



A new species of narrow-mouthed frog of the genus *Chiasmocleis* Méhelÿ 1904 (Anura, Microhylidae) from the Amazonian rainforest of Brazil

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Abstract

A new species of microhylid frog of the genus *Chiasmocleis* from the Amazonian rainforest of northern Brazil, in the states of Amazonas, Mato Grosso, Pará and Rondônia, is described and illustrated. The new species is characterized by the combination of: large size for the genus; robust body; finger I well developed; toe I developed; toes of males extensively webbed, of females basally webbed; toes fringed; dermal spines on the anterior portion of chin in males. An osteological description and brief notes on natural history are also given. Tadpole and advertisement call are unknown. The species was found in several herpetological collections misidentified as *Chiasmocleis bassleri*, *C. shudikarensis* or *C. ventrimaculata*, and a comparison with those species and comments on the taxonomy of the genus are provided.

Key words: Amphibia, taxonomy, osteology, dermal spines, natural history

Resumo

Uma nova espécie de sapo da família Microhylidae, gênero *Chiasmocleis*, da Floresta Amazônica do Brasil, estados do Amazonas, Mato Grosso, Pará e Rondônia, é descrita e ilustrada. A nova espécie é caracterizada pela combinação dos seguintes caracteres: tamanho grande para o gênero; corpo robusto; dedo I bem desenvolvido; artelhos dos machos com membranas bem desenvolvidas, das fêmeas com membrana basal; artelhos com franjas dérmica; espinhos dérmicos na porção anterior do queixo nos machos. Descrição da osteologia e notas sobre a história natural são fornecidas. O girino e o canto de anúncio da espécie são desconhecidos. A nova espécie foi encontrada em diversas coleções herpetológicas identificada como *Chiasmocleis bassleri*, *C. shudikarensis* ou *C. ventrimaculata*, e comparações entre o novo táxon e essas espécies são fornecidas, juntamente com comentários sobre a taxonomia do gênero.

Palavras-chave: Amphibia, taxonomia, osteologia, espinhos dérmicos, história natural

Introduction

The genus *Chiasmocleis* Méhelÿ, 1904 consists of 22 species distributed from Panamá through most of South America (Frost 2008). Seven of those species are currently associated with the Amazonian rainforest of northern South America: *Chiasmocleis anatypes* Walker & Duellman, 1974; *C. bassleri* Dunn, 1949; *C. hudsoni* Parker, 1940; *C. jimi* Charamaschi & Cruz, 2001; *C. magnova* Moravec & Köhler, 2007; *C. shudikarensis* Dunn, 1949; and *C. ventrimaculata* (Andersson, 1945).

Many microhylid genera, including *Chiasmocleis*, are diagnosed based on a few osteological characters; furthermore many species are morphologically similar, rendering the taxonomy of the group problematic. It

has been previously suggested that *Chiasmocleis* may not be monophyletic (Walker & Duellman 1974; Caramaschi & Cruz 2001; Moravec & Köhler 2007) but no evidence has been presented to support or refute the monophyly of the genus.

During fieldwork in Rio Xingu in the state of Pará, Brazil, we collected three specimens of an undescribed species of microhylid resembling members of the genus *Chiasmocleis*. Subsequently, additional specimens were found deposited in several herpetological collections misidentified as either *C. bassleri*, *C. shudikarensis* or *C. ventrimaculata*. We studied the osteology and the geographical variation of the new species. The pectoral girdle elements of these specimens, herein described as a new species, suggest that they belong to the genus *Chiasmocleis* (Parker 1934; Carvalho 1954).

Material and methods

We analyzed a total of 277 specimens of *Chiasmocleis*, 115 of them representatives of the new species described herein. Specimens examined are listed in Appendix I and in the species description, and are deposited in the following institutions: American Museum of Natural History, New York, New York, USA (AMNH); Célio F.B. Haddad Collection, Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil (CFBH), Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil (INPA); University of Kansas Museum of Natural History, Lawrence, Kansas, USA (KU); Museu Nacional, Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ); Museu Paraense Emílio Goeldi, Belém, Pará, Brazil (MPEG); Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZUSP); Universidade Federal do Acre, Rio Branco, Acre, Brazil (UFAC); Smithsonian Institution, National Museum of Natural History, Washington, District of Columbia, USA (USNM); Universität Hamburg Zoologisches Institut und Museum, Hamburg, Germany (ZMH).

Measurements were taken with an electronic caliper (to the nearest 0.1 mm) under a stereomicroscope as follows: SVL (snout-vent length); HL (head length; from snout to angle of the jaw); HW (head width; between the angle of jaws); ED (eye diameter; between anterior and posterior corner of the eye); IOD (inter-orbital distance; distance between anterior corner of the eyes); IND (inter-narial distance); END (eye-nostril distance; from the anterior corner of the eye to the posterior margin of nostril); THL (thigh length; from the middle of the cloacal opening to the outer edge of the flexed knee); TBL (tibia length; from the outer edge of the flexed knee to the heel); FL (foot length; from tibio-tarsal articulation to tip of fourth toe); 3FD (diameter of third finger disk diameter); 4TD (diameter of fourth toe disk). Fingers are numbered from inside to outside from I–IV for consistency with other works. Two paratopotypes, one male (MPEG 23318) and one female (MPEG 23324), were cleared and double stained for osteological observations following the technique by Taylor and Van Dyke (1985).

Sex was determined by presence of vocal sac and vocal slits (males), by the presence of eggs in abdominal cavity (females) or by dissection and checking for the presence of oviducts/ovaria.

Results

Chiasmocleis avilapiresae sp. nov.

Figs. 1–7; Table 1

Holotype. MPEG 23299 (field number MAR 979), an adult female, from Estação Científica do Programa Pró-Biodiversidade da Amazônia (PPBio), Floresta Nacional Caxiuanã, municipality of Portel, state of Pará, Brazil (~ 1°59'S, 51°39'W; represented by a star in Fig. 9), collected in a pitfall trap by M.A. Ribeiro-Jr and S.H. Abrantes on 27 March 2007.



FIGURE 1. *Chiasmocleis avilapiresae* **sp. nov.** from Anapu, Rio Xingu, Pará, Brazil. Adult female in life (paratype, MPEG 23279). SVL = 33.5 mm.

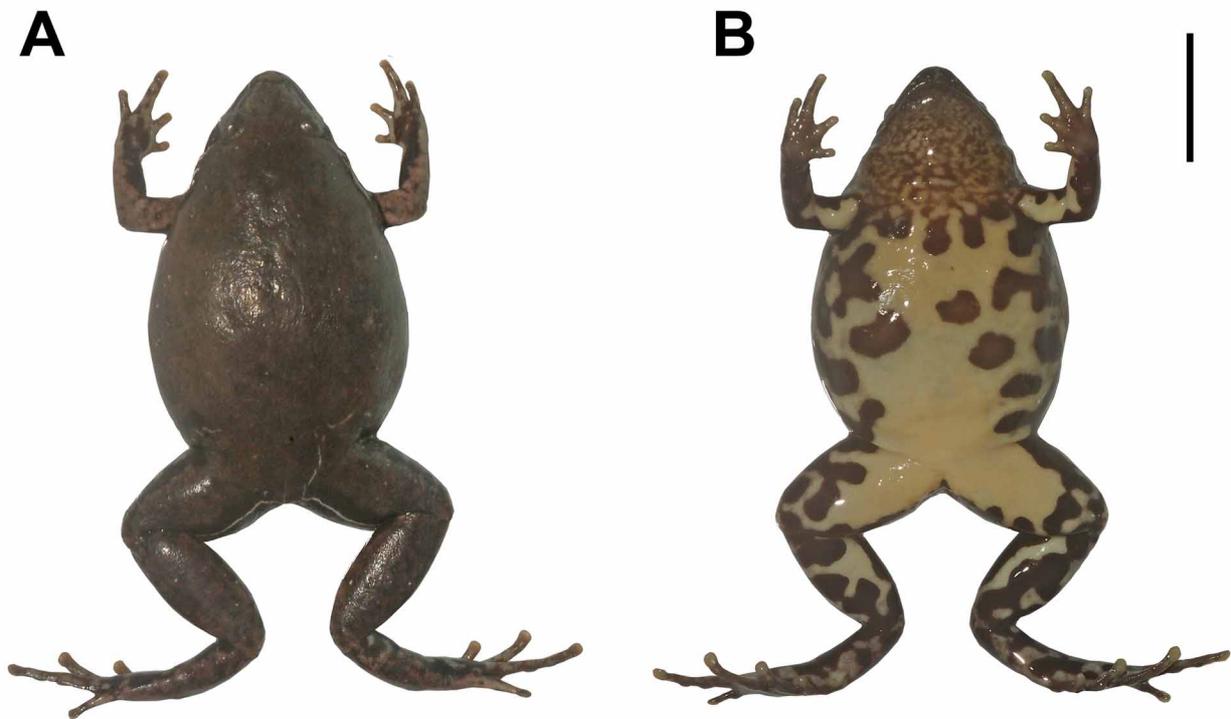


FIGURE 2. *Chiasmocleis avilapiresae* **sp. nov.** (holotype, MPEG 23299). (A) Dorsal and (B) ventral views. Scale bar = 10 mm.

Paratopotypes. MPEG 23300–06, 23318, seven adult females and one adult male respectively, collected by M.A. Ribeiro-Jr. and D.L. Arcoverde, on 26 January to 13 February 2007; MPEG 23307-17, 23319-26, 17 females and two males, collected by M.A. Ribeiro-Jr and S.H. Abrantes, on 16 March to 2 April 2007. MPEG 23318 and 23324 are cleared and stained; MPEG 23303 was dissected for myological studies.

Paratypes (numbers in parenthesis refer to localities in Fig. 9). INPA 17258-59, two females, from (1) Reserva Extrativista do Baixo Juruá, Rio Juruá, Juruá, state of Amazonas, Brazil (~ 3°45'S, 66°05'W), collected by V.T. Carvalho, S. Novelle and L. Lopes, on 20–29 May 2006; MPEG 5169, adult female, from (2) Porto Urucu, Amazonas, Brazil (~ 4°53'S, 65°20'W), collected by M.S. Hoogmoed and T.C. Ávila Pires, on 21 November 1989; INPA 14218, 14224, two females, from (3) Lago Ayapuã, Rio Purus, Beruri, Amazonas, Brazil (~ 4°24'S, 62°15'W), collected by F. Waldez, on 1-30 June 2005; USNM 266139–41, three adult males, from (4) Cachoeira Nazaré, western bank of Rio Ji-Paraná, state of Rondônia, Brazil (~ 9°45'S, 61°55'W), collected by A.L. Gardner, on 18–23 November 1986; USNM 284500–01, 565956, one female and two males, respectively, from (5) Nova Brasília, Rondônia, Brazil (~ 11°09'S, 61°34'W) and USNM 565955, female, from (6) Rio Morim, Nova Colina, Rondônia, Brazil (~ 10°50'S, 61°43'W); collected by P.E. Vanzolini, R.I. Crombie and C.M. de Carvalho, 2–8 November 1984; CFBH 5132-33, an adult female and a juvenile respectively, from (7) Fazenda Jaburi, Espigão D'Oeste, Rondônia, Brazil (~ 11°36'S, 60°44'W), collected by P.S. Bernarde, on 2–14 April 2001; INPA 13102, female, (8) Igarapé Estrema, Left bank of Rio Aripuanã, Aripuanã, Amazonas, Brazil (~ 6°17'S, 60°23'W), collected by the INPA Herpetology field expedition, on 3 May 2005; MNRJ 14231–80 respectively, 31 females, 13 males, five juveniles and one of undetermined sex, from (9) Aripuanã, state of Mato Grosso, Brazil (~ 10°10'S, 59°28'W), collected by U. Caramaschi and R.N. Feio, on 1–5 November, 2005; MPEG 18571–73, 23287–98, three adult females and 12 juveniles from (10) Acampamento base Sapopema, Parque Nacional da Amazônia, Itaituba, Pará, Brazil (~ 04°40'S, 56°33'W), collected by M.S. Hoogmoed and H.S. Silva-Filho, on 26 January to 18 February 2005; MPEG 23280, adult female, from (11) Tapuama, Rio Xingu, Altamira, Pará, Brazil (3°36'39''S, 52°20'26''W), collected by R. Bernardi and D. André, on 6 March 2008; MPEG 23277–79, three adult females, from (12) Fazenda Caracol, Rio Xingu, Anapu, Pará, Brazil (3°27'10''S, 51°40'31''W) collected by A. Lima, F. Rodrigues, M.J. Sturaro, and P.L.V. Peloso, on 15 March 2008; MPEG 22787, one adult female, from (13) Fazenda Riacho, Monte Verde, Portel, Pará, Brazil (~ 3°15'S, 50°19'W), collected by J.O. Gomes and T.C. Ávila-Pires on 23 March 2007; MPEG 23338, one female, from (14) Barragem da Pêra, Serra dos Carajás, Parauapebas, Pará, Brazil (~ 6°04'S, 49°54'W), collected by E. Carvalho-Jr and J.A. Chaves on 27 January 2005; MPEG 23339-41, three females, from (15) Noroeste II, Serra dos Carajás, Parauapebas, Pará, Brazil, (~ 6°04'S, 49°54'W), collected by E. Carvalho-Jr and J.A. Chaves on 1 November to 30 December 2005.

Diagnosis. A member of *Chiasmocleis* based on: (1) clavicle and procoracoid present; (2) clavicle reduced, not reaching the scapula, extending beyond medial part of coracoid; (3) procoracoid touching the coracoids; (4) palatines absent.

A large species for the genus; maximum SVL = 26.8 mm in males and 37.8 mm in females. Body ovoid and robust, head triangular, snout rounded in dorsal and lateral views, IOD about 2–3 times the IND. Four distinctive fingers and five toes present; all but first finger fringed in males, less fringed in females; fingers not webbed; finger I well developed with a distinct subarticular tubercle present between the proximal phalanges; distinct subarticular tubercles present on all fingers; toes fringed, less distinct in females; toes usually extensively webbed in males and only basally webbed in females (see Variation below). Males with dermal spines on fingers and toes; both sexes with dermal spines on dorsum and toes, more numerous and more developed in males. Males with many spines on anterior portion of chin. A light horizontal line on the posterior thigh is always present. *Chiasmocleis avilapiresae* is further characterized by having procoracoids and clavicles; clavicles do not reach the coracoids and they are entirely supported by the procoracoid cartilage; coracoids do not meet medially; procoracoids calcified near their contact with the coracoids; epicoracoids and anterior area of

sternum slightly calcified. Eight procoelous presacral vertebrae present; sacral diapophyses expanded laterally; urostyle without lateral expansions; phalangeal formula of hands 2-2-3-3 and of foot 2-2-3-4-3.

Description of the holotype (Figs. 2, 3). Body ovoid, robust; head short, triangular, snout short, wider than long, rounded in dorsal and lateral views; nostril not protuberant, directed anterolaterally; internarial distance slightly smaller than distance between eye and nostril and about the same as the eye diameter; canthus rostralis only slightly defined; loreal region oblique, slightly convex; eyes small, slightly protruding; interorbital area slightly concave, without cranial crests; occipital fold absent; postorbital fold present, tympanum not visible externally; upper jaw projecting beyond lower; lower lip with truncate, trilobed anterior margin; tongue large, ovoid, covering approximately $\frac{3}{4}$ of mouth floor, with free lateral and posterior borders; choanae small, rounded, widely separated, positioned anterolaterally, anterior to eye; vomerine teeth absent.

Arm and forearm slender, without tubercles or crests. Hand not webbed, fingers slightly fringed, fingers without dermal spines; finger I well developed, with a visible subarticular tubercle; relative finger length $I < II < IV < III$; finger tips with small disks, except in finger I. Subarticular tubercles well developed, nearly rounded; supranumerary tubercles absent; palmar tubercle large, divided into two parts, inner larger, rhomboid, outer smaller ovoid; thenar tubercle large, rounded, at base of finger II.

Legs short (combined THL, TBH and FL lengths 1.5 times the SVL), relatively robust; lacking tubercles; tibial and tarsal ridges absent; foot basally webbed, webbing formula $I2^- - 3II2^- - 3^+III2^+ - 4IV4^+ - 2^+V$; toes with well developed disks in all but first finger; fringes present on unwebbed portions of toes. Relative toe length $I < II < V < III < IV$; toes lack dermal spines; subarticular tubercles well developed; supranumerary tubercles absent; inner metatarsal tubercle present, oval, outer metatarsal tubercle absent.

Skin smooth with very few scattered dermal spines on dorsum, slightly more numerous around the cloacal region; absent ventrally and on members.

Measurements of the holotype (mm). SVL 34.9, HL 6.9, HW 9.6, ED 2.2, IOD 5.3, IND 2.3, END 2.7, THL 13.9, TBL 14.6, FL 22.4, 3FD 0.7, 4TD 1.1.

Color of the holotype in preservative. Dorsum uniformly greyish brown; arm olive brown; forearm dark brown at inner side and olive brown at outer side; fingers cream with dark spots; dorsal surfaces of thigh and tibia same color as dorsum; cloacal region and posterior surface of thigh dark brown with a transverse white line on each side above; throat cream with brown reticulation; belly cream with irregular brown spots; ventral surface of thigh cream with few dark brown spots; ventral surface of tibia cream with several dark brown spots. Color in life of the holotype is unavailable.

Variation. Measurements of the type specimens are given in Table 1. The species shows marked sexual dimorphism, with females being larger than males (Student's *t* test for SVL; $t=9.894$, $df=89$, $p=0.000$). Fingers slightly fringed in both sexes, fringes more developed in males; fingers with dermal spines in males, absent in females. Toes with dermal spines in males, lacking or very few spines in females. Males and females with dermal spines on body, spines in males more developed and more numerous, sometimes lacking in females. Males with many spines on anterior portion of chin (Fig. 6), absent in females. Females may present several spines around the cloaca. Variation in male and female foot webbing formula are, respectively: $I(1^+ - 1^+) - (2^+ - 2^+)II(2 - 1^+) - (3^+ - 2^+)III(2^- - 1^+) - (3^+ - 2^-)IV(4 - 2^-) - (2^- - 1^+)V$ and $I(2 - 2^-) - (3 - 3^+)II(2 - 2^-) - (4 - 3^+)III(3^- - 2^-) - (4^+ - 3^-)IV(4 - 4^+) - (3 - 2)V$.

A mid-dorsal light stripe is present in about 20% of the individuals examined. The light horizontal stripe on the posterior portion of the thigh is invariably present in all specimens. Throat pattern varies from uniformly light to uniformly dark (generally in males); however, most specimens show a reticulated pattern of dark marks against a light background (Fig. 7). Venter varies from light with almost no dark markings to having a few small scattered small brown to black dots and from having few large spots to showing a reticulated pattern, with dark markings against a light venter.

Variation of color in life; MPEG 18571 (field notes by M.S. Hoogmoed): Dorsum brown with indication of slightly lighter dorso-lateral bands. Forelimbs beige. Belly white, with large black spots at perimeter of

belly and under thighs. Ventral side of shanks with black and white marbling. A narrow white line on posterior surface of thigh.

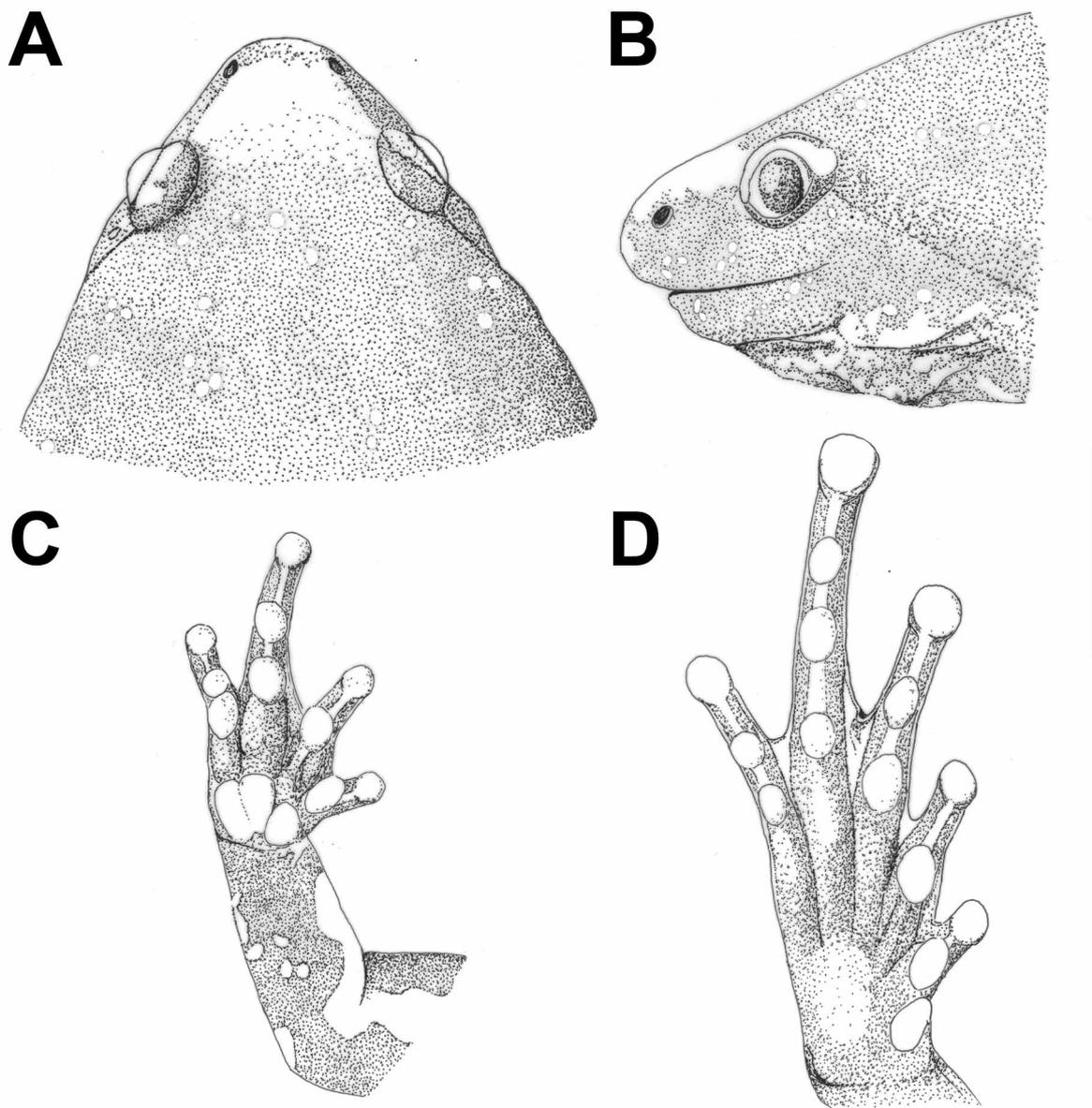


FIGURE 3. *Chiasmocleis avilapiresae* sp. nov. (holotype, MPEG 23299). (A) Dorsal and (B) lateral views of head; and ventral views of (C) right hand and (D) right foot. Scale bar = 5 mm.

MPEG 23279 (Fig. 1; our own field notes): Snout whitish. Dorsum greyish brown with scattered white spots; dorsolateral region reddish. Forelimbs yellow. Hindlimbs marbled with red, brown and grey tones. Throat, belly and under surface of thigh cream with dark brown spots. A narrow horizontal white line on back of thighs.

MPEG 23287 (fieldnotes by M.S. Hoogmoed): Dorsum grey brown with small white spots, white spots also present on hind limbs. Forelimbs orange-yellow. A narrow white line on back of thighs.

Osteology. Description based on two cleared and stained specimens (one male, MPEG 23318; and one female, MPEG 23324). The skull of *C. avilapiresae* is slightly wider than long (about 1.1 times), with its widest point at the angle of the jaws. The nasals are not in contact medially, although very close; nasals are in contact or just overlap the frontoparietals posteriorly. Frontoparietals paired, not in contact medially, overlap posterolaterally with the prootic and posteriorly with the exoccipital. Maxillary arch incomplete, maxilla do

not reach the quadratojugal, which is much reduced. Alary process of the premaxilla almost vertical. Vomer present, divided in an anterior and a posterior portion; posterior portion of the vomer apparently fused to the sphenetmoid. Palatines are absent.

TABLE 1. Measurements of type specimens (20 males, 71 females) of *Chiasmocleis avilapiresae* **sp. nov.** Abbreviations are listed in Material and Methods. *SD* = standard deviation. Juveniles and specimens with missing values excluded.

	Males (n = 20)			Females (n = 71)		
	Mean	SD	Range	Mean	SD	Range
SVL	24.2	1.6	22.2–26.8	31.9	3.4	23.6–37.8
HL	5.4	0.3	4.8–6.0	6.5	0.6	5.2–8.1
HW	6.5	0.6	5.8–7.7	7.9	0.8	6.3–9.6
ED	1.7	0.3	1.3–2.3	1.9	0.2	1.4–2.3
IOD	4.0	0.3	3.5–4.4	4.8	0.5	3.9–5.7
IND	1.7	0.2	1.4–2.0	2.0	0.2	1.5–2.9
END	1.9	0.2	1.6–2.3	2.4	0.3	1.7–3.0
THL	11.3	0.8	9.6–13.1	13.5	1.2	10.8–16.4
TBL	11.2	0.7	10.4–12.8	13.7	1.3	11.2–16.5
FL	17.1	1.0	16.1–18.9	20.7	2.0	17.0–25.5
IIIFD	0.6	0.1	0.5–0.7	0.7	0.1	0.5–0.9
IVTD	1.0	0.1	0.7–1.1	1.1	0.2	0.7–1.4

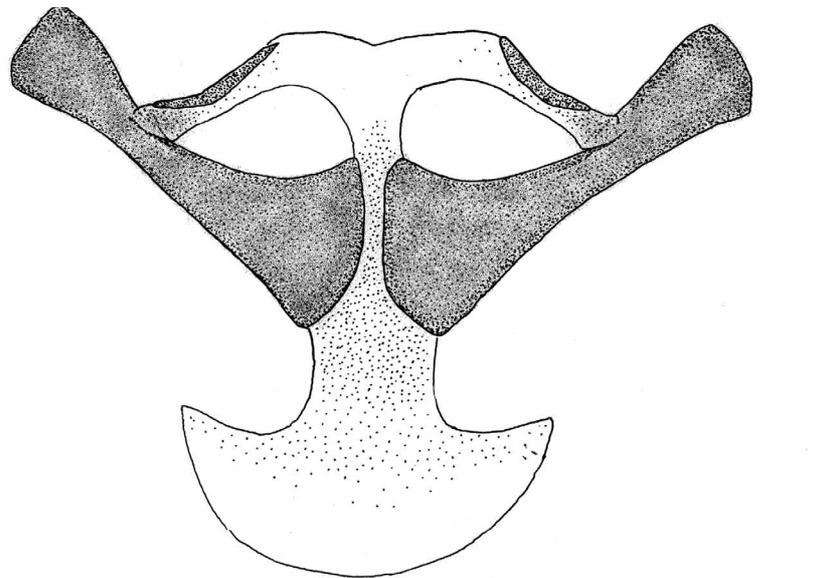


FIGURE 4. Pectoral girdle of *Chiasmocleis avilapiresae* **sp. nov.** (male, paratype, MPEG 23318). Pigmented areas are mineralized. Scale bar = 3 mm.

Pectoral girdle with procoracoid cartilages and clavicles present; omosternum not present; sternum present, broad, with round posterior margin, mainly cartilaginous but it shows some degree of mineralization in the anterior portion (Fig. 4). Coracoids do not touch or overlap medially; procoracoid in contact with coracoid. Clavicles slightly curved (MPEG 23324) to almost straight (MPEG 23318), entirely supported by procoracoid cartilage; clavicles not in contact laterally with coracoids, with which it forms an acute angle; clavicles broadly separated medially.

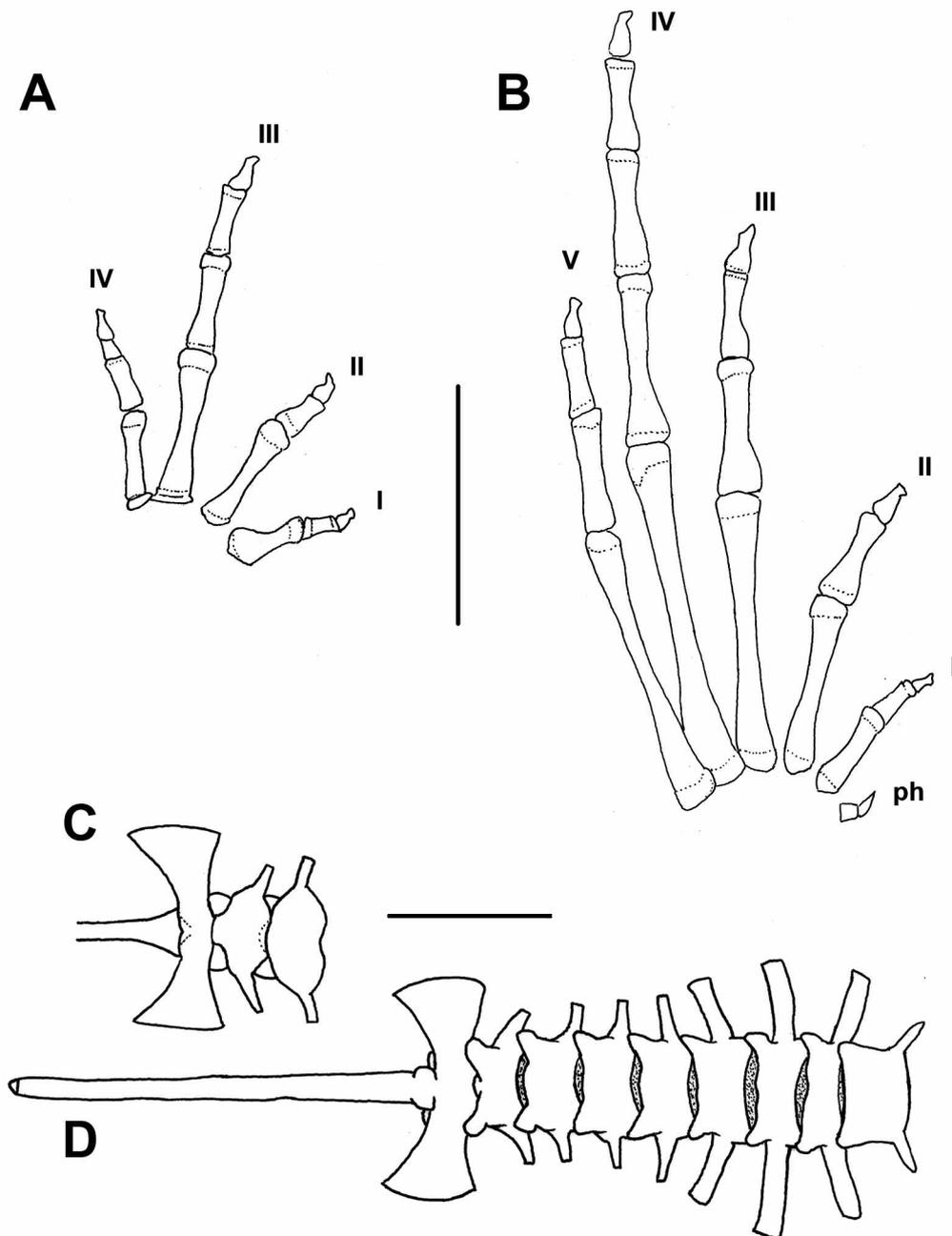


FIGURE 5. Phalanges of (A) right hand and (B) right feet; (C) ventral and (D) dorsal views of the vertebrae of *Chiasmocleis avilapiresae* **sp. nov.** (male, paratype, MPEG 23318). Fingers and toes are numbered from inside to outside. ph, prehallux. Scale bars = 3 mm.

Eight presacral vertebrae, all procoelous (Fig. 5). All presacrals with lateral processes; process more robust in presacrals II, III, and IV; processes projected anteriorly in Presacrals I, II, VII and VIII; projected posteriorly in presacrals III and IV, slightly posteriorly in presacral V; process in presacral VI is perpendicular to the vertebral column axis. Sacral diapophyses expanded laterally; urostyle without lateral projections.

Phalangeal formula in hands 2-2-3-3, and in foot 2-2-3-4-3 (Fig. 5). Terminal phalanges knobbed, with irregularly expanded tips (Fig. 5). Prepollical and prehallical elements present.



FIGURE 6. Ventral view of the head of an adult male *Chiasmocleis avilapiresae* sp. nov. (paratype, MNRJ 44260) showing dermal spines on the anterior portion of chin.

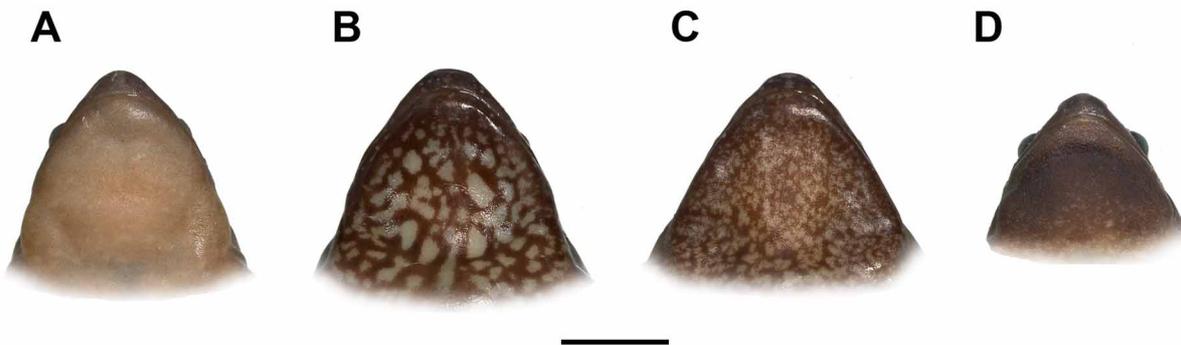


FIGURE 7. Variation in throat color pattern in the type series of *Chiasmocleis avilapiresae* sp. nov. (A) MNRJ 44280, female; (B) MPEG 23311, female; (C) MPEG 23279, female; (D) MNRJ 44232, male. Scale bar = 5 mm.

Etymology. The specific epithet honors Dr. Teresa C. S. de Ávila Pires, “T.C.”, professor and researcher at the Museu Paraense Emílio Goeldi. Teresa has worked to understand and protect the Amazonian herpetofauna for over 20 years, focusing mainly on the taxonomy, systematics and biogeography of lizards.

Distribution. Known from scattered localities in the Brazilian Amazon basin, south of the Solimões and Amazonas rivers, in the states of Amazonas, Mato Grosso, Pará, and Rondônia (Fig. 9).

Natural history. R.I. Crombie’s fieldnotes note that specimens from Nova Colina and Nova Brasília, Rondônia, were collected in primary forest or in clearings/pastures. Specimens occurred near isolated pools in stream flood plain, always on the bank of ponds distant 0.5–1 m from water, under leaves or pieces of bark. Crombie’s notes do not mention calling activity.

Specimens from Anapu, Itaituba and from the type locality (Caxiuanã, Pará) were collected in pitfall traps inside primary forest. Other microhylids collected in the same areas were *Chiasmocleis jimi*, *Ctenophryne geayi*, and *Hamptophryne boliviana*. *Chiasmocleis avilapiresae* occurs in sympatry with *C. bassleri* in at least three localities (Espigão do Oeste, Rondônia; Aripuanã, Mato Grosso and Itaituba, Pará). In Caxiuanã several specimens of the new species were found in stomachs of *Ceratophrys cornuta*, and one specimen was regurgitated by a *Leptodactylus paraensis* (M.A. Ribeiro-Jr, personal communication). A gravid female from the type locality contained approximately 1920 eggs. Advertisement call and tadpoles are unknown.

Comparisons

Chiasmocleis avilapiresae differs from all other species in the Amazonian rainforest by its larger size (maximum recorded SVL 26.8 mm in males and 37.8 mm in females); *C. anatipes* (20.0 mm in males, 30.0 mm in females; Rodriguez & Duellman 1994); *C. bassleri* (21.5 mm in males, 27.7 mm in females); *C. jimi* (19.8 mm in males, 28.8 mm in females); *C. hudsoni* (18.0 mm in males, 20.0 mm in females; Lima *et al.* 2006); in *C. magnova* (18.3 mm in females, males unknown; Moravec & Köhler 2007); *C. panamensis*, (24.3 mm in males, 26.3 mm in females; Nelson 1972), *C. shudikarensis* (24.5 mm in males, 29.0 mm in females), and *C. ventrimaculata* (23.1 mm in males, 27.3 mm in females). The size of *C. avilapiresae* females is approached by *C. albopunctata* (Boettger, 1885) (maximum SVL in females 38.0 mm; Caramaschi & Cruz 1997) and *C. schubarti* (34.5 mm; Cruz *et al.* 1997). *Chiasmocleis avilapiresae* is differentiated from both *C. albopunctata* and *C. schubarti* by extensive webs between the toes in males (absent in both species), by the presence of dermal spines on the anterior portion of the chin in males (absent), and by distinctly different color patterns. *C. albopunctata* presents irregular white blotches on the dorsum, arms and legs (absent in *C. avilapiresae*), while the venter of *C. albopunctata* is dark with irregularly distributed whitish blotches (white with dark spots in *C. avilapiresae*).

Additionally, extensive foot webbing in males sets *C. avilapiresae* apart from *C. bassleri*, *C. hudsoni*, *C. jimi*, *C. panamensis*, and *C. ventrimaculata* (all lacking webs or only basally webbed). Among Amazonian forms, extensive webbing was only reported for *C. anatipes* (Walker & Duellman 1974). Dunn (1949) when describing *C. shudikarensis* reported basal webbing present in his single specimen. We examined the holotype of *C. shudikarensis* (AMNH 43674), it is a female specimen in very good condition, and its toes are indeed only basally webbed. However, male specimens of *C. shudikarensis* from Brazil and French Guiana (examined by us), and from Surinam (M.S. Hoogmoed, personal communication) have extensive webbing on feet.

C. avilapiresae was found in several collections, misidentified as *C. bassleri*, *C. shudikarensis* and *C. ventrimaculata* (Fig. 8). However, the new species is differentiated from both *C. bassleri* and *C. ventrimaculata* by the basal webbing of the toes in the latter two species. *C. avilapiresae* also differs from *C. bassleri* by its longer first finger (visibly shorter in *C. bassleri*) and a less developed and hardly visible subarticular tubercle on the same finger in *C. bassleri*. Additionally, examined specimens of *C. bassleri* exhibit a dark inguinal spot (absent in the new species). According to the original description, the inguinal spot was present in the holotype of *C. bassleri* (AMNH 42699; Dunn 1949), but unfortunately it now has completely faded. Moravec and Köhler (2007) reported a tympanum completely covered by muscles in *C. bassleri*, whereas in the new species the tympanum is only covered posterodorsally by the *depressor mandibulae* muscle, similar to what is shown for *Elachistocleis cf. bicolor* by Manzano *et al.* (2003). The new species differs from *C. shudikarensis* by its more robust body (slender in *C. shudikarensis*) and in having slender fingers with less pronounced fringes in males (robust fingers and more extensive fringes in *C. shudikarensis*) and less developed subarticular tubercles. The throat of the holotype of *C. shudikarensis* presents a narrow light median line (never present in *C. avilapiresae*). This median line is present in some (Fig. 8A), but not all, specimens of *C. shudikarensis* from Manaus, Amazonas and Trombetas, Pará, Brazil, and is absent in all examined specimens from Petit Saut, French Guiana. Additionally, *C. avilapiresae* lacks an inguinal spot, present in all examined specimens of *C. shudikarensis*. Dunn (1949) described the inguinal spot of *C. shudikarensis* as “rather vague and irregular”, and we fully agree with that statement, because, although never absent, its size and shape varies greatly among specimens examined by us.

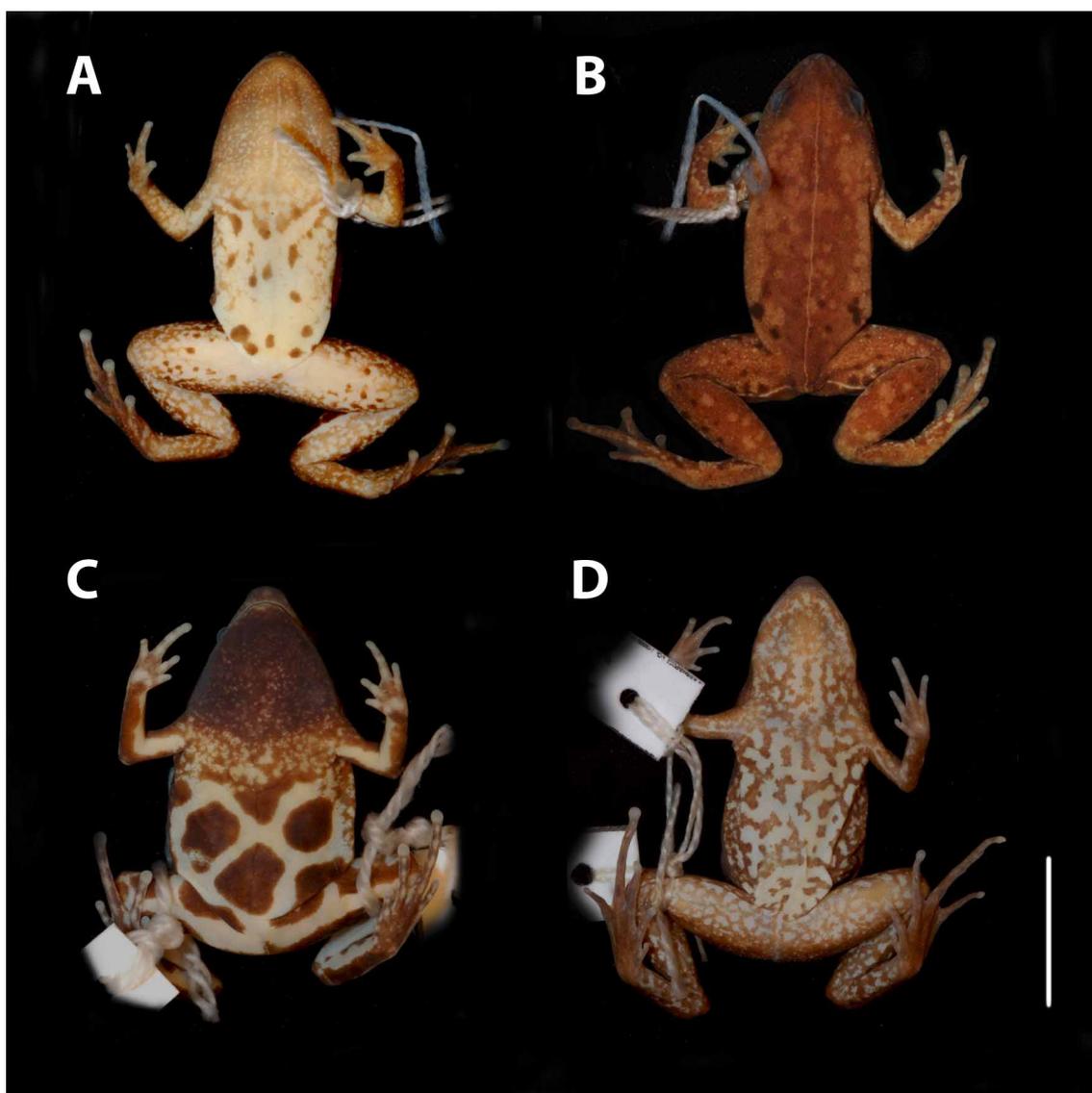


FIGURE 8. Preserved specimens of *Chiasmocleis* from the Amazonian Rainforest. (A) Ventral and (B) dorsal views of *Chiasmocleis shudikarensis*, MZUSP 60055; (C) ventral view of *C. bassleri*, KU 220478; and (D) ventral view of *C. ventrimaculata*, USNM 342660. Scale bar = 10 mm.

From *C. anatipes* the new species differs by its larger and more robust body (more slender in *C. anatipes*), by lack of extensive webbing in females (females extensively webbed in *C. anatipes*; Rodriguez & Duellman 1994), by presence of dermal spines on anterior portion of chin (absent in *C. anatipes*) and by color; dorsum is gray to grayish brown with reddish flanks in *C. avilapiresae*, while “dorsum dull olive-green to dull brown with green and/or gold metallic flecks” in *C. anatipes* (Walker & Duellman 1974).

As far as we are aware, among *Chiasmocleis*, the last presacral vertebrae being procoelous is only known in *C. avilapiresae* and *C. anatipes* (Walker & Duellman 1974). Unfortunately, in recent descriptions of *Chiasmocleis* little attention was given to osteological features, with the exception of the pectoral girdle elements (Caramaschi & Cruz 1997, 2001, Moravec & Köhler 2007).

Discussion

We observed high levels of morphological variation associated with geographic distribution among examined populations of *C. bassleri*, *C. shudikarensis*, and *C. ventrimaculata*. It is likely that part of the specimens

referred to those species belong to new taxa. Additional studies are being conducted to evaluate such variations. Several populations have been associated with those names without a detailed examination of anatomical structures, call, or molecular analyses (Duellman 1978; Nelson 1973; Rodriguez & Duellman 1994; Schlüter 2005, Bernarde 2007). The holotype of *C. bassleri* (AMNH 42699) is in poor condition and faded, and the type locality is vague (Rio Utoquinia to Rio Trapiche, Peru; Dunn 1949) rendering searches for topotypes unviable. We were unable to examine the holotype of *C. ventrimaculata* but had access to photos and notes on the specimen (Naturhistoriska Riksmuseet, Stockholm, Sweden; NHRM 1943), kindly made available by M.S. Hoogmoed. The holotype agrees well with the original description (Andersson 1945), and although not very well preserved (dried out) it is identifiable and clearly distinct of *C. avilapiresae* by its slender and smaller body, lack of the white line on posterior aspect of the thigh and by less developed subarticular tubercles.

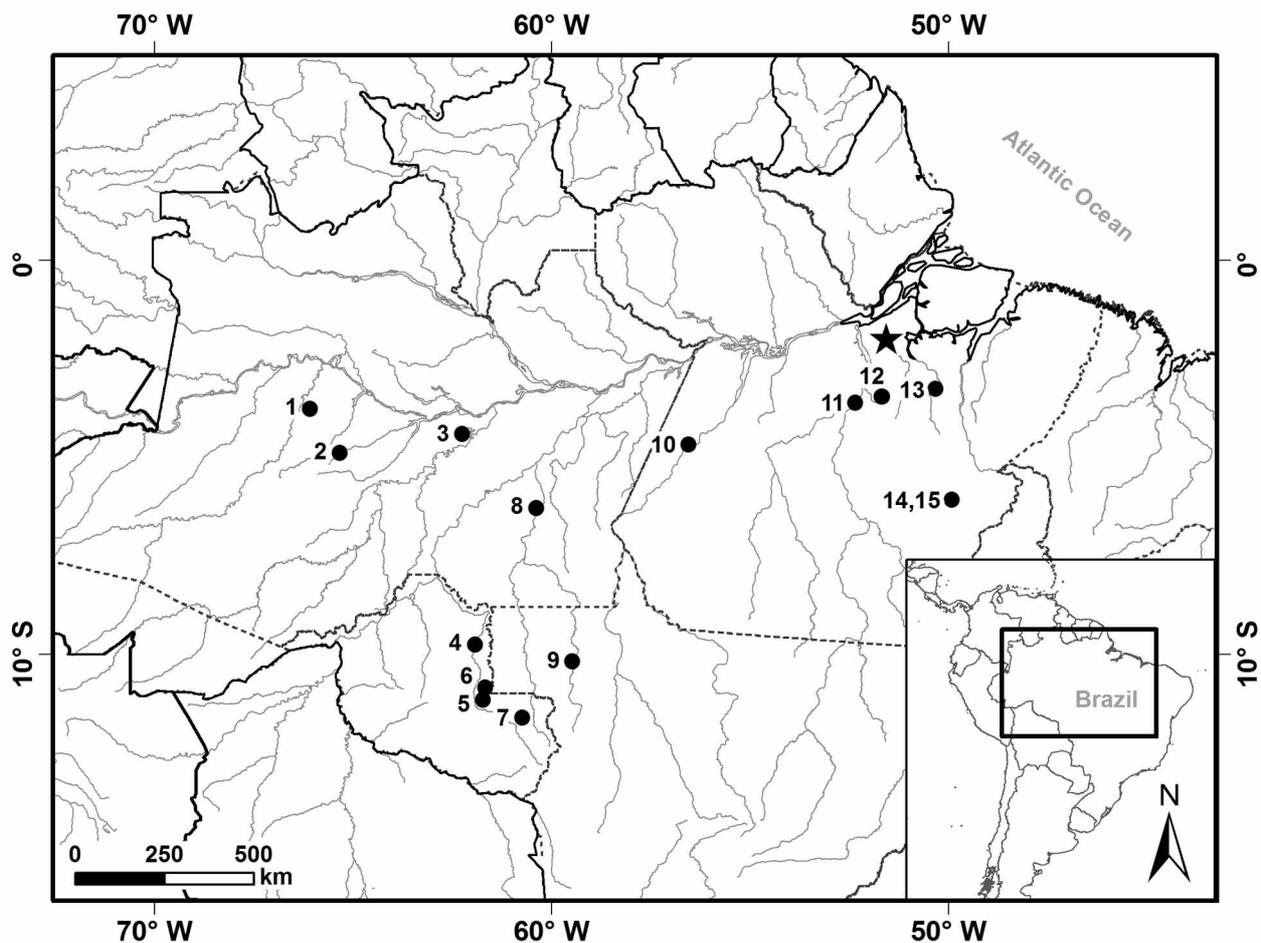


FIGURE 9. Geographic distribution of *Chiasmocleis avilapiresae* sp. nov. The star represents the type locality. Numbers refer to the localities cited in the text.

Despite recent efforts to elucidate the taxonomic status of populations of *Chiasmocleis* in the Brazilian Atlantic rainforest (Cruz *et al.* 1997, 1999, 2007), a modern revision of the genus over its entire distribution area is still needed. Several populations of northern South America with distinct morphological and color characters, that may represent distinct species, are being treated under the same name, without proper evaluation (see above). In addition to the morphological differences observed during the course of this work, putative call differences seems to exist at least among some of the populations assigned to *C. ventrimaculata* (Nelson 1973; Schlüter 2005).

Additionally, a modern phylogenetic analysis with extensive taxon sampling, combining molecular, morphological and reproductive data, is still lacking for Neotropical Microhylidae (Frost *et al.* 2006; Moravec & Köhler 2007). Such efforts may start to reveal cryptic lineages within many genera, including *Chiasmocleis*. Based on the large amount of species described recently and our knowledge of some others on the verge of being described, we think that diversity in the genus *Chiasmocleis* are likely underestimated.

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Appendix I. Additional material examined

Total number of specimens per species is in parentheses.

- Chiasmocleis albopunctata*** (6): **BRAZIL: Goiás:** U.H.E. Serra da Mesa, Minaçu (MPEG 9010-14); **Mato Grosso:** Querência (MPEG 21074)
- Chiasmocleis anatipes*** (1): **ECUADOR: Napo:** Santa Cecilia (UMMZ 132897, **paratype**)
- Chiasmocleis bassleri*** (28): **BRAZIL: Acre:** Reserva Extrativista Riozinho da Libertade, Tarauacá (UFAC 623); **Pará:** Parque Nacional da Amazônia, Rio Tapajós, Itaituba (MPEG 18574); Juruti (MPEG 22557); **ECUADOR: Napo:** Santa Cecilia (KU 124000, 150625, 150627); Lago Agrio (KU 126668); **PERU: Loreto:** Rio Utoquinia – Rio Tapiche, near the Brazilian border (AMNH 42699, **holotype**); Junction of Rio Sucusari & Rio Napo (KU 220478) 1.5 km North of Teniente Lopez (KU 222103-07); **Ucayali:** Balta, Rio Curanja (KU 197033-46).
- Chiasmocleis hudsoni*** (14): **BRAZIL: Amazonas:** Reserva INPA/WWF (MZUSP 64565, 64567-68); Rio Baria, Rio Negro (USNM 562555-57); **Pará:** UHE Cachoeira Porteira, Rio Trombetas (INPA 528-35).
- Chiasmocleis jimi*** (26): **BRAZIL: Pará:** Parque Nacional da Amazônia, Rio Tapajós, Itaituba (MPEG 18540-60); Fazenda Caracol, Rio Xingu, Anapu (MPEG 23281-85).
- Chiasmocleis magnova*** (1): **PERU: Loreto:** 3 km SSW of Mishana, Rio Nanay (AMNH 103550).
- Chiasmocleis shudikarensis*** (35): **BRAZIL: Amazonas:** Reserva INPA/WWF, Manaus (MZUSP 60035-39, 60041-49, 60051-52, 60059, 60061-63); **Pará:** UHE Cachoeira Porteira, Rio Trombetas (INPA 245, 277-78, 289, 320); **FRENCH GUIANA:** 20 km Petit Saut, River Sinnamary (MPEG 5029–33, 5060), Petit Saut, River Sinnamary (MPEG 5106-07, 5121); **GUYANA:** Shudikar-Wau, Upper Essequibo River, not far from Brazilian border (AMNH 43674, **holotype**).
- Chiasmocleis panamensis*** (2): **PANAMA: Old Panama:** (AMNH 52741, **holotype**; 53764, **paratype**).
- Chiasmocleis ventrimaculata*** (49): **BRAZIL: Acre:** Reserva Extrativista Riozinho da Libertade, Tarauacá (UFAC 641, 767, 810, 866, 897, 910, 927) Amazonas: Amanã, (INPA 9234-38); **ECUADOR: Morona-Santiago:** Miazal (USNM 236949–53); **PERU: Cuzco:** Kinkariari Creek, Rio Urubamba (USNM 538243); **Madre de Dios:** 15 km East of Puerto Maldonado, Cuzco Amazonico, (KU 205776, 206632, 206634-35, 215540-41). Manu National Park, Rio Manu, Pakitza (USNM 342660, 345292); Puerto Maldonado (USNM 343033, 343266–68); Rio Yullapichis, Panguana (ZMH 2255-58, 2260-63, 2442–50); **Sucumbios:** Santa Cecilia (KU 105255, 150665).