMH R01282 and KUH 135171as *Amphisbaena slateri* greatly extends the known geographic range of the species. The new northernmost locality record, Panguana Private Conservation Area, is 650

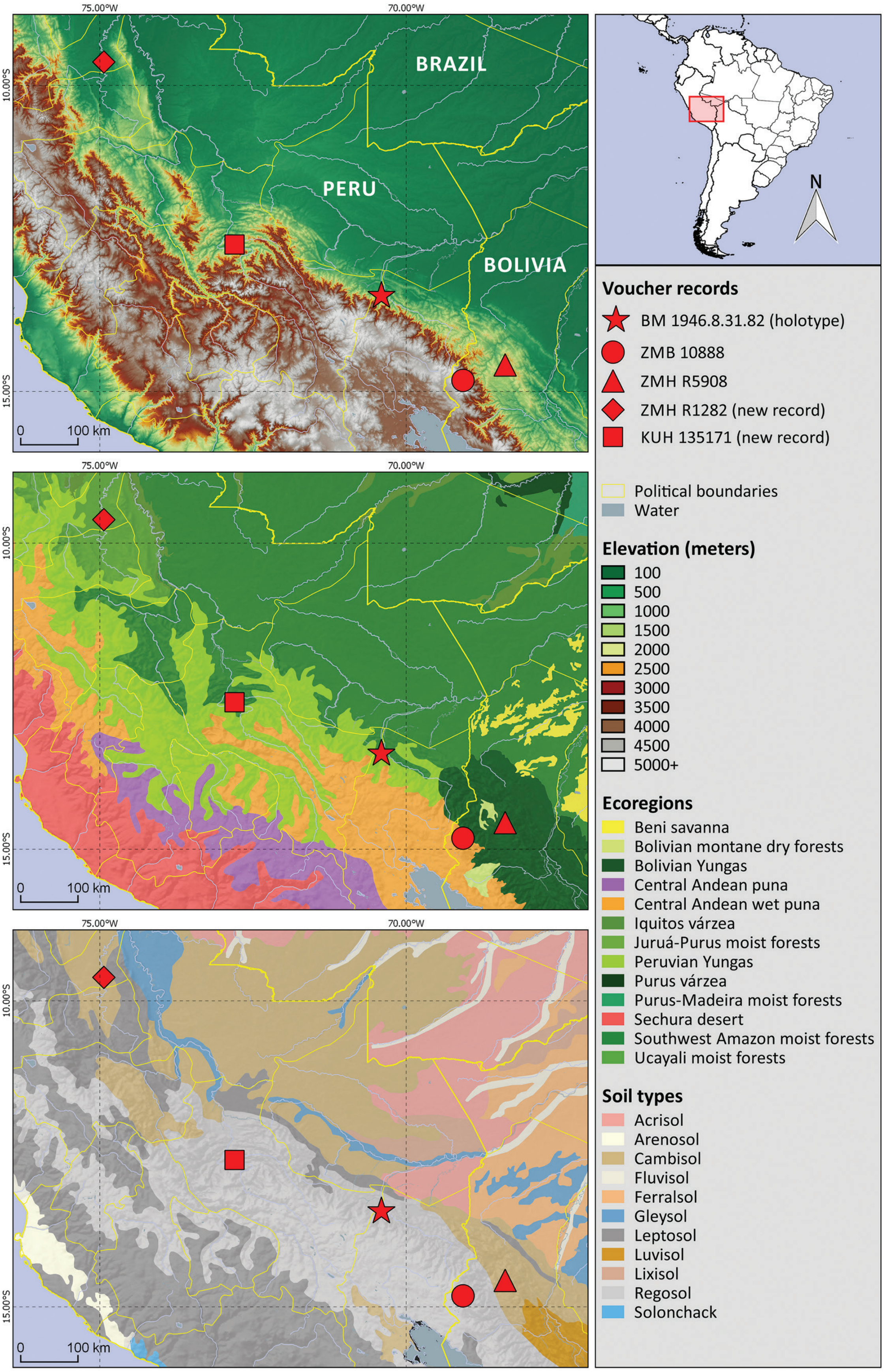

Figure 5. Known locality records for *Amphisbaena slateri* on a background of elevation gradient (top map), ecoregions (middle map), and soil type (bottom map).

km northwest of the type locality in the San Gaban river valley, and 400 northwest of Misión Coribeni, the closest site where the species is known to occur. Panguana is located at 260 m above sea level (m a.s.l.), the lowest elevation record for the species, while Misión Coribeni is at about 900 m a.s.l. Unfortunately, there is no precise elevation data for the holotype and for the two Bolivian specimens, which came from areas with rugged relief. But even if considering only the elevation of the valleys around of each locality, *A. slateri* inhabits areas between 260 and 3600 m a.s.l, probably the greatest elevation gradient among amphisbaenians (Gans 2005).

Amphisbaena slateri is an inhabitant of the Tropical and Subtropical Moist Broadleaf Forests (TSMBF) at the Andean foothills. The record of Pelechuco – not Pelecnes as stated in the specimen label and in Gans (1967) (Dirksen and Riva 1999) – could be considered an ecotone, between the TSMBF and the Montane Grasslands and Shrublands Biome (Central Andean Wet Puna ecoregion). However, given that the Wet Puna is characterized as a mountain grassland region (World Wildlife Fund 2018) and that *A. slateri* seems to be a forest inhabitant (Schlüter et al. 2004), it would be more probable that the specimen from Pelechuco was collected in the valleys of the Bolivian Yungas ecoregion. Cambisols and regosols, the two soil types from the localities where *Amphisbaena slateri* is recorded, are common in the region and mainly formed by the weathering of the rocks of the Andes (Gardi et al. 2014). Their texture along the known range of the species varies from a loamy sand (coarse texture) to silt loam (medium texture) (Nachtergaele et al. 2009), characteristics apparently suitable for any amphisbaenian, especially one with a generalized head shape like *A. slateri* (Gans 1968).

The morphological variation observed between the two Bolivian specimens (south) and the holotype (north), led to the suggestion that the 'south' and 'north' specimens could represent distinct populations (Gans 1967) or even 'races' (Gans 2005). Considering the sample now available, we note that the Peruvian specimens show more body annuli (202–213) and less midbody ventral segments (14) than the Bolivian ones (176–183; 16). Available data (Table 3) indicate the Bolivian specimens were collected at higher elevations, in areas probably of lower environmental temperatures. A possible influence of environmental temperature on somite formation (and hence in the number of body annuli in worm lizards and ventral plates in snakes) was detected by some authors (Vanzolini 1955, 1968, Hoge et al. 1977, Osgood 1978), but has recently been questioned (Arnold and Peterson 2002, Grazziotin et al. 2006). In spite of this, clinal variation is known for some worm lizard species (Vanzolini 1968, 2002, Saiff 1970, Montero 2016), but the availability of only five museum specimens of *A. slateri* hinders any adequate inference on whether the differences observed for this taxon is a sampling artifact, an indicative of clinal variation, or is even linked to undocumented taxonomic diversity.

Amphisbaena slateri is a poorly studied species and the two specimens described here, despite being collected decades ago, remained forgotten on museum shelves. This is not an uncommon phenomenon and reinforces the importance of continuous care and study of specimens deposited in natural history collections (Fontaine et al. 2012, Koch 2014). It is possible that additional specimens of *A. slateri* remain unidentified in other collections. We hope the information provided in this article helps curators, collection managers, and field biologists in the identification of Bolivian and Peruvian amphisbaenians, facilitating the discovery of additional records of *A. slateri* and other species in the future.

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Appendix 1

Specimens examined, not cited by Costa et al. (2018). UFMT: Universidade Federal do Mato Grosso, Brazil; ZUEC: Universidade Estadual de Campinas, Brazil; ZUFMS: Universidade Federal do Mato Grosso do Sul, Brazil. Locality names indicated as 'COUNTRY: State: Municipality, *Specific Locality*'.

***Amphisbaena camura*.** BRAZIL: Mato Grosso do Sul: unknown locality (ZUFMS 828, 829); Anastácio, *Estância Crioula* (ZUFMS 088); Aquidauana (ZUFMS 080, 328, 1243), *Vila Bancária* (ZUFMS 070), *Guanandy* (ZUFMS 093). ***Amphisbaena hogei*.** BRAZIL: São Paulo: Guará, *Eixo-Retiro* (ZUEC 3310, 3311, 3313). ***Amphisbaena kiriri*.** BRAZIL: Bahia: Campo Formoso (MFCH 3939 [holotype], UFMG 3080, 3081 [paratypes]). ***Amphisbaena leeseri*.** BRAZIL: Mato Grosso do Sul: Três Lagoas, *Fazenda Barra da Moeda* (ZUEC 3501, 3747, 3748). ***Amphisbaena nigricauda*.** BRAZIL: Espírito Santo: Vitória, *Praia de Camburi* (UFMT 9157, 9158, 9167, 9169, 9170).

Supplementary material 1

Unpublished typed manuscript by Carl Gans, written in 1980 reporting the discovery of ZMH R1282. This manuscript should have been published at the Mitteilungen aus dem Zoologischen Museum Hamburg (former name of Evolutionary Systematics) but was never submitted. Reproduced with the authorization of Gans Collections and Charitable Fund Trustees

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