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Authors: Miquéias Ferrão, Jiří Moravec, Igor Luis Kaefer, Rafael de Fraga, and Albertina Pimentel Lima
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New Species of *Scinax* (Anura: Hylidae) with Red-Striped Eyes from Brazilian Amazonia

Miquéias Ferrão,[1,2,3] Jiří Moravec,[4] Igor Luis Kaefer,[5] Rafael de Fraga,[1] and Albertina Pimentel Lima[2]

[1]*Programa de Pós-Graduação em Ecologia, Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil*
[2]*Coordenação de Biodiversidade (CBIO), Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil*
[4]*Department of Zoology, National Museum, Prague, Czech Republic*
[5]*Instituto de Ciências Biológicas, Universidade Federal do Amazonas, Manaus, Amazonas, Brazil*

Abstract.—**We describe a new small species of *Scinax* from the rain forests on the interfluve between Purus and Madeira Rivers, Brazilian Amazonia. The new species is diagnosed by snout–vent length 20.2−22.5 mm in males; a yellowish-bronze dorsum showing small spots along the body and limbs; a red stripe horizontally extended on the medial portion of the iris; posterior surface of thigh brown, in both live and preserved specimens. The advertisement call consists of two types: type A represents a series of multipulsed notes (note duration 0.097−0.115 sec, dominant frequency 2,541−3,015 Hz); type B consists of a single tonal note (note duration 0.015–0.019 sec, dominant frequency 2,584–2,950 Hz).**

The genus *Scinax* Wagler, 1820 consists of 72 species of small to medium sized treefrogs distributed from Mexico to southern South America (Frost, 2018). Currently, 30 *Scinax* species are known to occupy different habitats in the Amazonian lowlands (Sturaro and Peloso, 2014; Ferrão et al., 2016). Nevertheless, the diversity of Amazonian *Scinax* species is considerably underestimated attributable to insufficient sampling and misidentification of morphologically similar species (Ferrão et al., 2016). In fact, classifying *Scinax* species in the megadiverse Amazonian rain forests is a complex task that cannot be solved without an integrative approach to the taxonomy of this genus (e.g. Ferrão et al., 2016).

An example of commonly misidentified Amazonian *Scinax* species is *Scinax cruentommus* (Duellman, 1972a), a small sized treefrog with a red horizontal stripe on the iris, which was described from Santa Cecilia, Ecuador. During subsequent decades, the name *S. cruentommus* has been attributed to several populations from different parts of South America, such as French Guiana (Lescure and Marty, 2000; Salducci et al., 2002, 2005; Fouquet et al., 2007a,b), Colombia (Malambo-L and Madrid-Ordóñez, 2008), Peru (Duellman and Wiens, 1993), and Brazil (Zimmerman and Rodrigues, 1990; Souza, 2009; França and Venâncio, 2010; Bernarde et al., 2011, 2013; Carvalho et al., 2015; Ferrão et al., 2016). A comparison of morphological and genetic characteristics of the above populations, however, revealed that the name *S. cruentommus* actually is applied to several closely related but different species (Carvalho et al., 2015, Ferrão et al., 2016). This finding calls for a thorough taxonomic review of these cryptic species.

In a recent study, Ferrão et al. (2016) revealed the occurrence of three candidate-species of *Scinax* (*Scinax* sp. 1, *S.* sp. 4, and *S.* sp. 6) in the interfluve between the Purus and Madeira Rivers (PMI), in Brazilian Amazonia, that are genetically and morphologically close to *S. cruentommus*. The territory of the PMI is crossed by an abandoned Trans-Amazonian highway (BR-319), and current proposals to reconstruct this highway bring a very serious threat for regional forest habitats and their fauna (see Maldonado et al., 2012). Therefore, studies addressing species richness, species-habitat relations and describing new taxa from the territory of the PMI are of great importance for future actions addressing protection of the biological diversity of this area. Herein, we formally describe the first of the above-mentioned candidate species (*Scinax* sp. 1), which may be easily diagnosed by genetic, morphological, and bioacoustic characters.

Materials and Methods

Sampling and Storage.—We collected specimens during the rainy season in November 2013, at the Nascentes do Lago Jari National Park (5°56′40″S, 62°30′04″W, 71 m a.s.l., datum WGS84), near kilometer 450 of the highway BR-319, in the municipality of Tapauá (Amazonas, Brazil), PMI. We euthanized the specimens with a 2% benzocaine solution, preserved in 10% formaldehyde, and stored in 70% ethanol. We deposited the specimens in the Herpetological section of the zoological collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA-H).

Morphology.—We sexed specimens by observing the presence or absence of vocal sacs and vocal slits. We obtained morphometric data using a digital caliper 0.1 mm accuracy. We measured nine morphometric characters, following Duellman (1970): SVL (snout–vent length), HL (head length), HW (head width), ED (horizontal eye diameter), IND (internarial distance), IOD (interorbital distance), TD (horizontal tympanum diameter), TL (tibia length) and FL (foot length). Four additional measures followed Napoli (2005): END (eye–nostril distance), NSD (nostril to snout tip distance), 3FD (third finger disk diameter) and 4TD (fourth toe disk diameter). We followed Heyer et al. (1990) to measure length of tarsus (TAL), hand (HAL) and thigh (THL), and to describe the snout shape in dorsal and lateral view. Toe webbing formula follows Savage and Heyer (1967) and Myers and Duellman (1982). We described color in life based on field observations and digital photos.

Call Recording.—We recorded advertisement and territorial calls of one male in November 2013, at Tapauá, Amazonas State, Brazil. We used a ME 66 directional microphone (Sennheiser, Inc., Wedemark, Hanover, Germany) connected to a PMD 660 digital recorder (Marantz, Inc., Kawasaki, Kanagawa Prefecture, Japan) at sample rate of 44.1 kHz. We positioned the microphone approximately 1 m from the

[3]Corresponding Author. Email: uranoscodon@gmail.com
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acoustically active male and recorded calls at 2200 h at 25°C air temperature.

Call Description.—Oscillograms and spectrograms (Blackman window, 80 Hz of frequency resolution and 1024 of Discrete Fourier Transform-DFT) were generated in Raven 1.5 (Bioacoustics Research Program, 2014). We measured the following spectral and temporal parameters of the advertisement call type A: duration, number of pulses per note, pulse rate per second, upper, lower, and dominant frequencies, silent interval between calls and call repetition rate per minute. We measured the following spectral and temporal parameters of the advertisement call type B: duration, silent interval between the call type B and the previous call type A, and upper, lower, and dominant frequencies. The acoustic terminology followed Köhler et al. (2017), and the advertisement call figures were generated through seewave package (Sueur et al., 2008) using FFT = 256 points and 85% overlap.

Generic Placement.—Based on molecular data, the subfamily Scinaxinae was proposed by Duellman et al. (2016) to harbor the genera *Sphaenorhynchus*, *Scinax*, *Julianus*, and *Ololygon*. The last three genera are diagnosed by reduced or absent webbing between toes I and II, a feature shared with the new species (Duellman et al., 2016); however, there is no known adult morphological characteristic allowing us to distinguish among *Scinax*, *Julianus*, and *Ololygon*. Until now, the genus *Scinax* is the only poorly webbed Scinaxinae genera occurring in the Amazonia (Sturaro and Peloso, 2014; Ferrão et al., 2017).

We performed a molecular phylogenetic analysis to confirm the generic placement of the new species in *Scinax*. We used 16S rRNA sequences of three individuals of the new species obtained by Ferrão et al. (2016); GenBank accession numbers KU317428 (INPA-H 34688), KU317430 (INPA-H 34700), and KU317431 (INPA-H 34690). We included additional 16S sequences from other poorly webbed species of Scinaxinae (*Scinax*, *Ololygon*, and *Julianus*) and from *Sphaenorhynchus* obtained from the GenBank, as well as the sequences of *Osteocephalus taurinus* and *Trachycephalus resinifictrix* used as the root (Appendix 1).

We preliminarily aligned the sequence data set through ClustalW algorithm (Thompson et al., 1994) as implemented in BioEdit 7.0 (Hall, 1999), and we checked the resultant alignment by eye. After that, we pruned the entire data set to 517 bp to avoid the influence of a large amount of missing data in the phylogenetic reconstruction. The most probable evolutionary model to explain sequence diversity in the final alignment was selected by Akaike Information Criteria (AIC: Akaike, 1974) and Bayesian Information Criteria (BIC: Schwarz, 1978) in jModelTest 2.1.7 (Darriba et al., 2012). Both AIC and BIC recovered GTR + G + I as the most probable evolutionary model. We used Bayesian Inference to infer the phylogenetic tree in MrBayes 3.2 (Ronquist et al., 2011). We executed four runs of 10 million generations with a Metropolis-coupled Markov chain Monte Carlo algorithm (MCMC). Each run had four Markov chains with probabilities sampled every 1,000 generations. We examined stationarity of the posterior distributions (Effective Sample Sizes >200) in Tracer v.1.6 (Rambaut et al., 2018). MrBayes calculated the 50% majority rule consensus tree after discarding the first 25% of trees as burn-in. Interspecific pairwise Kimura-2-parameter (Kimura, 1980), and uncorrected-pairwise distances were generated in MEGA 6.06 (Tamura et al., 2013).

Results

Scinax ***strussmannae*** sp. nov.
(Figs. 1–5)

Scinax sp. 1 Ferrão et al. (2016); Ferrão et al. (2017); Ferrão et al. (2018)

Holotype.—INPA-H 34688 (field number APL 20286; GenBank accession number KU317428). An adult male (Fig. 1–3, 4C) from Nascentes do Lago Jari National Park, kilometer 450 of BR-319 Highway, Purus-Madeira Interfluve (5°56′40″S, 62°30′04″W, 71 m a.s.l., datum WGS84), municipality of Tapauá, State of Amazonas, Brazil, collected on 18 November 2013 by M. Ferrão.

Paratypes.—Five specimens: four adult males INPA-H 34689, INPA-H 34690 (GenBank accession number KU317431), INPA-H 34691, INPA-H 34692 (field numbers APL 20288, APL 20293, APL 20287, APL 20292, respectively), and one adult female INPA-H 34700 (field number APL 20295; GenBank accession number KU317430) collected together with the holotype.

Diagnosis.—A small species assigned to the genus *Scinax* based on molecular data that can be distinguished from other *Scinax* by the combination of the following characters: 1) SVL 21.8 ± 1.1mm (20.2–22.5 mm) in males; 2) truncate snout in dorsal view; 3) HL/SVL ratio = 0.36–0.40; 4) absence of tubercles on the lower jaw; 5) absence of tubercles on knee; 6) absence of dark brown bars on limbs; 7) posterior portion of the thigh uniformly brown; 8) absence of dorsal and dorsolateral dark stripes; 9) red horizontal stripe in the iris; 10) advertisement call consists of two call types: type A representing a series of multipulsed notes (note duration 0.097−0.115 sec, dominant frequency 2541−3015 Hz); and type B consisting of a single tonal note (note duration 0.015–0.019 sec, dominant frequency 2584–2950 Hz).

Comparisons.—We compared the new species with the 30 valid species of *Scinax* occurring in Amazonia sensu lato (Eva and Huber, 2005): *Scinax baumgardneri* (Rivero, 1961); *Scinax blairi* (Fouquette and Pyburn, 1972); *Scinax boesemani* (Goin, 1966); *Scinax chiquitanus* (De la Riva, 1990); *Scinax cruentommus* (Duellman, 1972b); *Scinax danae* (Duellman, 1986); *Scinax exiguus* (Duellman, 1986); *Scinax funereus* (Cope, 1874); *Scinax fuscomarginatus* (Lutz, 1925a); *Scinax fuscovarius* (A. Lutz, 1925b); *Scinax garbei* (Miranda-Ribeiro, 1926); *Scinax ictericus* Duellman and Wiens, 1993; *Scinax iquitorum* Moravec, Tuanama, Pérez and Lehr, 2009; *Scinax jolyi* Lescure and Marty, 2000; *Scinax karenanneae* (Pyburn, 1993); *Scinax kennedyi* (Pyburn, 1973); *Scinax lindsayi* Pyburn, 1993; *Scinax madeirae* (Bokermann, 1964); *Scinax nebulosus* (Spix, 1824); *Scinax onca* Ferrão, Moravec, Fraga, Almeida, Kaefer and Lima, 2017; *Scinax oreites* Duellman and Wiens, 1993; *Scinax pedromedinae* (Henle, 1991); *Scinax proboscideus* (Brongersma, 1933); *Scinax rostratus* (Peters, 1863); *Scinax ruber* (Laurenti, 1768); *Scinax ruberoculatus* Ferrão, Fraga, Moravec, Kaefer and Lima, 2018; *Scinax sateremawe* Sturaro and Peloso, 2014; *Scinax villasboasi* Brusquetti, Jansen, Barrio-Amorós, Segalla and Haddad, 2014; *Scinax wandae* (Pyburn and Fouquette, 1971); *Scinax x-signatus* (Spix, 1824). Examined specimens are listed in Appendix 2.

Scinax ***strussmannae*** sp. nov. differs from *S. garbei*, *S. jolyi*, *S. kennedyi*, *S. nebulosus*, *S. pedromedinae*, *S. proboscideus*, and *S. rostratus* (all in *S. rostratus* species group) by having truncated snout in dorsal view, absence of tubercles on the lower jaw, absence of tubercles on the knee, and by having posterior portion of the thigh uniformly brown (elongated or pointed snout; tubercles on the lower jaw and/or on the heel present; posterior portion of thigh spotted, marbled or brindle: Duell-

FIG. 1. Holotype of *Scinax **strussmannae*** sp. nov. (INPA-H 34688), from Nascentes do Lago Jari National Park, Tapauá, Amazonas, Brazil. Scale bar = 5 mm.

man, 1972a, 1973; Duellman and Wiens, 1992, 1993; Lescure and Marty, 2000).

The adult male body length is smaller in *S. **strussmannae*** sp. nov. (20.2–22.5 mm) than in males of: *S. baumgardneri* (SVL 29.0–32.0 mm; Rivero, 1961); *S. blairi* (SVL 27.8–30.1 mm; Fouquette and Pyburn, 1972); *S. boesemani* (SVL 28.4–31.8 mm; Duellman, 1986); *S. chiquitanus* (SVL 27.9–33.3 mm; Duellman and Wiens, 1993); *S. funereus* (SVL 29.8–36.9 mm; Duellman, 1971; Duellman and Wiens, 1993); *S. fuscovarius* (SVL 36–54 mm; Goldberg et al., 2018); *S. ictericus* (SVL 26.3–31.8 mm; Duellman, 2005); *S. iquitorum* (SVL 35.0–38.5 mm; Moravec et al., 2009a); *S. karenanneae* (SVL 26.6–28.9 mm; Pyburn, 1993); *S. onca* (SVL 31.3–34.5 mm; Ferrão et al., 2017); *S. oreites* (SVL 28.4–33.5 mm; Duellman and Wiens, 1993); *S. ruber* (SVL 29.4–41.2 mm; Duellman and Wiens, 1993); *S. sateremawe* (SVL 35.2–38.1 mm; Sturaro and Peloso, 2014); *S. x-signatus* (SVL 32.4–38.7 mm; Juncá et al., 2015).

FIG. 2. Ventral view of hand (A) and foot (B) of the holotype of *Scinax **strussmannae*** sp. nov. (INPA-H 34688), from Nascentes do Lago Jari National Park, Tapauá, Amazonas, Brazil. Scale: 2 mm.

The absence of dorsal and dorsolateral dark stripes differs in *S. **strussmannae*** sp. nov. from *S. fuscomarginatus*, *S. madeirae*, and *S. villasboasi* (dark dorsal and/or dorsolateral stripes present; Brusquetti et al., 2014). The dominant frequency (2,541–3,015 Hz) of the advertisement call of *S. **strussmannae*** sp. nov. differs from those of *S. exiguus* (3,811–4,802 Hz; Duellman, 1986; Carvalho et al., 2017) and *S. ruberoculatus* (1,809–1,895 Hz; Ferrão et al., 2018).

Superficially, the new species is most similar to *S. cruentommus*, *S. wandae* and *S. lindsayi*; in contrast, males of the new species are distinguishable from those of *S. cruentommus* by smaller SVL (20.2–22.5 vs. 24.8–27.7 mm; Duellman 1972b; Duellman and Wiens, 1993), and by higher ratio HL/SVL (0.36–0.40 vs. 0.31–0.35; Duellman, 1972b). In addition, *S. **strussmannae*** sp. nov. differs from *S. cruentommus* by advertisement call parameters, such as shorter call duration (0.097–0.115 vs. 0.215–0.370 s; Duellman, 1972b; Carvalho et al., 2015), lower number of pulses per call (23–27 vs. 39–54; Carvalho et al., 2015). The stained pattern of the dorsal color in *S. **strussmannae*** sp. nov. is easily distinguished from the striped pattern of *S. wandae*

FIG. 3. Holotype of *Scinax* ***strussmannae*** sp. nov. (INPA-H 34688, SVL = 20.2 mm), Nascentes do Lago Jari National Park, Tapauá, Amazonas, Brazil. Photo: Rafael de Fraga.

(Pyburn and Fouquette, 1971). Additionally, the new species differs from *S. wandae* by the smaller body size in males (20.2–22.5 vs. 23.4–26.9 mm; Pyburn and Fouquette, 1971), and by shorter call (0.097–0.115 vs. 0.442–0.710 sec; Pombal et al., 2011) and lower dominant frequency (2541–3015 Hz in vs. 3359–5167 Hz; Pombal et al., 2011). *Scinax* ***strussmannae*** sp. nov. differs from *S. lindsayi* by having snout truncated in dorsal view (rounded; Pyburn, 1992), red horizontal stripe on the iris (absence of red horizontal stripe on the iris; Pyburn, 1992), absence of dark brown bars on limb (present; Pyburn, 1992), and by having pulsed call (not pulsed; Pyburn, 1992).

There is an available name (*Hyla affinis* Spix, 1824) in the synonymy of *Scinax x-signatus*. The Spix's description is based on a specimen (ZSM 2495/0) from Brazilian Amazonia and depicts the species with red color of iris, but *S.* ***strussmannae*** sp. nov. differs from *Hyla afiinis* by having snout truncate in dorsal view (rounded in the holotype of *H. affinis*), canthus rostralis curved (straight in the holotype of *H. affinis*), absence of bars on the thigh, tibia, forearms, and flanks (present in *H. affinis*: Spix, 1824), and dorsum yellowish (greenish in *H. affinis*: Spix, 1824).

Description of Holotype.—Adult male (Fig. 1), 20.2 mm SVL; head longer than wide, HW 90% of HL; HL 38% of SVL; HW 34% of SVL; snout truncated in dorsal view and rounded in lateral view; END equal to 91% of ED; nostrils protruding dorsolaterally; region between nostrils slightly concave; *canthus rostralis* well defined, curved medially; ED 33% of HL; interocular portion flattened; supratympanic fold distinct; tympanum round and small, TD 35% of the ED; medium-sized vocal sac, subgular, externally expanded; vocal slits present, extending from lateral base of tongue to the mouth angles; tongue lanceolate; triangular dentigerous processes of vomers, separated from each other by half their length, each of them with six (right) and five (left) teeth; oval choanae; axillary membrane absent.

Arm slender, forearm moderately robust; ulnar tubercle absent; fingers long, relative length of fingers I < II < IV < III (Fig. 2A); finger webbing formula, I vestigial II 2–$3^{1/3}$ III 3–3 IV; finger discs large and elliptical (3FD/TD = 1.11); palmar tubercle flattened and bifid; tenar tubercle flattened and elliptical; subarticular tubercle of Finger I slightly conical, subarticular tubercles protruding on fingers II–IV; supernumerary tubercles distinct; nuptial pad present on the thumbs, extending from proximal margin of thenar tubercle to proximal margin of the subarticular tubercle.

Posterior limbs long, TL 52% of SVL, THL 50% of SVL; tarsal fold and tubercles absent; tubercles on knee and heel absent; foot length equals 42% of SVL; TAL 65% of FL; inner metatarsal tubercle elliptical and protuberant; outer metatarsal tubercle small, rounded, slightly protuberant, three times smaller than the inner metatarsal tubercle; subarticular tubercle on Toe I subconical and protuberant, subarticular tubercles rounded and slightly protruding on the toes II–V; supernumerary tubercles not evident; toe discs elliptical; 4TD the same size of ED (4TD/

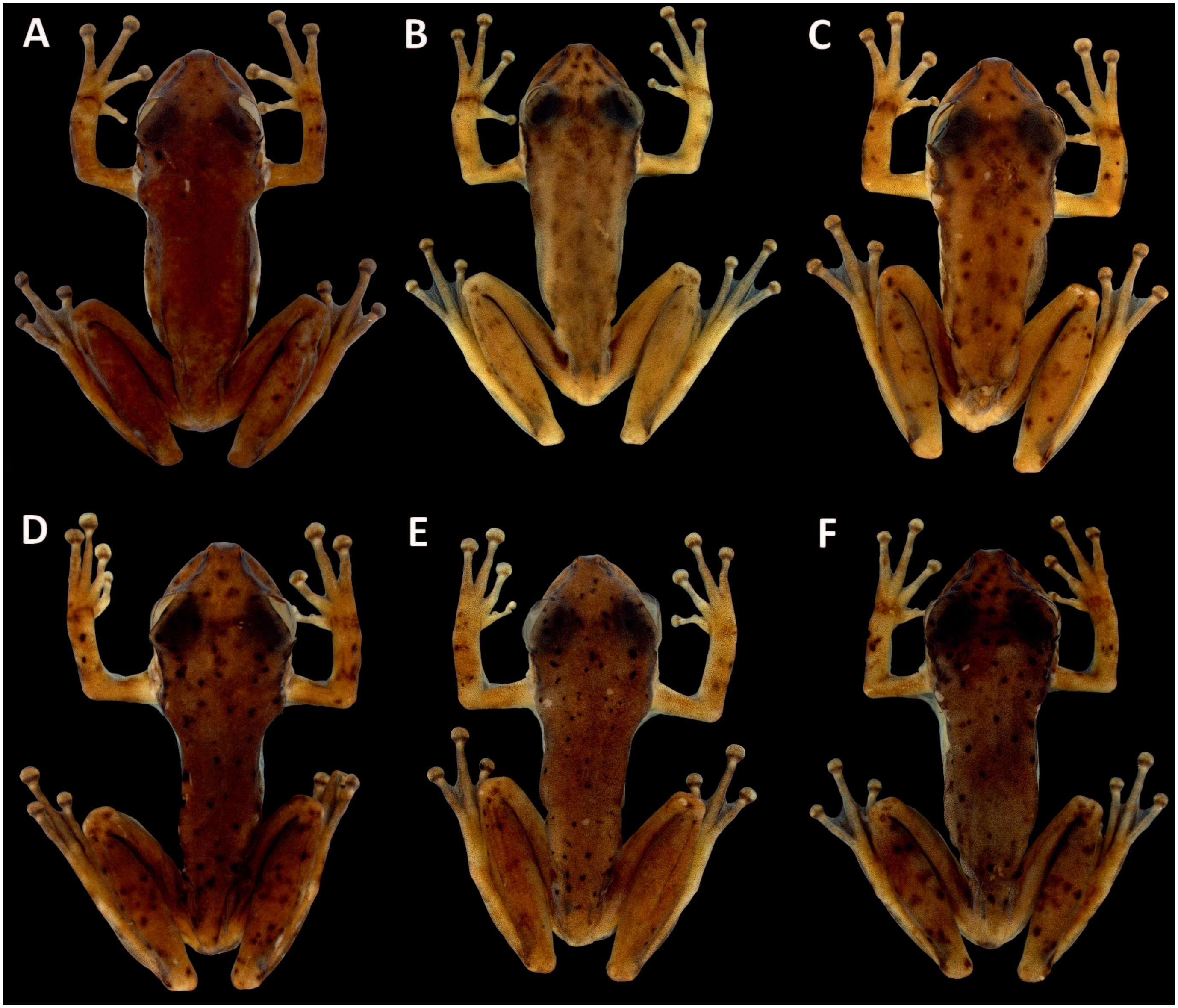

FIG. 4. Color in preservative of the *Scinax* ***strussmannae*** sp. nov. type series from Nascentes do Lago Jari National Park, Tapauá, Amazonas, Brazil. (A) INPA-H 34700, female, SVL 26.5 mm. (B) INPA-H 34689, male, SVL 20.7 mm. (C) INPA-H 34688, male, 20.2 mm. (D) INPA-H 34692, male, SVL 22.5 mm. (E) INPA-H 34691, male, SVL 22.5 mm. (F) INPA-H 34690, male, SVL 21.6 mm.

TD = 1.00); vestigial membrane between toes I and II, webbing formula II $1^{1/3}$–$2^{1/2}$ III $1^{1/3}$–$2^{1/2}$ IV $2^{1/2}$–1^{+} V (Fig. 2B). Anal opening at the middle level of the thighs.

Skin on the dorsal surface smooth, except in the upper and anterior regions of the tympanum, where it is shagreen; skin on flanks slightly areolate; vocal sac smooth; chest, belly, and ventral surface of the thigh areolate.

Color in Life of the Holotype.—Dorsum yellowish-bronze with light-brown spots, darker over the snout and eyelids (Fig. 3). An irregularly shaped light-brown spot on the interorbital region. Brown canthal stripe. Upper lip light-cream, yellowish-cream below the eye and tympanum. Iris golden, with a broad medial horizontal red stripe. Brown supratympanic band extending from the corner of the eye to the medial portion of the flank. Yellowish-cream inconspicuous stripe on ventrolateral portion of the flanks. Inguinal region greenish-bronze. Dorsal surface of hand yellowish-cream. Dorsal surface of the forearm yellowish-bronze, with a dark-gray spot on distal portion, a small dark-gray spot on the medial portion, and an inconspicuous brown spot in the proximal portion. Dorsal surface of arm yellowish-cream. Anterior and dorsal surfaces of thigh greenish-bronze. Posterior portion of thigh brown. Dorsal surface of the tibia and tarsus yellowish-bronze, with small marbled light-brown spots. Cream spots on the ankles. Dorsal surface of the feet greenish-bronze. Vocal sac bright-yellow. Chest cream and belly gray. Ventral surface of thigh grayish. Ventral surface of tarsus grayish-green. Palmar and plantar surfaces gray.

Variation within the Type Series.—In preservative, dorsal color light brown, brownish-gray to brown. Small to large dark-brown spots present on the snout in 83% of the type-series (Fig. 4B–F) and absent on the others (Fig. 4A). Dorsal dark-brown spots denser in brown specimens (Fig. 4D–F), except in the female specimen (Fig. 4A). Brown spots on the eyelids varying in size and number. Light brown band in the interorbital region present on 67% of individuals, absent on remaining specimens. Gray to dark-brown band between nostril and eye present in all

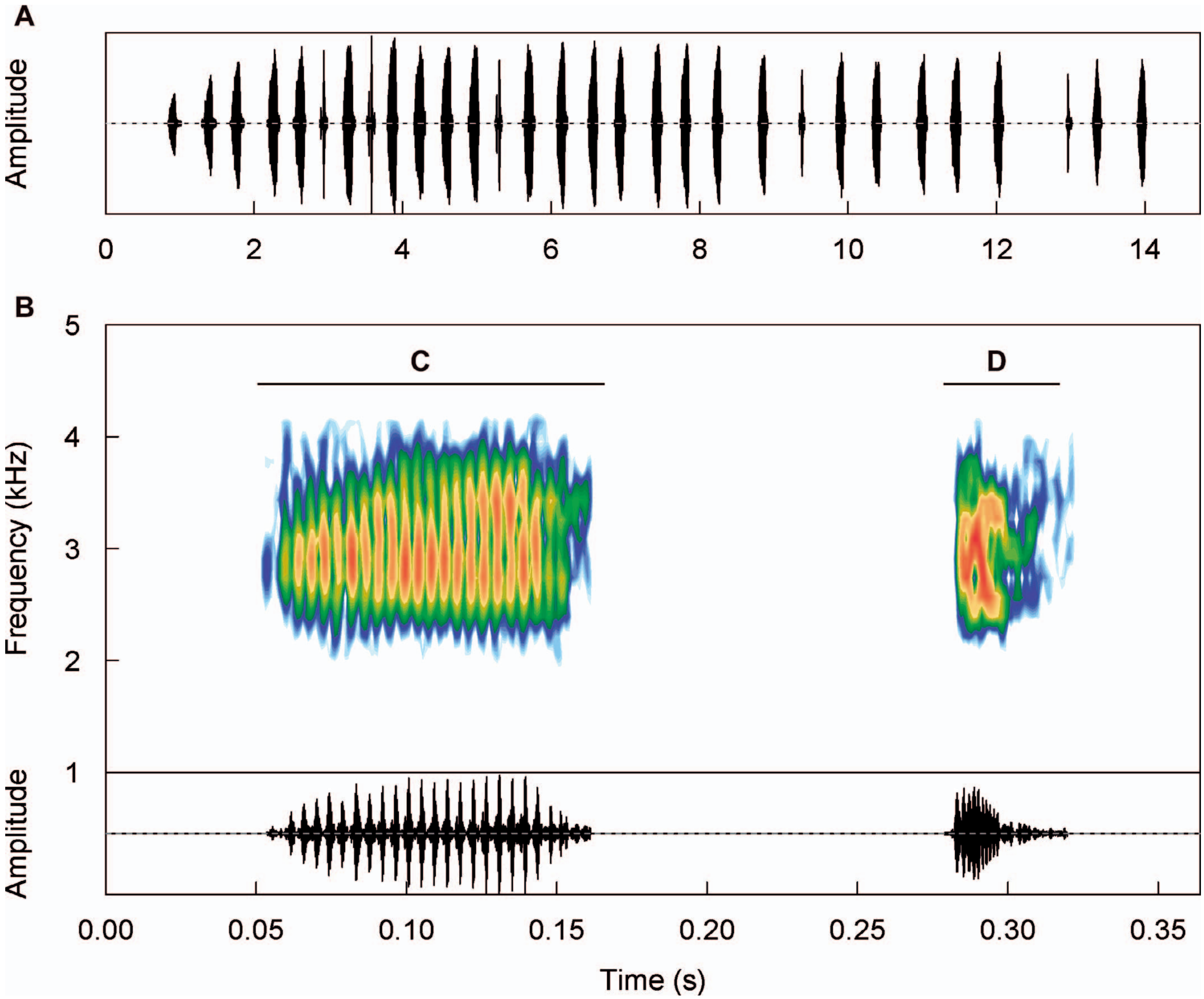

FIG. 5. Wave form and audiospectrogram of the advertisement call type A interspersed with advertisement call type B of *Scinax* ***strussmannae*** sp. nov. (INPA-H 34691, SVL 22.5 mm) from Nascentes do Lago Jari National Park, Tapauá, Amazonas, Brazil (A). Wave form and detailed audiospectrogram (B) of the advertisement call type A (C) and type B (D).

specimens. Upper lip cream with light or dark brown spots in all specimens, varying in number and size. Light to dark brown supratympanic band evident in all specimens, extending to above of axillar region in 50% of individuals, to the inguinal region in 33% and on 17% it extends to 1/3 of the flanks. Light dorsolateral stripe extending from the postocular portion to the inguinal region in 17% of specimens, absent on the remaining. Light stripe on the lower portion of the flanks, ventrally bordered by a light brown or light gray stripe or spots in 83% of the individuals, absent on the others. Inguinal region grayish-cream in 50% of the series, light brown in the other half.

Upper distal portion of the finger digits cream to light-brown, brown in the proximal portion. Dorsal surface of hand and fingers light-brown. Light to dark brown stripe on the proximal surface of the hand. Dorsal surface of the forearm cream to light-brown, with dark-brown spots or bars. Arm cream on 67% of specimens, light brown on 33%; dark brown spots just on 50% of the series. Anterior surface of the thigh light brown on 67% of the specimens, light gray on 17%, and brown on 17%. Upper surface of the thigh cream on 50% of the series, light brown on 33% and brown on the remaining. Posterior surface of the thigh brown on 67% of the specimens, and light brown on 33%. Dorsal surface of the tibia cream to brown, with dark brown spots on 67% of the series, light brown on 17%, and gray on the remaining. The number of spots on the dorsal surface of the tibia varies: 67% of the specimens have conspicuous dark spots but are inconspicuous on 33% of them. Dorsal surface of the tarsus cream on 67% and light brown on 33% of the specimens, with brown spots or blotches. Dorsal surface of foot and toes cream on 67% of specimens and light brown on the remaining. Proximal portion of toe and finger digits dark brown in all specimens, distal portion of digits cream on 83%, and light brown on 17% of the series. Toe webbing translucent cream on 67% of specimens and light brown on 33%. Vocal sac, chest, and belly cream. Ventral surface of the hand cream on 67% of specimens and light brown on the others. Ventral surface of the

TABLE 1. Measurements (mm) and morphometric ratios of the type-series of *Scinax* ***strussmanae*** sp. nov. Abbreviations are defined in the Materials and Methods section (holotype in bold). Morphometric ratios are presented with two decimals.

INPA-H	34691	**34688**	34689	34692	34690	34700
Sex	M	**M**	M	M	M	F
SVL	22.5	**20.2**	20.7	22.5	21.6	26.5
HL	8.3	**7.6**	7.6	9.0	8.3	9.7
HW	7.3	**6.8**	7.0	7.6	7.1	9.0
ED	2.8	**2.5**	2.5	2.9	2.8	3.0
TD	1.0	**0.9**	0.7	1.4	1.1	1.5
IOD	2.3	**2.0**	2.3	2.5	2.2	2.9
IND	1.9	**1.7**	1.6	1.9	1.7	1.9
TAL	5.9	**5.5**	5.6	6.0	5.8	6.8
FL	8.5	**8.5**	8.7	9.5	9.1	10.6
HAL	5.9	**5.7**	5.8	6.1	6.0	7.3
3FD	0.9	**1.0**	1.0	1.1	1.0	1.0
4TD	0.9	**0.9**	0.9	1.1	1.1	0.9
END	2.5	**2.2**	2.6	2.5	2.3	3.0
TL	11.1	**10.6**	10.7	11.2	11.2	13.0
THL	10.4	**10.0**	10.1	9.8	10.4	11.9
NSD	0.6	**0.7**	0.7	0.7	0.6	0.9
HL/HW	1.14	**1.12**	1.09	1.18	1.17	1.08
HL/SVL	0.37	**0.38**	0.37	0.40	0.38	0.37
HW/SVL	0.32	**0.34**	0.34	0.34	0.33	0.34
IOD/HW	0.32	**0.29**	0.33	0.33	0.31	0.32
END/ED	0.89	**0.88**	1.04	0.86	0.82	1.00
TD/ED	0.36	**0.36**	0.28	0.48	0.39	0.50
TL/SVL	0.49	**0.52**	0.52	0.50	0.52	0.49
THL/SVL	0.46	**0.50**	0.49	0.44	0.48	0.45
TAL/FL	0.69	**0.65**	0.64	0.63	0.64	0.64

tarsus light cream on 50%, brown on 33%, and light brown on 17% of the specimens. Ventral surface of foot light brown on 67% of specimens and brown on the remaining.

Toe webbing of *S.* ***strussmannae*** sp. nov. varies subtly within the type series and it follows the formula: I vestigial II ($1^{1/2}$–$1^{1/3}$)–($2^{1/2}$–$2^{2/3}$) III ($1^{+1/3}$–$1^{1/2}$)–($2^{1/3}$–$2^{2/3}$) IV ($2^{1/2}$–$2^{2/3}$) –1^{+} V. Dentigerous processes of vomers are absent on the left side in 42% of the specimens. Number of teeth 2–7 on the right side and 3–5 on the left side. The proportional ratios between morphometric characters of the single female in our sample follow the same range as in the males. Measures and morphometric ratios of the type series are presented in Table 1.

Vocalization.—The advertisement call of *Scinax* ***strussmannae*** sp. nov. is composed of two types of calls: type A and type B (Fig. 5). Call type A (Fig. 5C) consists of a series of single short multipulsed notes and can be characterized by the following numerical call parameters (range followed by mean ± SD in parentheses): notes/call 17–30 (24 ± 6.6, $N = 3$); note duration 0.097–0.115 sec (0.106 ± 0.005, $N = 21$); note repetition rate 85–175 notes/min (139 ± 24); pulse/note 23–27 (25.1 ± 1.1, $N = 21$); pulse duration 0.002–0.003 sec (0.002 ± 0.0005, $N = 63$); interval between pulses 0.001–0.003 sec (0.002 ± 0.0004, $N = 63$); pulse repetition rate 200–250 pulses/sec (225 ± 25, $N = 42$); silent interval between calls 0.221–0.601 sec (0.338 ± 0.093, $N = 21$); lower frequency 2,213–2,441 Hz (2,255 ± 49, $N = 21$); upper frequency 3,595–3,803 Hz (3,696 ± 80, $N = 21$); dominant frequency 2,541–3,015 Hz (2,816 ± 93, $N = 21$).

Call type B (Fig. 5D) consists of a single tonal note and may intercalate call type A. Its characteristics are as follows: note duration 0.015–0.019 sec (0.017 ± 0.001, $N = 6$); lower frequency 2,200–2,354 Hz (2,280 ± 55, $N = 6$); upper frequency 3,125–3,621 Hz (3,380 ± 210, $N = 6$); dominant frequency is 2,584–2,950 Hz (2,774 ± 147, $N = 6$). The silent interval between call B and previous call A is 0.250–0.883 sec (0.388 ± 0.246, $N = 6$).

Phylogenetic Relationships and Genetic Distances.—The Bayesian phylogenetic tree based on a fragment of 517 bp of the 16S rRNA indicated that *Scinax* ***strussmannae*** sp. nov. is closely related to other nominal and candidate species characterized by having red-striped iris (*S. cruentommus* and *Scinax* sp. 1, *Scinax* sp. 4, and *Scinax* sp. 6 sensu Ferrão et al., 2016) and to *S. wandae* (Fig. 6). Excepted by *S. wandae* that occur in Colombia and Venezuela, all the other taxa in this clade occur in the PMI. The uncorrected pairwise and K2P distance between sequences of the new species and *S. cruentommus* is 9% and 10%, respectively. The genetic distances between *S.* ***strussmannae*** sp. nov. and *S. wandae* are larger, ranging from 10% (p-distance) to 11% (K2P). The clade composed by *S.* ***strussmannae*** sp. nov., *S. cruentommus*, *S. wandae*, and other Amazonian taxa with red-striped iris was grouped with the clade comprising the small species of *Scinax* characterized mainly by having dorsolateral marks or stripes (*S. fuscomarginatus*, *S. madeirae*, *S. villasboasi*) and with *S. staufferi*. The smallest and largest genetic distances between sequences of *S.* ***strussmannae*** sp. nov. and those from the above-mentioned species, was recovered with *S. staufferi* (11% p-distance; 12% K2P) and *S. villasboasi* (16% p-distance: 18% K2P), respectively.

Distribution and Natural History.—*Scinax* ***strussmannae*** sp. nov. has been found only in Nacentes do Lago Jari National Park, Purus-Madeira rivers interfluve, Amazonas, Brazil (Fig. 7). All specimens in our sample were collected in primary rain forest, which is classified as dense ombrophylous lowland forest with emergent canopy (IBGE, 1997). The males call from low vegetation and dry branches around small temporary pools. The specimen that we recorded in this study was calling on a dry palm leaf, ~80 cm above a small isolated (not connected to a stream) pool. The reproduction of the new species has an explosive character. Although we have spent ~1,000 h sampling frogs along the study area during rainy season, we observed just a single explosive reproductive event.

Etymology.—The specific epithet honors Christine Strüssmann for her friendship and outstanding contribution to Brazilian herpetology.

Suggested Common English Name.—Strüssmann's Snouted Treefrogs.

DISCUSSION

Scinax ***strussmannae*** sp. nov. groups with other diminutive species of *Scinax* with a red and brown horizontal stripe in the middle portion of the iris (*S. cruentommus*, *S. wandae*); however, the new species is not cryptic in relation to any of these correlated species. The new species can be easily distinguished based on external morphology and bioacoustical characters. Additionally, 16S rRNA sequences of *S.* ***strussmannae*** sp. nov. showed high uncorrected pairwise genetic distances in relation to close related nominal species, as *S. wandae* (10%) and *S. cruentommus* (9%). These levels of genetic divergence among species are greater than those suggested by Vences et al. (2005) and Fouquet et al. (2007b) as evidence for interspecific difference among tropical frogs.

Our research group has applied a massive frog sampling along 450 RAPELD plots (see Magnusson et al., 2013) longitudinally distributed >1,500 km in the Brazilian Amazonia. Despite that, *S.* ***strussmannae*** sp. nov. was found in <1% of the plots and during a single event of explosive reproduction.

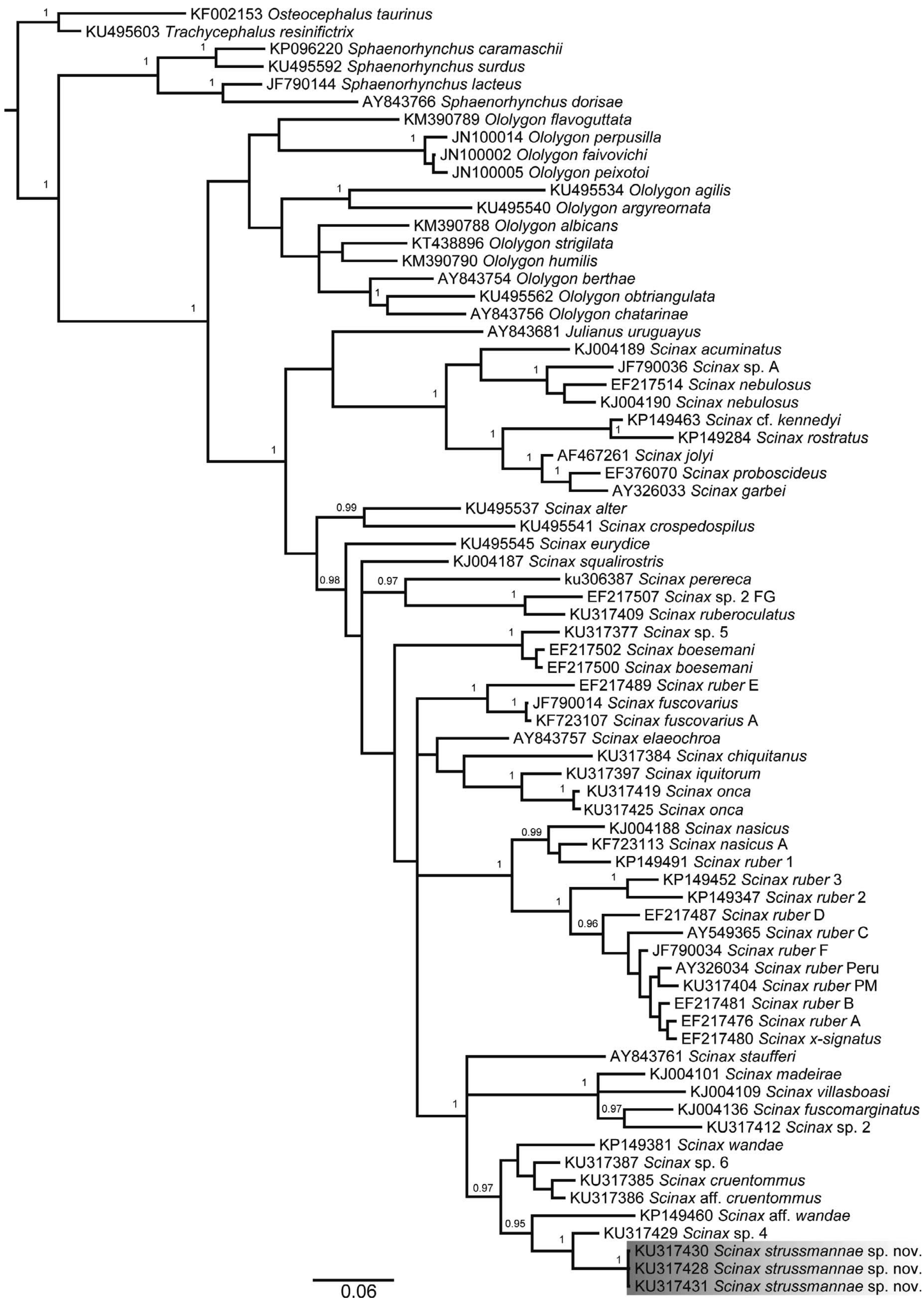

FIG. 6. Bayesian 50% consensus tree inferred from mitochondrial 16S rRNA. Posterior probabilities are given above the node when ≥ 0.95. Shaded area highlights the new species.

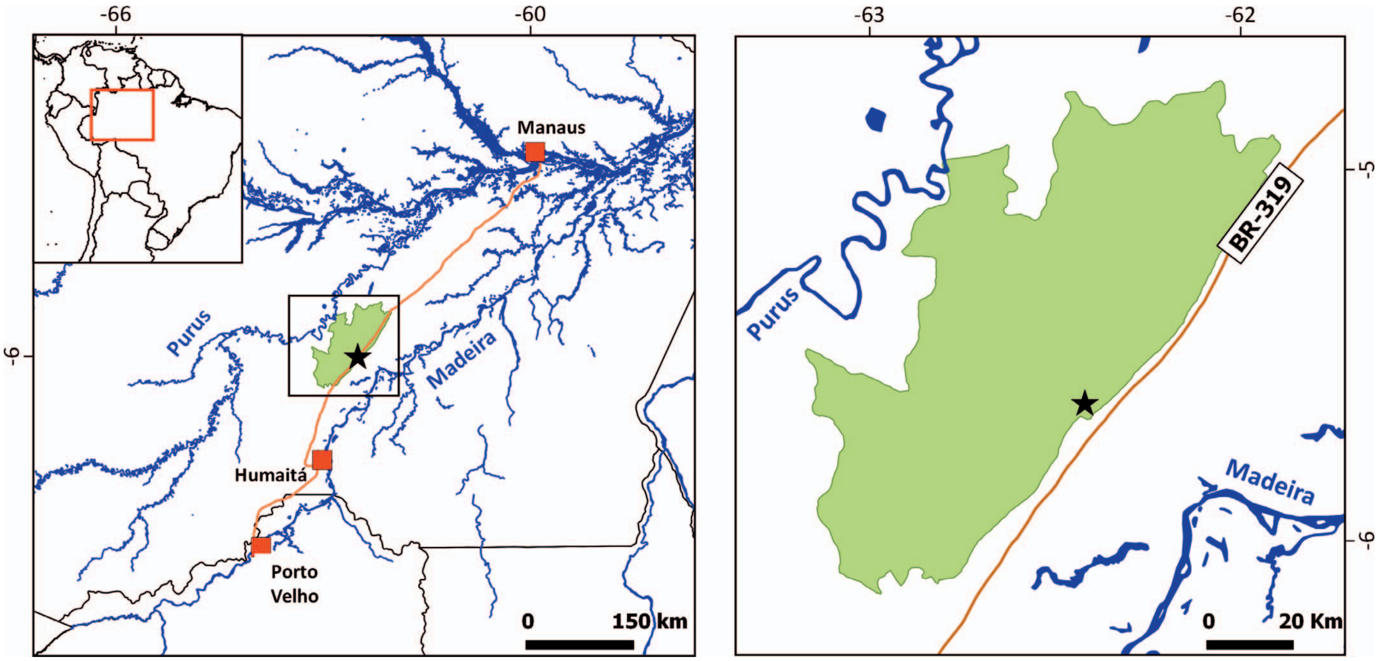

FIG. 7. Geographic range of *Scinax* ***strussmannae*** sp. nov. in the interfluve between the Purus and Madeira Rivers, Brazilian Amazonia. Black star: type locality, border of Nascentes do Lago Jari National Park (green polygon) in contact with the federal highway BR-319, Municipality of Tapauá, Amazonas, Brazil.

These findings suggest the new species is narrowly distributed in the Amazonian rain forests, probably because it is a habitat-specialist; however, detectability seems to be strongly affected by sparse calling events. Although the new species occurs in the Nascentes do Lago Jari National Park, the specimens reported here inhabit forests in the border between the park and the BR-319 federal highway, where native habitats are strongly threatened by illegal logging (MF and RF, pers. obs.). In fact, a third of the primary and old secondary forests in the PMI should be deforested until 2050 attributable to human occupation expanding through road reconstruction (Fearnside et al., 2009, Maldonado et al., 2012, Graça et al., 2014).

In addition to *S.* ***strussmannae*** sp. nov., the PMI is the type locality of eight recently described frogs (Lima and Caldwell, 2001; Caldwell and Lima, 2003; Lima et al., 2010; Simões et al., 2010; Brown et al., 2011; Sturaro and Peloso, 2014; Ferrão et al., 2017, 2018; Melo-Sampaio et al., 2018) and one salamander (*Bolitoglossa madeira* Brcko, Hoogmoed, and Neckel-Oliveira, 2013). Furthermore, *Hydrolaetare dantasi* (Bokermann, 1959) and *Osteocephalus castaneicola* (Moravec, Aparicio, Guerrero-Reinhard, Calderón, Jungfer and Gvoždík, 2009) were recently found in the PMI, which represented the species' first records in the Amazonas state (Ferrão et al., 2014) and Brazil (Meneghelli and Entiauspe, 2014), respectively. Finally, two discontinuously distributed frog species that are usually rare in collections (*Hyalinobatrachium cappellei* [Van Lidth de Jeude, 1904] and *Callimedusa* [=*Phyllomedusa*] *atelopoides* [Duellman, Cadle and Cannatella, 1988]) have been recently reported from the PMI (Simões et al., 2012; Fraga et al., 2014.). These studies highlight the remarkable amphibian diversity in the PMI, which should not be overlooked in environmental impact assessments. The PMI is under rapidly increasing anthropogenic pressure, which has caused habitat loss by road paving (Soares-Filho et al., 2006; Fearnside et al., 2009) and artificial flooding by hydroelectric power plants (Fearnside, 2014).

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Appendix 1. Voucher numbers, localities, and GenBank accession numbers of samples used for phylogenetic analyses.

Species	Voucher	Location	GenBank	Authors
Julianus uruguayus	CFBH 5788	Brazil, Rio Grande do Sul, Cambará do Sul	AY843681	Brusquetti et al., 2014
Ololygon agilis	CFBHT 09033	Brazil, Espirito Santo, Paraju	KU495534	Lyra et al., 2017
O. albicans		Brazil	KM390788	Chaves et al., unpubl. data
O. argyreornata	CFBHT 02212	Brazil, Espirito Santo, Vitoria	KU495540	Lyra et al., 2017
O. berthae	MLPA 2137	Argentina, Buenos Aires, Atalaya	AY843754	Faivovich et al., 2005
O. faivovichi	MNRJ40902	Brazil, São Paulo, Porcos Pequena	JN100002	Bell et al., 2012
O. flavoguttatus		Brazil	KM390789	Chaves et al., unpubl. data
O. humilis		Brazil	KM390790	Chaves et al., unpubl. data
O. peixotoi	CFBH 9437	Brazil, São Paulo, Ilha da Queimada Grande	JN100005	Bell et al., 2012
O. perpusilla	CFBH12869	Brazil, São Paulo, Ubatuba	JN100014	Bell et al., 2012
O. strigilata	MZUESC11080	Brazil, Camacan, Bahia	KT438896	Nogueira et al., 2016
Scinax acuminatus	IIBPH 277	Paraguay, Estancia San Jose, Neembucu	KJ004189	Brusquetti et al., 2014
S. alter	CFBHT 03712	Brazil, Espirito Santo, Mimoso do Sul	KU495537	Lyra et al., 2017
S. boesemani A		French Guiana, Savane roche virginie	EF217500	Fouquet et al., 2007a
S. boesemani B		French Guiana, Grand santi	EF217502	Fouquet et al., 2007a
S. chiquitanus	INPAH35560	Brazil, Rondônia, Porto Velho, module 14	KU317384	Ferrão et al., 2016
S. crospedospilus	CFBHT 16741	Brazil, Sao Paulo, Sao Luis do Paraitinga	KU495541	Lyra et al., 2017
S. cruentommus	INPAH34697	Brazil, Amazonas, BR-319, module 1	KU317385	Ferrão et al., 2016
S. aff. *cruentommus*	INPAH34596	Brazil, Amazonas, BR-319, module 6	KU317386	Ferrão et al., 2016
S. elaeochroa	MVZFC 14457	Costa Rica, Heredia, Starkey's Woods	AY843757	Faivovich et al., 2005
S. eurydice	CFBHT 04365	Brazil, Rio de Janeiro, Petropolis	KU495545	Lyra et al., 2017
S. fuscomarginatus	CFBH24362	Brazil, Minas Gerais, Lagoa Santa	KJ004136	Brusquetti et al., 2014
S. fuscovarius	AS 502	Bolivia, Los Lagos	JF790013	Schulze et al., 2015
S. fuscovarius	MNKA 9772	Bolivia, Santa Cruz, Ñuflo de Chavez, San Sebastián	JF790014	Jansen et al., 2011
S. garbei	KU 202764	Ecuador, Chimborazo	AY326033	Darst and Cannatella, 2004
S. iquitorum	NMP6V 71267-1	Peru, Puerto Almendras	KU317397	Ferrão et al., 2016
S. jolyi		French Guiana	AF467261	Salducci et al., 2002
Scinax cf. *kennedyi*	AJC 4074	Colombia, Casanare, Sabanalarga, Sabanalarga	KP149463	Guarnizo et al., 2015
S. madeirae	CFBH25469	Brazil, Rondônia, Porto Velho	KJ004101	Brusquetti et al., 2014
S. nebulosus	CFBHT10951	Brazil, Piauí, Baixa Grande	KJ004190	Brusquetti et al., 2014
S. nebulosus		French Guiana, Road 8/pk6	EF217514	Fouquet et al., 2007a
S. proboscideus		French Guiana, Kaw	EF376070	Salducci et al., unpubl. data
S. perereca	CFBHT 1470	Brazil, Paraná, Ararapira	KU306387	Souza et al., unpubl. data
S. onca	INPAH34586	Brazil, Amazonas, BR-319, module 7	KU317425	Ferrão et al., 2016
S. onca	INPAH34595	Brazil, Rondônia, Porto Velho	KU317419	Ferrão et al., 2016
S. rostratus	AJC 3422	Colombia, Santander, San Vicente de Chucuri	KP149284	Guarnizo et al., 2015
S. ruber A	137bm	French Guiana, Cacao	EF217476	Fouquet et al., 2007a
S. ruber B		French Guiana	EF217481	Fouquet et al., 2007a
S. ruber C	IWK 109	Guyana, Iwokrama, Muri Scrub camp	AY549365	Faivovich et al., 2004
S. ruber D	QCAZ25275	Ecuador, parroquia Dayuma, canton coca,Orellana	EF217487	Fouquet et al., 2007a
S. ruber F	MNKA 9539	Bolivia, Santa Cruz, Velasco, Caparu	JF790034	Jansen et al., 2011
S. ruber PM	INPAH34645	Brazil, Amazonas, BR-319, módulo 2	KU317404	Ferrão et al., 2016

APPENDIX 1. Continued.

Species	Voucher	Location	GenBank	Authors
S. ruber 1	AJC 2324	Colombia, Orocué, Casanare	KP149491	Guarnizo et al., 2015
S. ruber 2	AJC 3532	Colombia, San Vicente, Santander	KP149347	Guarnizo et al., 2015
S. ruber 3	AJC 3378	Colombia, Sabanalarga, Casanare	KP149452	Guarnizo et al., 2015
S. ruber Peru	KU 207622	Peru, Madre de Dios, Cusco Amazonico	AY326034	Darst and Cannatella, 2004
S. ruberoculatus	INPAH34623	Brazil, Amazonas, BR-319, module 8	KU317409	Ferrão et al., 2016
S. squalirostris	CFBH21975	Brazil, São Paulo, Serra da Bocaina	KJ004187	Brusquetti et al., 2014
S. staufferi	UTA A-50749	Guatemala, Zacapa, 2.9 km S Teculutan	AY843761	Faivovich et al., 2005
S. villasboasi	CHUNB40161	Brazil, Pará, Serra do Cachimbo	KJ004109	Brusquetti et al., 2014
S. wandae	AJC 4105	Colombia, Sabanalarga, Casanare	KP149381	Guarnizo et al., 2015
S. aff. *wandae*	AJC 3464	Colombia, San Juan de Arama, Meta	KP149460	Guarnizo et al., 2015
S. x-signatus	260mc	French Guiana, Arataï	EF217480	Fouquet et al., 2007a
S. strussmannae sp. nov.	INPAH34688	Brazil, Amazonas, BR-319, module 9	KU317428	Ferrão et al., 2016
S. strussmannae sp. nov.	INPAH34690	Brazil, Amazonas, BR-319, module 9	KU317431	Ferrão et al., 2016
S. strussmannae sp. nov.	INPAH34700	Brazil, Amazonas, BR-319, module 9	KU317430	Ferrão et al., 2016
Scinax sp. 2	INPAH34670	Brazil, Amazonas, BR-319, module 11	KU317412	Ferrão et al., 2016
Scinax sp. 2 FG		French Guiana, Kaw	EF217507	Fouquet et al., 2007a
Scinax sp. 4	INPAH34693	Brazil, Amazonas, BR-319, module 11	KU317429	Ferrão et al., 2016
Scinax sp. 5	INPAH34703	Brazil, Amazonas, BR-319, module 5	KU317377	Ferrão et al., 2016
Scinax sp. 6	INPAH35562	Brazil, Rondônia, Porto Velho, module 17	KU317387	Ferrão et al., 2016
Scinax sp. A	MNKA 9134	Bolivia, Santa Cruz, Ñuflo de Chavez, San Sebastián	JF790036	Jansen et al., 2011
Sphaenorhynchus caramaschii	CFBHT 12419	Brazil, Sao Paulo, Ribeirao Grande	KP096220	Araujo-Vieira et al., 2015
Sphaenorhynchus dorisae	MJH 46	Brazil, Amazonas, Manaus, Lago Janauri	AY843766	Faivovich et al., 2005
Sphaenorhynchus lacteus	MNK:A 9387	Bolivia	JF790144	Jansen et al., 2011
Sphaenorhynchus surdus	CFBHT0 5536	Brazil, Santa Catarina, Lebon Regis	KU495592	Lyra et al., 2017
Trachycephalus resinifictrix	MTR_UFCX22P46	Brazil, Mato Grosso, Vila Rica	KU495603	Lyra et al., 2017
Osteocephalus taurinus	PHV 2692	Brazil, Mato Grosso, Barra do Garcas	KF002153	Jungfer et al., 2013

APPENDIX 2

List of specimens examined for morphological comparisons.

Abbreviations: (AM) Highway at State of Amazonas, Brazil; (PDBFF) Projeto Dinâmica Biológica de Fragmentos Florestais (a project in Brazil focused on dynamics of forest fragments), (km) kilometer; (INPA-H) Herpetological Section of the Zoological Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil; (RMNH) Nationaal Natuurhistorisch Museum, Leiden, The Netherlands; (QCAZ) Museo de Zoología, Pontificia Universidad Católica del Ecuador, Quito, Ecuador; (KU) University of Kansas, Museum of Natural History, Division of Herpetology, Lawrence, Kansas, USA; (ANDES-A) Museo de Historia Natural ANDES, Universidad de los Andes, Bogotá, Colombia; (ZSM) Zoologische Staatssammlung München, München, Germany.

Hyla affinis: BRAZIL: "fluminis Amazonum" = Rio Amazonas (ZSM 2495/0, holotype, photo).

Scinax boesemani: SURINAME: Paramaribo: near Zanderij (RMNH12601, holotype, photo). BRAZIL: Roraima: Caracaraí, Viruá National Park (INPA-H 25972, INPA-H 25974).

Scinax chiquitanus: BRAZIL: Rondônia: Porto Velho (INPA-H 35554, INPA-H 35555, INPA-H 35556, INPA-H 35557, INPA-H 35558, INPA-H 35560).

Scinax cruentommus: ECUADOR: Napo: Santa Cecilia (KU 126587, holótipo, photo); Orellana: Parque Nacional Yasuní (QCAZ 8184), Río Napo (QCAZ 43772, QCAZ 44754). BRAZIL: Amazonas: Careiro da Várzea, Ramal do Purupuru (INPA-H 34697).

Scinax funereus: ECUADOR: Orellana: Río Napo, Primavera (QCAZ 43799, photo), Tambococha (QCAZ 55280, QCAZ 55283; photo).

Scinax fuscomarginatus: BRAZIL: Roraima: Boa Vista, Maracá Ecological Station (INPA-H 34662, INPA-H 34634, INPA-H 34646, INPA-H 34661); Caracaraí, Viruá National Park (INPA-H 19371, INPA-H 19372, INPA-H 19376, INPA-H 19378, INPA-H 19383, INPA-H 19384).

Scinax garbei: BRAZIL: Roraima: Caracaraí, Viruá National Park (INPA-H 25964, INPA-H 27496).

Scinax madeirae: BRAZIL: Rondônia: Alta Floresta, Corumbiaria Park (INPA-H 7050, INPA-H 7051).

Scinax nebulosus: BRAZIL: Pará: Alter do Chão (INPA-H 34647, INPA-H 34653); Rondônia: Costa Marques, Real Forte Príncipe da Beira (INPA-H 34641); Roraima: Caracaraí, Parque Nacional do Viruá (INPA-H 27535, INPA-H 27536, INPA-H 27537).

Scinax onca: BRAZIL: Amazonas: Berurí (INPA-H 20582, INPA-H 20586, INPA-H 34585, INPA-H 34584, INPA-H 34581, INPA-H 34583, INPA-H 34587); Rondônia: Porto Velho (INPA-H 34591, INPA-H 34590, INPA-H 34589, INPA-H 34592, INPA-H 34595, INPA-H 34588, INPA-H 34594, INPA-H 34593).

Scinax proboscideus: BRAZIL: Amazonas: Manaus, Colosso Reserve at PDBFF (INPA-H 10304); Presidente Figueiredo, Vila Pitinga (INPA-H 1870); Pará: Oriximiná (INPA-H 304).

Scinax ruberoculatus: BRAZIL: Amazonas: Careiro da Várzea, BR-319, km 100 (INPAH 34600, INPA-H 34601, INPA-H 34604, INPA-H 34614, INPA-H 34615, INPA-H 34622, INPA-H 34598, INPA-H 34624, INPA-H 34627, INPA-H 34629), km 168 (INPA-H 34602); Borba, BR-319, km 220 (INPA-H 34610, INPA-H 34620); Beruri, BR-319, km 220 (INPA-H 34608), km 360 (INPAH 34599, INPA-H 34607, INPA-H 34609, INPA-H 34611, INPA-H 34612, INPA-H 34617, INPA-H 34618, INPA-H 34621, INPA-H 34625, INPA-H 34626, INPA-H 34628, INPA-H 34630); Manicoré, BR-319, km 400 (INPA-H 34603, INPA-H 34606, INPA-H 34616, INPA-H 34623); Tapauá, BR-319, km 450 (INPA-H 34613, INPA-H 34619, INPA-H 34605, INPA-H 34665).

Scinax sateremawe: BRAZIL: Amazonas: Borba, Ramal Novo Horizonte (INPA-H 34695, INPA-H 34708).

Scinax wandae: COLOMBIA: Casanare, Sabanalarga (ANDES-A 1234, ANDES-A 1071, ANDES-A 1072, ANDES-A 1234: photo).