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PENSOFT

First records in Brazil for *Arthrosaura versteegii* van Lidth de Jeude, 1904 (Reptilia, Gymnophthalmidae), a possible species complex, and distribution extension for *Arthrosaura montigena* Myers & Donnelly, 2008, in Venezuela

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Abstract

Arthrosaura versteegii van Lidth de Jeude, 1904 is known to occur on the Guiana Shield from eastern Venezuela to western French Guiana, between 100 m and 1400 m a.s.l. No records for Brazil are known. Herein, we report specimens morphologically similar to *A. versteegii* from 2 areas in Brazilian Amazonia, south of the Amazon river. However, the Brazilian specimens exhibit 2 distinct types of hemipenes that also differ from that of Guianan males of *A. versteegii*. Moreover, the reexamination of 2 specimens of *A. versteegii* collected in the Venezuela highlands show that they are *A. montigena* Myers & Donnelly, 2008, leaving *A. versteegii* restricted to the eastern Amazonian lowlands.

Key words

South America; Neotropics; Squamata; hemipenis; distribution.

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Introduction

Van Lidth de Jeude (1904) described *Arthrosaura versteegii* based on a single specimen (RMNH 4469) from the Cottica Mountains ("Suriname") in extreme western French Guiana, just east of the Marowijne river that forms the border between Suriname and French Guiana. The specimen had been collected by a Dutch topographical expedition and Van Lidth de Jeude apparently had not realized that the Cottica Mountains were outside Suriname. Van Lidth de Jeude (1904) and Burt and Burt (1931) noted the similarities between *A. versteegii* and *A. reticulata* (O'Shaugnessy, 1881) from Ecuador. Brongersma (1932) reviewed all species which at that time were considered to belong to *Arthrosaura* and suggested that *A. versteegii* might be a subspecies of *A. reticulata*. However, he had no specimens of *A. reticulata* for direct comparison**.** Brongersma (1935) compared the holotypes of *A. reticulata* and *A. versteegii* (the only specimens of both taxa known at that time) and came to the conclusion that the differences between the 2 species were rather on a subspecific level, so that they should be considered subspecies of 1 species. Thus, the taxon described by Van Lidth de Jeude (1904) became *A. reticulata versteegii.* Cunha (1961) followed Brongersma's (1935) conclusion, but later, Cunha (1967) described *A. amapaense* and con-

sidered *A. reticulata* and *A. versteegii* as separate species. Peters and Donoso-Barros (1970) considered *A. versteegii* and *A. reticulata* as different species, but Brongersma's opinion was shared by Hoogmoed (1973), who identified the specimens from Suriname as *A. reticulata versteegii* and considered *A. amapaense* Cunha, 1967 as a synonym of it. Hoogmoed and Avila-Pires (1992) reviewed the genus *Arthrosaura* and came to the conclusion that *A. versteegii* was a valid species with a rather restricted distribution in the northern part of the Guiana Shield. They also resurrected *A. tyleri* (Burt & Burt, 1931) from the synonymy of *A. reticulata*, where it had been placed by Cunha (1967), and they considered *A. amapaense* a synonym of *A. reticulata*. After this review, several new species of *Arthrosaura* were described: *A. synaptolepis* Donnelly, McDiarmid & Myers, 1992, *A. testigensis* Gorzula & Señaris, 1998, *A. guianensis* MacCulloch & Lathrop, 2001, *A. montigena* Myers & Donnelly, 2008, and *A. hoogmoedi* Kok, 2008. Thus, considering also *A. kockii* (van Lidth de Jeude, 1904), the number of recognized species in *Arthrosaura*, in 2008, was 9 (not 8 as stated by Goicoechea et al. 2016).

MacCulloch and Lathrop (2001) described *A. guianensis* and suggested that the genus might be divided into 2 groups: 1 containing species with relatively short bodies and long limbs, with 4 supraoculars, and another group of species with relatively long bodies and short limbs, and only 3 supraoculars. Kok (2008) formalized these groups as the *A. kockii*- and the *A. reticulata*-group respectively.

Myers and Donnelly (2008) provided a key to the species of *Arthrosaura* (*A. hoogmoedi* was not included because it had not yet been published). They suggested that the 2 specimens of *A. versteegii* from near the base of Ptari Tepui (RMNH 25261–62) should be compared directly with the type material of *A. montigena*, as they thought suspicious the "broad geographic and elevational range" of *A. versteegii* as given by Hoogmoed and Avila-Pires (1992) .

Goicoechea et al. (2016), in a paper dealing with molecular systematics of teioid lizards, transferred *A. guianensis* and *A. hoogmoedi* to the genus *Loxopholis* Cope, 1868. However, part of their own data did not support their decision, they did not consider the morphological differences between *Arthrosaura* and *Loxopholis* as presently understood, and only 4 of the 9 species in the genus were included in their study. New molecular analyses soon to be published point in another direction, and therefore, we continue to treat for now both species as members of the genus *Arthrosaura*.

Recently our attention was called to a specimen of *Arthrosaura* from southern Amazonia, in Brazil. Having examined it, we concluded that it was most similar to *A. versteegii*, previously not known from this area (Hoogmoed and Avila-Pires 1992, Avila-Pires 1995). We then searched for additional material and made detailed comparisons between specimens from both north and south of the Amazon. The results of this study are presented here.

Methods

The MPEG collection, which has a good representation of specimens from Brazilian Amazonia, was thoroughly searched for additional *A. versteegii*-like specimens. We reexamined the specimens of *A. versteegii* from the Guianas, including the Venezuelan specimens of *A. versteegii* (RMNH 25261–62) reported by Hoogmoed and Avila-Pires (1992). Following the suggestion of Myers and Donnelly (2008), we compared these specimens with the paratype of *A. montigena* (AMNH R-140230). Material (including types) of *A. versteegii* and *A. montigena* from the following musea (museum acronyms follow Sabaj 2016) were studied and are listed in Table 1: AMNH, EBRG, MHNLS, MNHN (Paris), MPEG and RMNH. Specimens from EBRG and MHNLS from Venezuela were examined based on photos, all others directly. Coordinates and altitude may be approximations, secondarily obtained based on available locality data. We recovered data from field notes, in order to obtain an idea of the habitat of the species.

In addition, we examined the hemipenes of some of these specimens from both north and south of the Amazon River. We prepared hemipenes of *A. versteegii* (MNHN 1999.4910, from French Guiana, previously depicted and described by Gasc, 1981 while still on the specimen) and of the morphologically similar specimens from south of the Amazon (MPEG 24950, from Vitória do Xingu, Pará, Brazil; MPEG 28440 and MPEG 28443, from Novo Progresso, Pará, Brazil). For comparative purposes, we also prepared hemipenes of *A. reticulata* (RMNH 25265 from the Lucie river, Suriname, north of the Amazon river; MPEG 25967 from Parauapebas and MPEG 32008 from Vitória do Xingu, both in Pará, south of the Amazon river), and we used data from Myers and Donnelly (2008) and Nunes (2011) on the hemipenis of *A. montigena.* Hemipenes were removed and prepared following the procedures described by Pesantes (1994), Manzani and Abe (1988) and, for eversion and filling, Zaher and Prudente (2003). For coloration of mineralized structures, we used an alcohol solution of Alizarin Red (Uzzell 1973). Hemipenial terminology follows Myers and Donnelly (2008).

Results

New records. Table 1, Figure 1.

The Brazilian localities, from where *A. versteegii* was not previously known, are all well south of the Amazon River, and the southernmost locality (W of Castelo dos Sonhos) is about 1200 km due south of the 2 southernmost localities (Sipaliwini, Suriname, and Koulimapopane, French Guiana) in the Guiana region (Table 1, Fig. 1). Thus, the presently known distribution covers part of the eastern lowlands of the Guiana Shield and reaches far south of the Amazon between the rivers Tapajós and Xingu, nearly reaching the northern border of the Brazilian Shield. In the Belo Monte area, *A. versteegii* was only

collected on the west bank of the Xingu river, apparently being absent from the east bank of that river.

In Venezuela, 2 specimens (RMNH 25261–62) previously identified as *A. versteegii* by Hoogmoed and Avila-Pires (1992) are here re-identified as *A. montigena* (see below). This species was previously known only from Auyántepui, approximately 140 km to the northwest. In addition, MHNLS 11168, from a locality about 60 km north of that of the RMNH specimens and reported by Gorzula and Señaris (1998) as *A. versteegii*, seems also to be *A. montigena*. These data indicate that *A. versteegii* occurs only in eastern Amazonian lowlands,

Table 1. Data on known specimens of *Arthrosaura versteegii* and *A. montigena*.

Fig.	Country	District/state	Locality	Latitude (N)	Longitude (W)	Altitude (m)	Collection no.
1	French Guiana	Saint Laurent du Maroni	Cottica Mountains	03°53′	054°12′	Up to 700	RMNH 4469 (holotype)
2	Suriname	Sipaliwini	Airstrip Sipaliwini	02°01.590′	056°07.650′	250	RMNH 13443
3	Suriname	Sipaliwini	Marowijne Mountains km 9.1	04°45.181′	054°30.242′	200	RMNH 13444
4	Suriname	Sipaliwini	Lely Mountains Camp IV	04°23.685′	054°39.892′	630	RMNH 25260
5	Suriname	Sipaliwini	Kabalebo area, road to Amotopo km 117, 4 km S Baruba creek	04°18.486′	057°41.325′	100	RMNH 25263–25264
6	French Guiana	Saint Laurent du Maroni	Koulimapopane	02°19.588′	054°33.195′	470	MNHN 1975.2438
7	French Guiana	Cayenne	Riviere Arataya, Saut Parare	04°02.15′	052°40.68′	29	MNHN 1999.4910
8	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°23.70′	051°55.883′	93	MPEG 19390
9	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°29.20′	051°48.083′	93	MPEG 19418, 19501
10	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°24.880′	051°45.681′	95	MPEG 24944
11	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°24.899′	051°45.825′	85	MPEG 24950
12	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°24.778′	051°45.279′	80	MPEG 25521
13	Brazil	Pará	9 km S Novo Progresso, near airport	07°08.149′	055°24.818`	250	MPEG 28440–28443, 28467–28468
14	Brazil	Pará	Novo Progresso, BR-163, W of Castelo de Sonhos	08°19.850′	055°12.634′	340	MPEG 28465
15	Brazil	Pará	10 km S Novo Progresso along BR-163, 13 km E	07°09.097′	055°17.990′	310	MPEG 28466, 28469
16	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°22.069′	051°53.942′	109	MPEG 32028
17	Brazil	Pará	Vitória do Xingu, UHE Belo Monte	03°16.761′	051°46.378′	71	MPEG 32029
18	Venezuela	Bolívar	Summit Auyántepui AMNH–Terramar Camp 4	05°58′	062°33′	1600	EBRG 2905 (holotype)
19	Venezuela	Bolívar	Summit Auyántepui AMNH–Terramar Camp 1	05°51′	062°32′	1700	AMNH 140230 (paratype)
20	Venezuela	Bolívar	24 km NE Kavanayen, road to Fuerte Cagramasu	05°32′	061°18′	1400	RMNH 25261–25262
21	Venezuela	Bolívar	2 km E San Ignacio de Yuruaní	05°00′	061°08′	400–1400	MHNLS 11168

Table 2. Comparison between specimens of *Arthrosaura* dealt with in this paper.

	***A. versteegii*: Suriname & French Guiana**	***A. versteegii*: Pará, Brazil**	***A. montigena*: Auyántepui, Venezuela†**	***A. montigena*: Kavanayen, Venezuela**
Maximum SVL (M/F)	49/45	46/49	40/48	-/47
Scales around midbody	31–36	31–38	35	34–38
*Dorsals, transverse rows	25–28	26–28	31	32–33
Ventrals, transverse rows	15–18	16–18	18	18–20
Lamellae fourth finger	11–14	11–14	11–12	10–11
Lamellae fourth toe	15–20	16–20	15	15–16
*Frontonasal – supraocular contact	no	no	yes	yes
*Prefrontal shape	pentagonal	pentagonal	quadrangular	quadrangular
*Prefrontal medial suture	short to long	medium to long	very short	short
*Frontal – 1st supraocular contact	short to no contact	short to no contact	"broad"	short
Interparietal in relation to parietal (width)	distinctly narrower to subequal	distinctly narrower to subequal	subequal	distinctly narrower
Occipitals	4–6	4–7	3–5	6
*Nasal	undivided	undivided	semidivided	variable
*Dorsolateral light line	From rostral along canthus rostralis and lateral margin of supraoculars to forelimbs, and on base of tail		Mainly visible from nape to shortly posterior to forelimbs, and from sacrum to base of tail; fainter between posterior corner of eye and nape, and on middle part of body	

† Data based on Myers and Donnelly (2008) and examination of the paratype (AMNH R-140230).

* Characters that differ between *A. versteegii* and *A. montigena*.

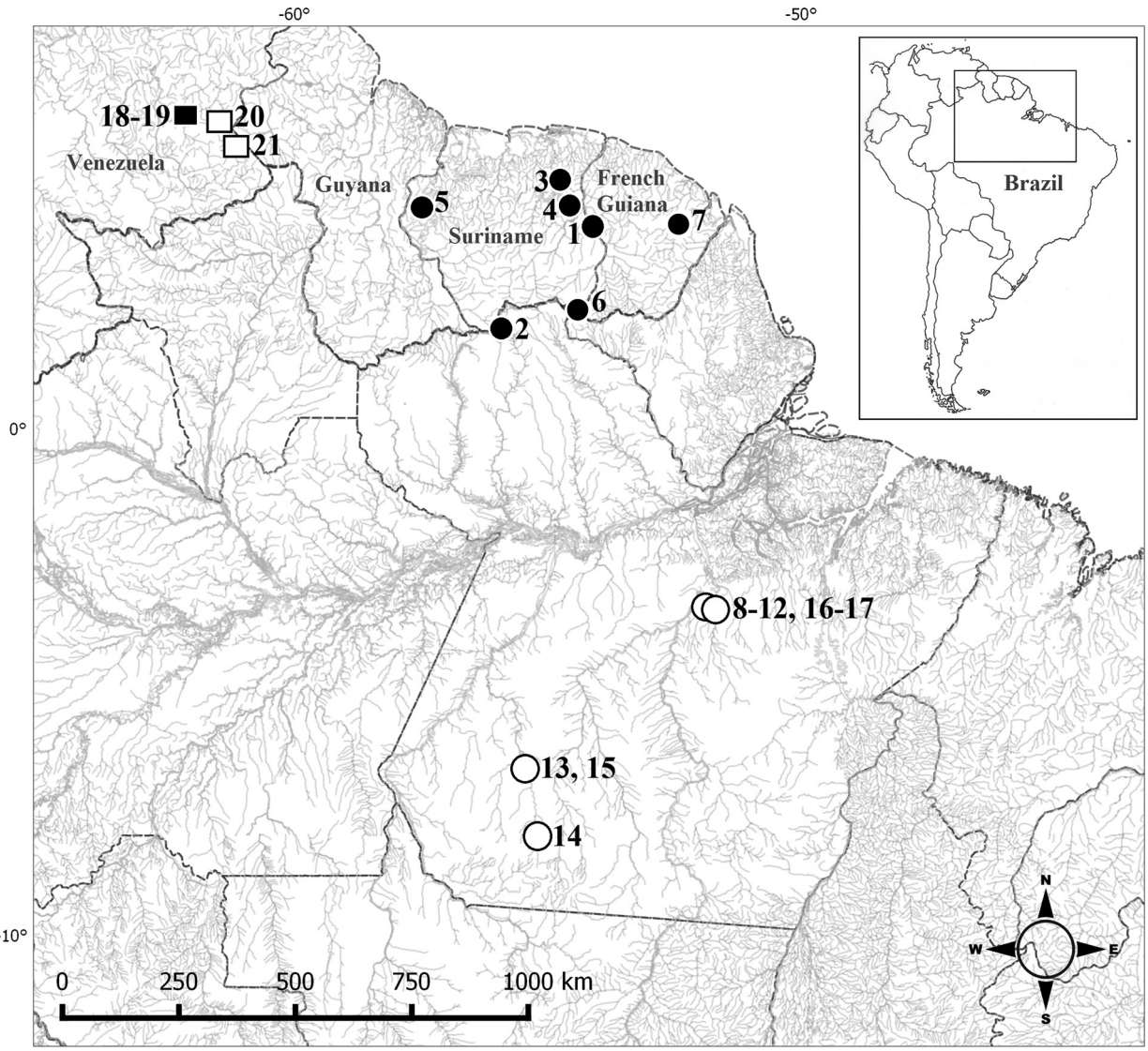


Figure 1. Map showing known records of *Arthrosaura versteegii* (circles) and *A. montigena* (squares). New records are represented by open symbols (in the case of *A. montigena*, it indicates the locality of the specimens previously identified as *A. versteegii*). For locality numbers, see Table 1. Rectangle in the inset shows the area in South America represented in the larger figure.

while *A. montigena* occupies the uplands and highlands of southeastern Venezuela.

Arthrosaura versteegii was found in Suriname both in savanna forest and in high primary forest (Hoogmoed and Avila-Pires 1992). The Brazilian material was collected in forested areas, mostly in pitfalls. In Castelo dos Sonhos and the locality near the airport of Novo Progresso, W of the road BR-163, specimens were caught in high, original to lightly logged rainforest. In the Novo Progresso locality 13 km E of BR-163, specimens were collected in pitfalls in a heavily disturbed open forest on a hillside between a road and pasture. Three of the specimens collected in Vitória do Xingu were said to have been collected in "mata" (i.e. any type of forest), but most likely rainforest (personal observation MSH). The remaining 2 specimens from Vitória do Xingu have no data on habitat, but the coordinates seem to fall in (degraded) forested areas. One hand-collected specimen was found in leaf litter, during daytime. One female (MPEG 28442, SVL 46 mm), collected 27 November 2005, had 2 well-developed eggs in the oviducts. Preanal and femoral pores were small in males with SVL 35–39 mm, and well developed in males with SVL 45–49 mm.

Identification. We found specimens similar to *Arthrosaura versteegii* in the herpetological collection of MPEG identified as *A. reticulata* and *Leposoma percarinatum*. Some of those had been reported earlier (Hoogmoed et al. 2007, 2008) as *Ptychoglossus brevifrontalis*, others as *A. reticulata* (Galatti et al. 2012, Leme Engenharia 2012, Vaz-Silva et al. 2015) and *Leposoma* (= *Loxopholis*) *percarinatum* (Müller 1923) (Vaz-Silva et al. 2015). Our comparisons of specimens of *A. versteegii* from Suriname and French Guiana showed no differences in external morphology with the specimens from the Tapajós–Xingu interfluve. Considering the similarity with *A. montigena* and the doubts raised by Myers and Donnelly (2008) about the identity of the Venezuelan specimens identified as *A. versteegii*, we also included *A. montigena* in our

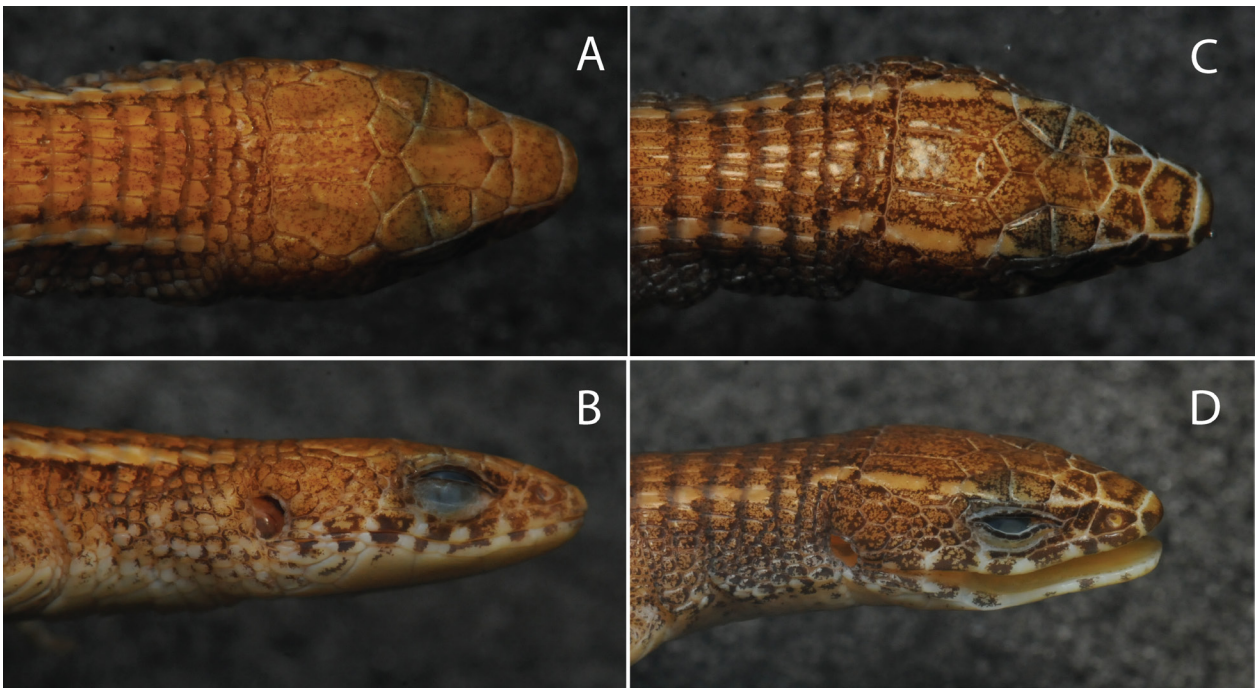
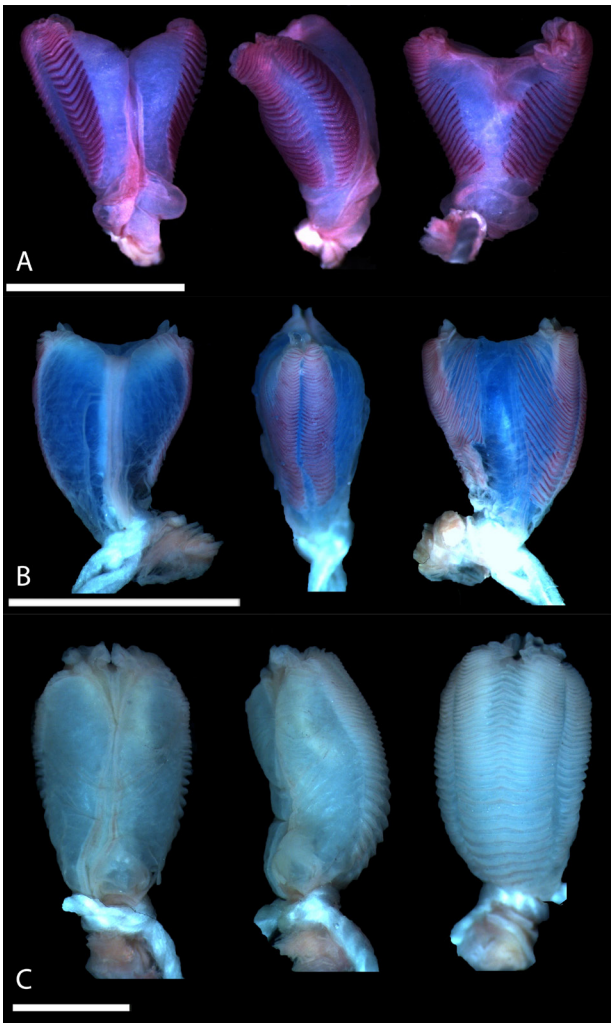


Figure 2. Comparison of head scales in *Arthrosaura montigena* and *Arthrosaura versteegii*. Dorsal and lateral views of head and nape of *A. montigena*, RMNH 25261, female, SVL = 47 mm, from NE Kavanayen, Bolívar, Venezuela (2A, B), and *A. versteegii*, MPEG 24944, female, SVL = 49 mm, from Vitória do Xingu, Pará, Brazil (2C, D).



comparisons (Table 2). The 2 species differ in the number of transverse rows of dorsals (at least in the few specimens of *A. montigena* known), in the shape and contacts of some of the head scales, and in details of the dorsolateral light lines that are present in both species (Fig. 2). We call attention to the fact that differences in head scales are all related: as the prefrontals tend to be longer in *A. versteegii*, they present a longer medial suture; they contact the loreal, precluding the contact between the frontonasal and first supraocular, giving the prefrontals a pentagonal (not a quadrangular) shape; and they extend further posteriorly, in some cases even reaching the second supraocular, so that the frontal has only a short contact, or no contact at all, with the first supraocular. Specimens from south of the Amazon river agree with *A. versteegii* from Suriname and French Guiana in all these characters.

On the other hand, RMNH 25261–62, from Venezuela, differ from all specimens of *A. versteegii* we examined and agree in most characters with *A. montigena* (Table 2). MHNLS 11168, reported by Gorzula and Señaris (1998) as *A. versteegii*, also has head scales similar to those of *A. montigena*. We therefore consider these records as referring to *A. montigena*.

The hemipenes (Fig. 3) of *A. versteegii* from French Guiana and *A. versteegii*-like specimens from Vitória do Xingu and Novo Progresso are similar in the presence of lobes with small protuberances around each apex; sulcate

◄ **Figure 3.** Hemipenes of *A. versteegii* in sulcate (left), lateral (central) and asulcate (right) views. **A** = MNHN 1999.4910, from French Guiana; and *A. versteegii*-like specimens **B** = MPEG 24950, from Vitória do Xingu, Pará, Brazil; **C** = MPEG 28440, from Novo Progresso, Pará, Brazil. Scale bar (bottom of each figure) = 5 mm.

Table 3. Comparison of the hemipenes of *Arthrosaura versteegii*-like specimens.

French Guiana (MNHN 1999.4910)	Vitória do Xingu (MPEG 24950)	Novo Progresso (MPEG 28440, 28443)
Roughly globose shape	Roughly globose shape	Roughly cylindrical
Lobes pronounced, c 1/3 the hemipenis body (area covered with lamellae)	Lobes less pronounced, c 1/4 the hemipenis body (area covered with lamellae)	Lobes divided only close to the apices
Small protuberances on the apices of each lobe well separated from those on the other lobe	Small protuberances on the apices of each lobe well separated from those on the other lobe	Small protuberances on the apices of each lobe, medial ones (almost) touching those from the other lobe
Sulcate face nude, sulcus spermaticus deep, bifurcation at the crotch, diverging in an angle of almost 180º from each other; bifurcated segment of sulcus spermaticus hardly visible from sulcate face	Sulcate face nude, sulcus spermaticus deep, bifurcation at the crotch, diverging in an angle of almost 180º from each other; bifurcated segment of sulcus spermaticus hardly visible from sulcate face	Sulcate face nude, sulcus spermaticus deep, bifurcation before reaching crotch, diverging in an angle between 30–40º from each other; bifurcated segment of sulcus spermaticus partially visible from sulcate face.
Sides of hemipenis with two longitudinal rows of 28 plicae lined with small spicules, and separated by a narrow space, except distally where they are in contact; they form weak chevrons at the side of the nude sulcate area, and are weakly recurved at the asulcate area	Sides of hemipenis with two longitudinal rows of 42 plicae lined with small spicules, and separated by a narrow space, except distally where they are in contact; they are recurved both at the side of the nude sulcate area and at the asulcate area	Sides of hemipenis occupied mainly by a longitudinal row of 32–33 plicae that border the sulcate nude area; this is separated by a narrow space from the asulcate plicae. Plicae (both lateral and asulcate) more spaced from each other proximally than distally and lined with small spicules
Asulcate face with a wide nude area separating the plicae, narrower proximally than distally. The 15 basalmost plicae extend into the asulcate area but do not come close to the apex medially	Asulcate face with a relatively wide nude area separating the plicae, slightly wider proximally than distally. Among the basalmost plicae, 15 extend into the asulcate area, distalmost plicae up to the medial area of the apex	Plicae continuous on asulcate face, with no nude area. They form weak chevrons of 22–24 plicae medially, with nine extra plicae on each lobe that do not meet medially

face with a wide nude area; sulcus spermaticus deep, straight, distally divided; plicae in 2 longitudinal rows separated by a narrow space, variably extending into the asulcate face, lined with small spicules. No orificium was observed between the lobes. Besides these common traits, however, we observed several differences between localities, shown in Table 3. The hemipenes from French Guiana and Vitória do Xingu are more similar to each other and to those of *A. reticulata* and *A. montigena*, all presenting a globose shape with distinct lobes, and a nude area on the asulcate face that separates a row of plicae on each side (Fig. 3A, B). The hemipenis of specimens from Novo Progresso is roughly cylindrical, with hardly divided lobes and asulcate face covered with continuous plicae (Fig. 3C). They also differ from each other in the number of plicae and some other characters.

In summary, at the moment specimens of *A. versteegii* are known from 5 localities in Suriname between 100 and 630 m above sea level (a.s.l.), the type locality in French Guiana (Cottica Mountains, maximally 700 m a.s.l.; Hoogmoed and Avila-Pires 1992), and 2 other localities in French Guiana, lower than 500 m a.s.l. (Gasc 1990). South of the Amazon, in Pará, we found *Arthrosaura versteegii*-like specimens in 3 localities in the municipality of Novo Progresso and 4 localities in the municipality of Vitória do Xingu, at altitudes between 70 and 340 m a.s.l. Differences in hemipenes suggest that they may form a complex of cryptic species, but until more data is available (e.g., hemipenes from other localities, molecular data), we prefer to consider all the specimens as *A. versteegii*. Below we present a chresonym list for *A. versteegii* and *A. montigena*:

Arthrosaura versteegii

Arthrosaura Versteegii van Lidth de Jeude 1904: 89.

Arthrosaura versteegii—Burt and Burt 1931: 313, 1933: 56; Brongersma 1932: 77–79; Peters and Donoso-Barros 1970: 75 (partly); Hoogmoed and Avila-Pires 1992: 470 (partly); Avila-Pires 2005: 32 (partly); Massary 2004: 55.

Arthrosaura reticulata versteegii—Brongersma 1935: 264; Hoogmoed 1973: 242; Hoogmoed and Lescure 1975: 155; Hoogmoed 1975: 146 (partly); Gasc 1976: 28, 1981: 305, 306.

Arthrosaura reticulata verstegei [sic]—Gasc 1990: 48 (photo), 49.

Ptychoglossus brevifrontalis (partly)—Hoogmoed et al. 2007: 94, 97, 98; 2008: 147, 151, 152.

Arthrosaura reticulata—Gasc 1990: 71, 73; Galatti et al. 2012: 13, 30, 41 (partly); Leme Engenharia 2012: 662, 668, 681 (partly); Vaz-Silva et al. 2015: 211 (partly).

Leposoma percarinatum (partly)—Vaz-Silva et al. 2015: 211.

Arthrosaura montigena

Arthrosaura montigena Myers and Donnelly 2008: 89.

Arthrosaura versteegii—Hoogmoed and Avila-Pires 1992: 470 (partly); Gorzula and Señaris 1998: 124; Avila-Pires 2005: 32 (partly); Myers and Donnelly 2008: 90 (note 25); Rivas et al. 2012: 14.

Discussion

Myers and Donnelly (2008) presented an identification key for all the species of *Arthrosaura*, except *A. hoogmoedi*. This latter species differs from both *A. versteegii* and *A. montigena* by presenting 4, instead of 3, supraoculars (Kok 2008). Myers and Donnelly (2008), in their description of *A. montigena*, emphasized its distinctiveness from *A. versteegii*, the most similar species, but this was done based on the description by Hoogmoed and Avila-Pires (1992); they did not compare specimens directly. By comparing specimens, we did not observe 2 of the differences they pointed out. The first one, concerning the guttural fold, was due to confusion, since we talked about the gular fold, which borders the collar; a guttural fold is indistinct in both species. The second one regards the ventrolaterals of Myers and Donnelly (2008) or lateralmost ventrals of Hoogmoed and Avila-Pires

(1992), and their delimitation with the lateral scales. Even though the former authors considered that they are "not or but indistinctly demarcated" and the latter authors that they are "sharply demarcated by a zone of small scales", the 2 species hardly differ in these scales and the contact between them. Two other differences indicated by Myers and Donnelly (2008) seem to vary within the species. In *A. versteegii*, the interparietal is usually narrower than the parietals, but they are subequal in some specimens, and it is also possible to suppose that *A. montigena* shows the same variation. The nasal scale is undivided in all specimens of *A. versteegii* and semidivided in the 2 types of *A. montigena*. In RMNH 25262, it is also semidivided (division running from naris to supralabial), but in RMNH 25261, a division was not detected; therefore, this character may be variable in *A. montigena*.

Nunes (2011) examined the hemipenis of 5 of the 9 known species of *Arthrosaura*. In all these species, the hemipenis is globose, bilobed, with a nude area on the asulcate face, as we observed in *A. versteegii* (not examined by Nunes 2011) from French Guiana and Vitória do Xingu, Brazil, and quite distinct from the hemipenis found in the specimens from Novo Progresso, Brazil. Intraspecific variation in hemipenis has already been observed in lizards and snakes. Myers and McDowell (2014) discuss several cases of hemipenial polymorphism, especially in snakes, demonstrating that it is not possible to assume any explanation a priori as granted. Despite frequently being considered conservative, in some cases hemipenes seem to evolve rapidly, showing large differences within a species or in closely related species. Examples in lizards are the cases of *Norops altae* (Dunn, 1930) and *N. monteverde* (Köhler, 2009), presented by Köhler (2009); *Norops osa* (Köhler, Dehling & Köhler, 2010) and *N. polylepis* (Peters, 1874), discussed by Köhler et al. (2012); and *Iphisa elegans* Gray, 1851 (Nunes et al. 2012). Köhler et al. (2012) found that, at least considering sequences of mitochondrial cytochrome b, *N. osa* forms a clade within *N. polylepis*, even if their hemipenes differ in several characters, demonstrating the close affinity of these 2 taxa. In the case of the specimens studied here, it is interesting to note that the largest differences were not found between the population north of the Amazon and those south of it, but between the 2 populations in Pará, both in the Xingu–Tapajós interfluve. Irrespective of whether they represent the same or distinct species, considering that the hemipenis of the specimens from Novo Progresso differs from those of most *Arthrosaura* species, we may suppose that this population may have undergone some strong selective pressure that led to hemipenial divergence, as proposed in other cases by Myers and McDowell (2014). However, without additional studies to give a better picture of the variation in the whole group and how these populations relate to each other, any conclusion would be too speculative.

At least in part of its distribution area, *A. versteegii* occurs syntopically with *A. reticulata*. Hoogmoed and Avila-Pires (1992) mentioned both species from the proximities of the airstrip Sipaliwini (1 and 4 specimens, respectively). On the left (west) margin of Xingu river, in the surroundings of UHE Belo Monte, Pará, 8 specimens of *A. versteegii* and 51 of *A. reticulata* were collected (while 32 *A. reticulata* and not a single *A. versteegii* were collected on the right [east] margin). On the other hand, in Novo Progresso, Pará, the 9 *Arthrosaura* collected were all *A. versteegii*, and during recent work in the Calha Norte area of Pará, north of the Amazon, specimens of only *A. reticulata* were found (Avila-Pires et al. 2010). In French Guiana, all records (see chresonym list) refer to *A. versteegii*, while the presence of *A. reticulata* needs to be confirmed.

The recent appearance of *A. versteegii* in collections from Pará south of the Amazon may be a consequence of a relatively restricted area of occupancy due to microhabitat restrictions (together with an increase in collecting effort), but it can also be related to the use of pitfall traps, which capture species that rarely emerge from the leaf litter and therefore are difficult to detect during active collecting. In this case, the species' apparent rarity could be a result of seclusive habits. A similar case happened with *Ptychoglossus brevifrontalis* Boulenger 1912, which, for a long time was thought to have a peripheral Amazonian distribution, but more recently was found to occur all over Amazonia (Peloso and Avila-Pires 2010).

Lehr (2002: 202), in his list of amphibians and reptiles from Peru, reports *A. versteegii* from Peru, but it is unclear on which basis he does so. The species is not mentioned in the main text of his book, and he does not provide any literature reference for this supposed occurrence.

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Authors' contributions

TCSAP and MSH conceived the study, examined the material and wrote the text. MBS prepared the hemipenes, described and compared them and provided input for the final text.

References

Avila-Pires TCS (1995) Lizards of Brazilian Amazonia (Reptilia: Squamata). Zoologische Verhandelingen Leiden 299: 1–706.

Avila-Pires TCS (2005) Reptiles. In: Hollowell T, Reynolds RP (Eds) Checklist of the terrestrial vertebrates of the Guiana Shield. Bulletin of the Biological Society of Washington 13: 25–40

Avila-Pires TCS, Hoogmoed MS, Rocha WA (2010) Notes on the Vertebrates of northern Pará, Brazil: a forgotten part of the Guianan Region, I. Herpetofauna. Boletim do Museu Paraense Emilio Goeldi. Ciências Naturais 5 (1): 1–112.

Brongersma LD (1932) III. Notes on the species of *Arthrosaura*. Zoologische Mededelingen 15: 76–88.

Brongersma LD (1935) Herpetological notes X-XII. XII. Note on *Arthrosaura reticulata* (O'Shaugn.) and *Arthrosaura versteegii* Lidth. Zoologische Mededelingen 18: 261–265.

Burt CE, Burt MD (1931) South American lizards in the collection of the American Museum of Natural History. Bulletin of the American Museum of Natural History 61 (7): 227–395.

Burt CE, Burt MD (1933) A preliminary check list of the lizards of South America. Transactions of the Academy of Science of St Louis 28: i–v, 1–104.

Cope ED (1868) Sixth contribution to the herpetology of tropical America. Proceedings of the Academy of Natural Sciences of Philadelphia 20: 305–313.

Cunha OR (1961) II. Lacertílios da Amazônia. Os lagartos da Amazônia Brasileira, com especial referência aos representados na coleção do Museu Goeldi. Boletim do Museu Goeldi, Zoologia 39: 1–189.

Cunha OR (1967) Lacertílios da Amazônia. III. O gênero "*Arthrosaura*" Boulenger, 1885 (Lacertilia, Teiidae). Atas do Simpósio Biota Amazônica 5 (Zoologia): 141–170.

Donnelly MA, McDiarmid RW, Myers CW (1992) A new lizard of the genus *Arthrosaura* (Teiidae) from southern Venezuela. Proceedings of the Biological Society of Washington 105 (4): 821–833. http://doi.org/10.1206/308.1

Dunn ER (1930) Notes on Central American *Anolis*. Proceedings of the New England Zoological Club 12: 15–24.

Galatti U, Oliveira SN, Avila-Pires TCS, Hoogmoed MS, Bernardi JAR, Lima AA, Sturaro MJ, Lima CJS, Peloso PLV, Rocha RAT, Silva VS, Sodre D, Silva F, Lima MACS (2012) Caracterização da comunidade de anfíbios e répteis terrestres da área de influência direita do AHE Belo Monte. Relatório final, 52 pp., EIA Belo Monte, Vol. 18. Relatório MPEG Fauna terrestre, Herpetofauna. http://licenciamento.ibama.gov.br/Hidreletricas/Belo%20Monte/EIA/Volume%2018%20-%20RELATORIOS%20MPEG%20FAUNA%20TERRESTRE/TEXTO/HERPETOFAUNA/HERP%20BMONTE%20FINAL.pdf. Accessed on: 2018-06-20.

Gasc J-P (1976) Contribution a la connaissance des Squamates (Reptilia) de la Guyane Francaise. Nouvelles localités pour les Sauriens. Comptes Rendues de la Societé Biogeographique 454: 17–36.

Gasc J-P (1981) Quelques nouvelles données sur la répartition et l'écologie des Sauriens de Guyane Française. Revue d'Ecologie (Terre et Vie) 35: 273–325.

Gasc J-P (1990) Les lezards de Guyane. Raymond Chabaud, Paris, 76 pp.

Goicoechea N, Frost DR, de la Riva I, Pellegrino KCM, Sites J, Rodrigues MT, Padial JM (2016) Molecular systematics of teioid lizards (Teioidea/Gymnophthalmoidea: Squamata) based on the analysis of 48 loci under tree-alignment and similarity-alignment. Cladistics 32: 624–671. http://doi.org/10.1111/cla.12150

Gorzula S, Señaris CJ (1998) Contribution to the herpetofauna of the Venezuelan Guayana. I. A data base. Scientia Guaianae 8: 1–268.

Gray JE (1851) Description of a new genus and family of Cyclosaurian lizards, from Para. Proceedings of the Zoological Society of London 19: 38–39.

Hoogmoed MS (1973) Notes on the herpetofauna of Suriname IV. The lizards and amphisbaenians of Suriname. Biogeographica 4: 1–419. http://doi.org/10.1007/978-94-010-2706-9

Hoogmoed MS (1975) De hagedissen en wormhagedissen van Suriname III. de teju's. Lacerta 33 (9–10): 143–160.

Hoogmoed MS, Avila-Pires TCS (1992) Studies on the species of the South American lizard genus *Arthrosaura* Boulenger (Reptilia: Sauria: Teiidae), with the resurrection of two species. Zoologische Mededelingen Leiden 66 (35): 453–484.

Hoogmoed MS, Lescure J (1975) An annotated checklist of the lizards of French Guiana, mainly based on two recent collections. Zoologische Mededelingen Leiden 49 (13): 141–171.

Hoogmoed MS, Ribeiro-Junior MA, Araujo CO (2007) Avaliação do estado de conhecimento da herpetofauna na região da BR-163 no Estado do Pará. In: Venturieri A, Zoneamento ecológico-econômico da área de influência da Rodovia BR-163 (Cuiabá–Santarém), Vol. 2, Capítulo 7 Meio ambiente e recursos naturais. Embrapa Amazônia oriental, Belém, 89–98

Hoogmoed MS, Ribeiro-Junior MA, Araujo CO (2008) Avaliação do estado de conhecimento da herpetofauna, no eixo de influência da BR-163, PA. Relatório ZEE BR163 Vol 2 Capitulo 7. Embrapa Amazônia oriental, Belém, 143–152.

Köhler G (2009) New species of *Anolis* formerly referred to as *Anolis altae* from Monteverde, Costa Rica (Squamata: Polychrotidae). Journal of Herpetology 43 (1): 11–20. http://doi.org/10.1670/07-180R2.1

Köhler G, Dehling D.M., Köhler J (2010) Cryptic species and hybridization in the *Anolis polylepis* complex, with the description of a new species from the Osa Peninsula, Costa Rica (Squamata: Polychrotidae). Zootaxa 2718: 23–38.

Köhler J, Hahn M, Köhler G (2012) Divergent evolution of hemipenial morphology in two cryptic species of mainland anoles related to *Anolis polylepis*. Salamandra 48 (1): 1–11.

Kok PJR (2008) A new highland species of *Arthrosaura* Boulenger, 1885 (Squamata: Gymnophthalmidae) from Maringma tepui on the border of Guyana and Brazil. Zootaxa 1909: 1–15.

Lehr E (2002) Amphibien und Reptilien in Peru. Natur und Tier Verlag, Münster, 206 pp.

Leme Engenharia (2012) Herpetofauna Belo Monte, EIA, Vol. 14: 652–690. http://licenciamento.ibama.gov.br/Hidreletricas/Belo%20Monte/EIA/Volume%2014%20-%20ADA%20e%20AID%20(Bi%f3tico)-Fauna%20Terrestre/TEXTO/HERPETOFAUNA/DIAGNOSTICO%20HERPETOFAUNA.pdf. Accessed on: 2018-06-20.

Lidth de Jeude TW, van (1904) Note II. Reptiles and Batrachians from Suriname. Notes from the Leiden Museum 25: 83–94.

MacCulloch RD, Lathrop A (2001) A New Species of *Arthrosaura* (Sauria: Teiidae) from the Highlands of Guyana. Caribbean Journal of Science 37 (3–4): 174–181.

Manzani PR, Abe AS (1988) Sobre dois novos métodos de preparação de hemipênis de serpentes. Memórias do Instituto Butantan 50: 15–20.

Massary J-C (2004) Les lézards de Guyane. Carnet de Nature, Roger Le Guen, Gariés, 55 pp.

Müller L (1923) Neue oder seltene Reptilien und Batrachier der Zoologischen Sammlung des bayrischen Staates. Zoologischer Anzeiger 57 (7/8): 145–156.

Myers CW, Donnelly MA (2008) The summit herpetofauna of Ayantepui, Venezuela: report from the Robert G. Goelet American Museum–Terramar expedition. Bulletin of the American Museum of Natural History 308: 1–147.

Myers CW, McDowell SB (2014) New taxa and cryptic species of Neotropical snakes (Xenodontinae), with commentary on hemipenes as generic and specific characters. Bulletin of the American Museum of Natural History 385: 1–112.

Nunes PMS (2011) Morfologia hemipeniana dos lagartos microteídeos e suas implicações nas relações filogenéticas da família Gymnophthalmidae (Teiioidea: Squamata). PhD thesis, Universidade de São Paulo, São Paulo. http://doi.org/10.11606/T.41.2011.de-14122011-150555

Nunes PMS, Fouquet A, Curcio FF, Kok PJR, Rodrigues MT (2012) Cryptic species in *Iphisa elegans* Gray, 1851 (Squamata: Gymnophthalmidae) revealed by hemipenial morphology and molecular

data. Zoological Journal of the Linnean Society 166: 361–376. http://doi.org/10.1111/j.1096-3642.2012.00846.x

O'Shaugnessy AWE (1881) An account of the collection of lizards made by Mr. Buckley in Ecuador and now in the British Museum, with descriptions of new species. Proceedings of the Zoological Society of London 1881: 227–245.

Peloso PLV, Avila-Pires TCS (2010) Morphological variation in *Ptychoglossus brevifrontalis* Boulenger, 1912 and the status of *Ptychoglossus nicefori* (Loveridge, 1929) (Squamata, Gymnophthalmidae). Herpetologica 66: 357–372. http://doi.org/10.1655/09-048.1

Pesantes OS (1994) A method for preparing the hemipenis of preserved snakes. Journal of Herpetology 28: 93–95. http://doi.org/10.2307/1564686

Peters W (1874) Über neue Saurier (*Spæriodactylus*, *Anolis*, *Phrynosoma*, *Tropidolepisma*, *Lygosoma*, *Ophioscincus*) aus Central-america, Mexico und Australien. Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin 1873: 738–747.

Peters JA, Donoso-Barros R (1970) Catalogue of the Neotropical Squamata: Part II. Lizards and Amphisbaenians. Bulletin of the United States National Museum 297: i–viii, 1–293. http://doi.org/10.5479/si.03629236.297.1

Rivas AR, Molina CR, Ugueto GN, Barros TR, Barrio-Amoros CL, Kok PJR (2012) Reptiles of Venezuela: an updated and commented checklist. Zootaxa 3211: 1–64.

Sabaj MH (2016) Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an Online Reference. Version 6.5. American Society of Ichthyologists and Herpetologists. http://www.asih.org/resources/standard-symbolic-codes-institutional-resource-collections-herpetology-ichthyology. Accessed on: 2016-08-16

Uzzell TM (1973) A revision of lizards of the genus *Prionodactylus*, with a new genus for *P. leucostictus* and notes on the genus *Euspondylus* (Sauria, Teiidae). Postilla 159: 1–67.

Vaz-Silva W, Oliveira RM, Gonzaga AFN, Pinto KC, Poli FC, Bilce TM, Penhacek M, Wronski L, Martins JX, Junqueira TG, Cesca LCC, Guimarães VY, Pinheiro RD (2015) Contributions to the knowledge of amphibians and reptiles from Volta Grande do Xingu, northern Brazil. Brazilian Journal of Biology 75 (3) (Supplement): 205–218. http://doi.org/10.1590/1519-6984.00814BM

Zaher H, Prudente ALC (2003) Hemipenis of *Siphlophis* (Serpentes, Xenodontinae) and techniques of hemipenial preparation in snakes: a response to Dowling. Herpetological Review 34: 302–307.