Taxonomic Revision of the *Scinax alter* Species Complex (Anura: Hylidae)

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***Scinax alter*, a taxon belonging to the *S. ruber* clade, has been previously suggested to represent a species complex. We analyzed variation among populations of *Scinax alter* using advertisement calls, dorsal color pattern, and external morphology. We identified three diagnosable groups distributed throughout the Atlantic Forest of eastern Brazil, which differ mainly in the advertisement call, dorsal drawing pattern, snout–vent length, and presence of tubercles on tarsus. *Scinax alter* was restricted to populations from south of Bahia State to Rio de Janeiro State, and two new species were related to the southern populations: *Scinax imbegue*, from Parque das Nascentes, Municipality of Blumenau (27°03′S, 49°05′W, 412 m a.s.l.), Santa Catarina State, Brazil, and *Scinax tymbamirim*, from Córrego Grande (27°35′S, 48°31′W, at sea level), Municipality of Florianópolis, Santa Catarina State, Brazil.**

THE tree frog genus *Scinax* Wagler is currently comprised of more than a hundred recognized species occurring from eastern to southern Mexico to Argentina and Uruguay, including the Caribbean islands Trinidad and Tobago, and Santa Lucia (Frost, 2011). According to Pombal et al. (1995a), *Scinax* has been taxonomically problematic owing to the large number of species, their morphological conservatism and similarity, and the continual discovery of many undescribed species. Recently, a cladistic analysis of the genus *Scinax* performed by Faivovich (2002) recognized two major clades in the genus *Scinax*: the *S. catharinae* clade and the *S. ruber* clade. The *Scinax ruber* species group was first recognized by Dunn (1933), but its species composition has been modified several times since (Lutz, 1954, 1973; Cochran, 1955; León, 1969; Duellman, 1972, 1977; Fouquette and Delahoussaye, 1977; Duellman and Wiens, 1992; Pombal et al., 1995a; Faivovich, 2002; Faivovich et al., 2005). The *S. ruber* clade (*sensu* Faivovich, 2002) bears no relation to the *S. ruber* group as last defined by Pombal et al. (1995a), including all species of the *S. ruber* and *S. staufferi* groups (as species unassigned to a species group) plus the monophyletic *S. rostratus* group. Recently, in a systematic review of the family Hylidae, Faivovich et al. (2005) corroborated these results and further redefined the *S. ruber* clade to include the monophyletic *S. uruguayus* group. Following this arrangement the *S. ruber* clade currently includes at least 57 species (Frost, 2011).

Hyla rubra orientalis, a nominal taxon belonging to the *Scinax ruber* clade, was described by Lutz (1968) based on 15 specimens collected in ''Crubixá, Santa Leopoldina, Estado do Espírito Santo, Brasil'', and later renamed as *Hyla rubra altera* by B. Lutz (1973). According to Duellman (1977), this ''*nomen novum*'' was necessary because of the previous name *Hyla orientalis* Bedriaga, 1890. *Hyla rubra altera*, described as a subspecies of *Scinax ruber* (Laurenti, 1768), was initially recognized as full species by Carvalho-e-Silva and Peixoto (1991; as *Ololygon altera*). Later, Duellman and Wiens (1992) considered *Ololygon* as a junior synonym of *Scinax* and used the combination *Scinax alterna* (an incorrect subsequent spelling). Although this new name was published without a reasonable explanation, Pombal et al. (1995b) reaffirmed that *Scinax alter* must be recognized as full species, due to considerable differences between *Scinax alter* and *S. ruber* in size and color pattern.

Scinax alter is currently known to occur from the coastal plains of the Pernambuco south to Rio Grande do Sul and Minas Gerais states (Lutz, 1973; Silvano and Pimenta, 2001); despite that, Kwet and Di-Bernardo (1999), Kwet (2001a, 2001b), and Kwet et al. (2010) already considered the southern populations from Rio Grande do Sul and Santa Catarina as an undescribed species. Due to the complex taxonomic history and geographic variation of advertisement calls and adult morphology, Pombal et al. (1995a, 1995b) suggested that *S. alter* might represent a species complex. Herein, we delimit the specific name *S. alter* and describe two new species using an alpha-taxonomical revision based on the variations in bioacoustics, morphology, and dorsal pattern of samples currently referred to *S. alter*.

MATERIALS AND METHODS

We examined preserved specimens of *Scinax alter* from several collections in Brazil (Appendix I). Institutional abbreviations can be found in Sabaj Pérez (2010), with the addition of AL-MN (Adolpho Lutz Collection, housed at Museu Nacional), MCNAM (Museu de Ciências Naturais, Belo Horizonte, MG), MUFAL (Museu de História Natural da Universidade Federal de Alagoas, Maceió, AL), and MZUEFS (Museu de Zoologia da Universidade Estadual de Feira de Santana, Feira de Santana, BA).

We analyzed 815 males and females specimens from samples of *Scinax alter* representing the entire geographical range of this taxon (Fig. 1; see Material Examined) and developed a series of criteria for drawing general dorsal patterns. Drawings were made using a Zeiss stereomicroscope with a drawing tube. Standards for the dorsal outline and profile of the snout follow Heyer et al. (1990). Webbing formulae follow Savage and Heyer (1967), as modified by Myers and Duellman (1982). The sex was determined by the presence of vocal sac and vocal slits in adult males. Tadpole stage is according to Limbaugh and Volpe (1957), as modified by Gosner (1960).

We measured 17 morphometric characters from the samples of *S. alter*, using the 14 morphometric characters described in Duellman (2001) as modified by Napoli (2005): SVL (snout–vent length), HL (head length), HW (head width), ED (eye diameter), TD (tympanum diameter), UEW (upper eyelid width), IOD (interorbital distance), IND (internarial distance), END (eye–nostril distance), NSD

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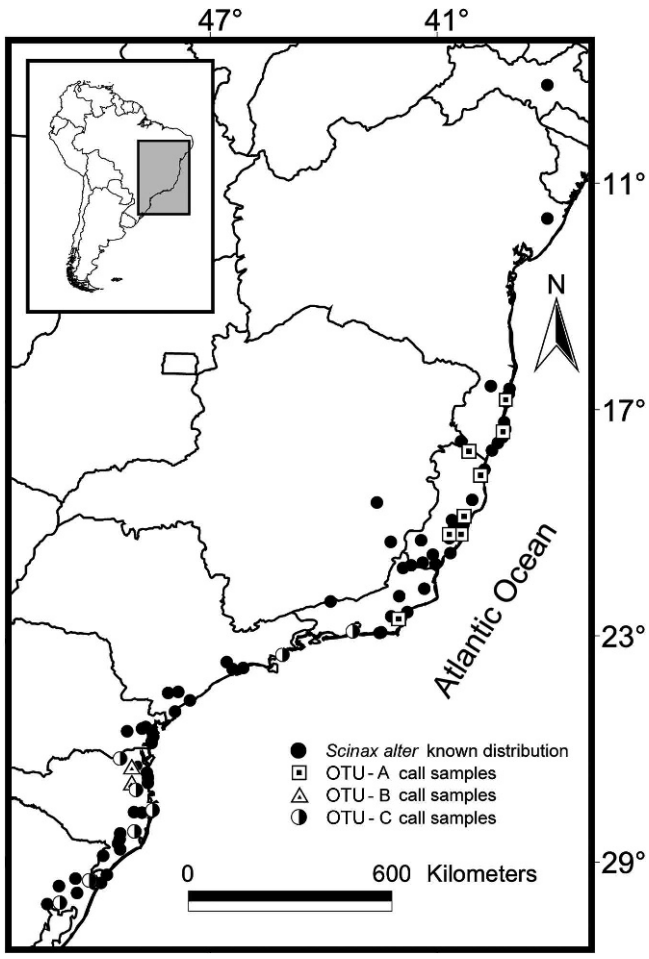

Fig. 1. Previously known distribution of the *Scinax alter* species complex and that from which advertisement calls were analyzed.

(nostril to tip of snout distance), TL (tibia length), FL (foot length including tarsus), 3FD (third finger disk diameter), and 4TD (fourth toe disk diameter). The remaining measurements were THL (thigh length; following Heyer et al., 1990), FAL (forearm length: straight line distance between the elbow and the wrist), and HAL (hand length: straight line distance between the wrist and the tip of the third finger). SVL, HL, HW, FAL, HAL, THL, TL, and FL were measured with Vernier calipers (precision 0.05 mm); all other variables were measured with an ocular micrometer in a Zeiss stereomicroscope. To examine morphometric variation we group distinct male samples ($n = 375$) in operational taxonomic units (hereafter OTUs; as defined by Heyer, 2005). Groupings were based on acoustic, dorsal color pattern, and external morphology homogeneity. We used a canonical discriminant analysis (hereafter CDA) to study multivariate patterns. This method ordinates *a priori* groups so that it maximizes the between-group variation in relation to the within-group variation, thus producing maximal separation between groups in a reduces space of canonical discriminant variables (hereafter CDs; Malhotra and Thorpe, 1997). These procedures were carefully evaluated before taxonomic decisions.

We digitized the sound recordings (Fig. 1) with a sampling frequency of 11.025 kHz and 16 bits (see Material Examined). We made the waveforms and audiospectrograms in the Avisoft SAS Lab Light 3.74 and Sound Ruler V4 with a bandwidth of 161 Hz, Fast Fourier Transform length (FFT) of 256, overlap 93.75%, frame 100%, window Flat Top, and time-resolution of 1.45 ms. The terminology used for the description of the advertisement calls followed Wells (1977) and Littlejohn (2001).

RESULTS

Operational taxonomic units of *Scinax alter* are alike in morphological traits and the divergence in the characters here studied was enough to determine taxonomic units when at least one non-overlapping character was found in the comparisons. Therefore, we focused our analysis on the advertisement calls, a well-known prezygotic isolation mechanism (see Wells, 2007 for revision), in the variation of the dorsal drawing pattern, and morphometrics to determine the species' boundaries.

Our analysis of advertisement calls revealed a single periodic pulse train without frequency modulation as the basic characteristic of these calls (Fig. 2). The general frequency parameters and temporal parameter of call duration showed high variation with some overlap. The temporal parameters related to the pulses were more conservative and presented different values. Thus, three distinct types of advertisement calls became evident in the sound recordings we examined: call ''type A'' with pulse duration 0.010–0.011 s (0.010 ± 0.000; $n = 160$ pulses), interval between pulses 0.004–0.006 s (0.005 ± 0.000; $n = 160$ pulse intervals), and pulse rate 72–74 pulses/s (73 ± 0.65; $n = 80$ calls); call ''type B'' with pulse duration 0.005–0.008 s (0.007 ± 0.001; $n = 160$ pulses), interval between pulses 0.018–0.025 s (0.020 ± 0.02; $n = 160$ pulse intervals), pulse rate 34–39 pulses/s (35 ± 0.97; $n = 80$ calls); call ''type C'' with pulse duration 0.018–0.020 s (0.019 ± 0.01; $n = 160$ pulse intervals), interval between pulses 0.007–0.008 s (0.007 ± 0.000; $n = 160$ pulse intervals), pulse rate 39–40 pulses/s (40 ± 0.42; $n = 80$ calls).

We reported seven dorsal patterns in the drawings (Fig. 3). Individuals that show dorsal patterns ''A'' to ''D'' are associated with the population samples that exhibit the type A advertisement call (Figs. 2A, 3A–D; hereafter OTU A); dorsal patterns ''B'' and ''D'' are associated with the population samples with the type B advertisement call (Figs. 2B, 3B, 3D; hereafter OTU B); and dorsal patterns ''E'' to ''G'' are restricted to the population samples having the type ''C'' advertisement call (Figs. 2C, 3F–G; hereafter OTU C).

The CDA based on the grouped samples of the three OTUs (375 measured adult males) shows two canonical axes (CDs). CD1 accounted for 91% of the total variation and CD2 for 9%. The standardized coefficients and factor loadings of the canonical axes are presented in Table 1. The two canonical axes show that OTU A is partially separated from OTU B, and promoted an almost complete separation of OTU C from the remaining OTUs (Fig. 4). When we look for the axes individually, CD1 is mostly influenced by IND, SVL, NSD, TD, and HL, respectively (Table 1), shows almost complete separation of OTU C from OTU A and OTU B, and complete overlapping between OTU A and OTU B (Fig. 4). CD2 is mostly influenced by TL, IOD, HW, END, and FL, respectively (Table 1), shows partial separation between OTU A and OTU B, and complete overlapping between OTU C from OTU A and OTU B (Fig. 4).

These three OTUs can be distinguished from the following species groups or complexes by their presenting different or absent characteristics from the *S. alter* species complex:

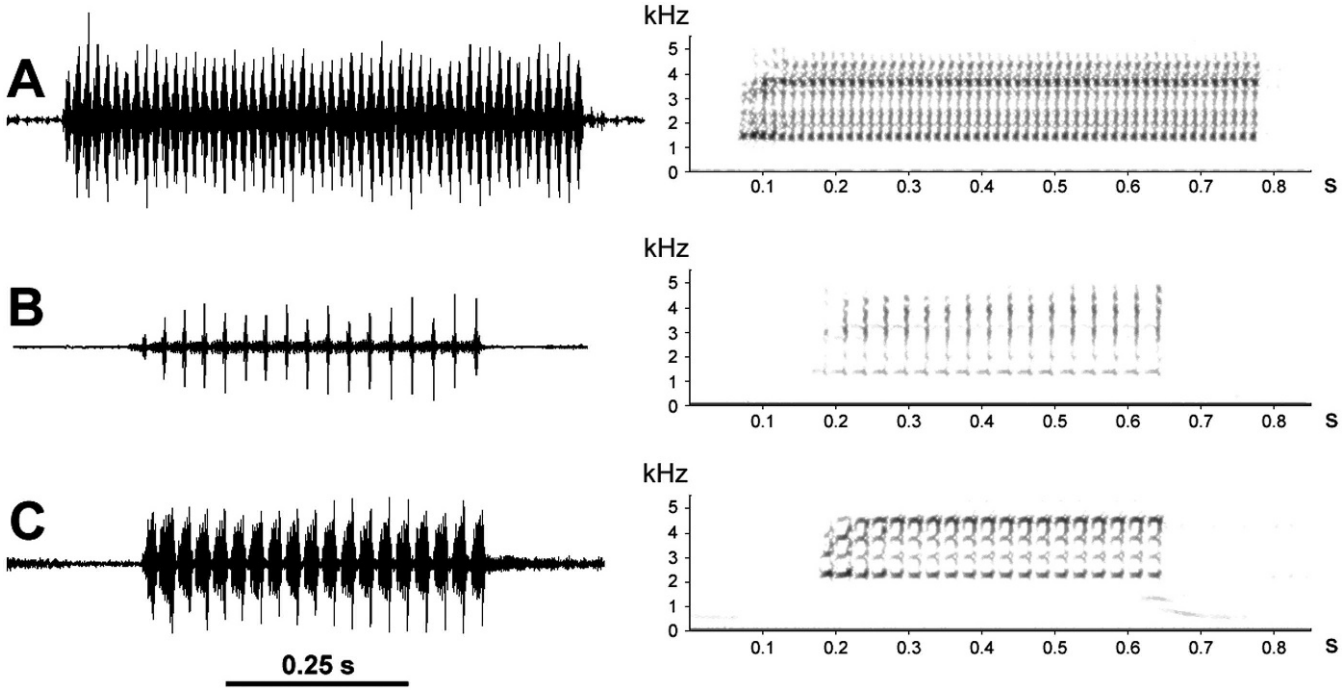

Fig. 2. Waveforms (left) and audiospectrograms (right) of the advertisement calls types presented by *Scinax alter*. (A) UFBA unvouchered record, Santa Teresa, Espírito Santo State, Brazil, 2215 h, air temperature 22.5°C, water temperature 25°C; (B) AK 22B15, Blumenau, Santa Catarina State, Brazil, 2130 h, air temperature 29°C; (C) AK 15B18, Florianópolis, Santa Catarina State, Brazil, 2100 h, air temperature 21.5°C. Additional information for recordings are in Material Examined section.

S. rostratus species group (differ by the presence of pointed tubercle on heel and well-protruding snout; *sensu* Faivovich et al., 2005), *S. uruguayus* species group (differ by the presence of bicolored iris; Faivovich et al., 2005), *S. staufferi* species group (differ by the presence of long and pointed snout; *sensu* Duellman and Wiens, 1992), and *S. auratus* species complex (differ by the presence of several notes in the advertisement call; *sensu* Nunes and Pombal, 2011), and the *S. duartei* species complex (differ by the presence of interocular blotch extending in two longitudinal stripes to inguinal region; *sensu* Pugliese et al., 2009). Additionally, the OTUs can also be differentiated from the *Scinax x-signatus* Spix (the problems of this complex comes from the several morphotypes under the same name, type locality not restricted, and lost type; see Pombal et al., 1995a; Fouquet et al., 2007; Pugliese et al., 2009) and from *S. dolloi* (name not associated with any known population; see Faivovich et al., 2005, for details) by the absence of flash blotches on hidden portion of the thighs and flanks (present in the lost holotype of *S. x-signatus* according to Spix, 1824 [original description], and in the types of *S. dolloi* according to J. Faivovich, pers. comm.). Additionally, we exclude for the specific comparisons the species that inhabit high elevations or Pacific lowlands (where the barrier provided by Andes presents a challenge for dispersion): *S. cabralensis* Drumond, Baêta, and Pires, *S. camposseabrai* (Bokermann), *S. castroviejoi* De la Riva, *S. crospedospilus* (A. Lutz), *S. chiquitanus* De la Riva, *S. elaeochorus* (Cope), *S. hayii* (Barbour), *S. manriquei* Barrio-Amorós, Orellana, and Chacón-Ortiz, *S. maracaya* (Cardoso and Sazima), *S. oreites* Duellman and Wiens, *S. perereca* Pombal, Haddad, and Casahara, *S. quinquefasciatus* (Fowler), and *S. tigrinus* Nunes, Carvalho, Jr., and Pereira. Thus, for the taxonomic purposes, the specific comparisons were restricted to the following species unassigned to species groups or complexes in the *S. ruber* clade (*sensu* Faivovich et al., 2005) that inhabit South American low elevations: *S. acuminatus* (Cope), *S. blairi* (Fouquette and Pyburn), *S. cruentommus* (Duellman), *S. cuspidatus* (A. Lutz), *S. eurydice* (Bokermann), *S. funereus* (Cope), *S. fuscovarius* (A. Lutz), *S. granulatus* (Peters), *S. ictericus* Duellman and Wiens, *S. iquitorum* Moravec, Tuatama, Pérez-Peña, and Lehr, *S. karenanneae* (Pyburn), *S. lindsayi* Pyburn, *S. pachycrus* Miranda-Ribeiro, *S. ruber* (Laurenti), and *S. similis* (Cochran).

Based on aforementioned characteristics and known type locality, the OTU A, with a northern distribution, was named *S. alter* B. Lutz (1973). The other two OTUs with more southern distribution ranges were not associated with any described species or synonyms and are here proposed as new species.

Scinax alter (B. Lutz, 1973)

Figures 5A, 6A, 7A

Hyla fuscomarginata (non A. Lutz, 1925).—Bokermann (1966).
Hyla rubra orientalis B. Lutz, 1968.
Hyla rubra altera B. Lutz, 1973 (replacement name for *Hyla rubra orientalis* B. Lutz).
Ololygon altera.—Carvalho-e-Silva and Peixoto (1991).
Scinax altera.—Pombal et al. (1995a).
Scinax alterus.—Silvano and Pimenta (2001; incorrect subsequent spelling).
Scinax alter.—Alves and Carvalho-e-Silva (2002; correct citation of the specific epithet).

Holotype.—MNRJ 4030, adult male, Brazil, Espírito Santo State, Municipality of Santa Leopoldina, Ribeirão Crubixá-Mirim, 20°06′S, 40°31′W, 400 m a.s.l., Elio Gouvêa, 16 March 1960.

Paratopotypes.—MNRJ 14288–14299, 4031–4032 (12 males, 2 females, respectively), collected with the holotype.

Fig. 3. Standards for general dorsal patterns of *Scinax alter* species complex.

Non-type material.—Brazil, Bahia, Alcobaça: MNRJ 52862; Caraíva: CFBH 13322–13326; Caravelas: MNRJ 34982–34983, MZUEFS 2004–2007; Eunápolis: MNRJ 31642–31645, 32877; Mucuri: MNRJ 18340, 31557–31558; Nova Viçosa: MNRJ 19059, 52391; Porto Seguro: MNRJ 25630, 28904–28905, 28912, 42563–42564, 46483, 47815–47817; Prado: MNRJ 29201, 29768–29769, 42420–42436, 47711; Trancoso: MNRJ 47815–47817; Espírito Santo, Aracruz: CFBH 4029, 5361–5362, 5563, 16253; Cariacica: MCP 2819–2825, MNRJ 24634–24635, 26139, 27865–27869, 27877–27879, 28420, 28428–28429; Conceição da Barra: MNRJ 48856–48871, 48873–48897, 48899–488905, 6481–6487; Domingos Martins: MNRJ 18460; Linhares: CFBH 1032–1033; Marechal Floriano: CFBH 1472; Muniz Freire: CFBH 4108; Presidente Kennedy: MNRJ 24804–24806; Santa Leopoldina: CFBH 1350–1351, topotypes; Santa Teresa:

Table 1. Standardized Coefficients and Factor Loadings (*r*) from a Canonical Discriminant Analysis (CDA; Fig. 4) for 17 Morphometric Characters of Three Operational Taxonomic Units (OTUs) of Adult Males of *Scinax alter*. Cum. prop. = cumulative proportion of eigenvalues.

Characters	VC 1	VC 2	*r* (VC1)	*r* (VC2)
SVL	0.92168	−0.575785	0.7788	0.4452
HL	0.16674	−0.395381	0.7194	0.5087
HW	−0.09974	1.306892	0.6842	0.6228
IND	0.61271	−0.284070	0.8967	0.1481
NSD	0.17840	−0.075788	0.7486	0.0907
UEW	−0.78207	0.200915	0.2196	0.4297
ED	0.17450	−0.538163	0.6429	0.2440
IOD	−0.03700	0.349160	0.4947	0.6363
END	−0.19502	0.304942	0.4565	0.6180
TD	0.16275	0.216882	0.7403	0.4108
FAL	0.07474	0.062765	0.5775	0.4872
HAL	0.22482	0.133685	0.6280	0.5487
3FD	0.19912	−0.485165	0.5650	0.4014
4TD	−0.01025	0.070593	0.5038	0.4096
THL	0.31055	0.158843	0.5888	0.5859
TL	−1.36864	0.281093	0.4198	0.6575
FL	0.11478	−0.022548	0.5837	0.5877
Eigenvalues	4.12473	0.419066	—	—
Cum. prop.	0.90777	1.000000	—	—

MNRJ 24804–24806, 26088, 28358–28359, 30111–30121, 30878, 34924–34925, 38384–38389, 40620–40622, 40767, 43767; São Mateus: CFBH 1518, 1531, 1566, MNRJ 18424–18427, 31395–31397; Serra: CFBH 1442, 1484,10838; Vitória: CFBH 1352–1353, MNRJ 18410–18411. Minas Gerais, Ipatinga: MCNAM 4188–4192; Nanuque: MCNAM 2918–2919, 7009–7024, 7025–7041, 7043–7057, 7059–7086; Orizânia: MCNAM 8350; Rio Preto: MCNAM 8331. Rio de Janeiro, Arraial do Cabo: MNRJ 43375–43380, 45728, 45732, 54088; Bom Jesus do Itabapoana: MNRJ 51876–51884, 51913; Campos dos Goytacazes: MNRJ 51885–51893, 51905–51911, 51912; Casemiro de Abreu: MNRJ 42501; Duque de Caxias: MNRJ 53730, 53747–53749; Itaperuna: MNRJ 51914; Macaé: MNRJ 47430–47444; Maricá: MNRJ

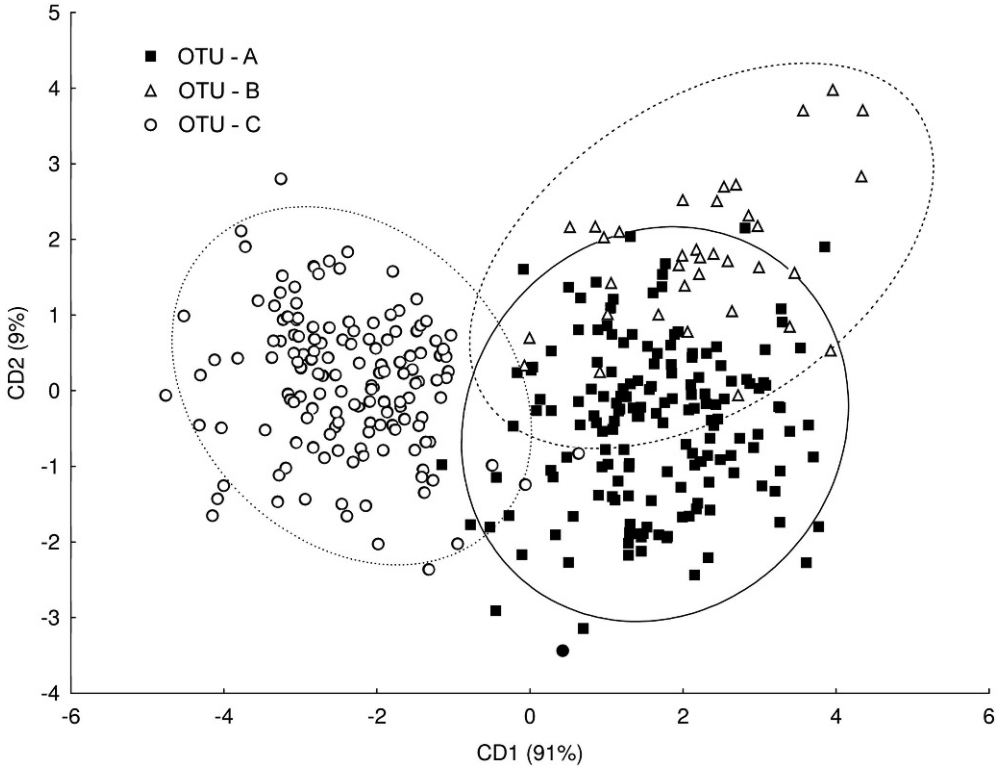

Fig. 4. Plots of individual scores resulted from canonical discriminant analysis (CDA) of morphometric data from three Operational Taxonomic Units (OTUs) of adult males of *Scinax alter* in the space of the first with the second canonical axes. Confidence ellipses (95%) for the scores of each OTU are shown.

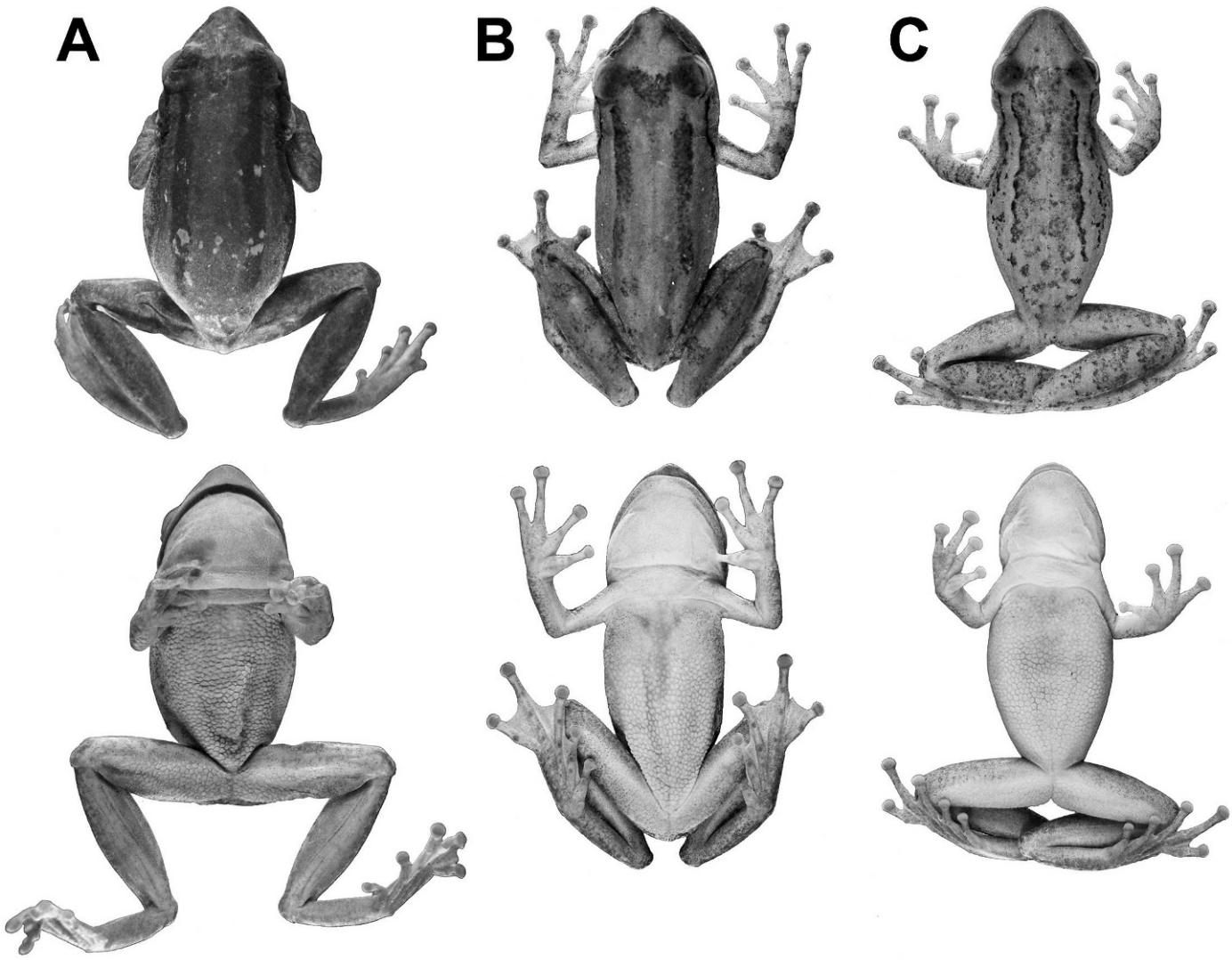

Fig. 5. Dorsal and ventral views of the holotypes of *Scinax alter* (A; MNRJ 4030; 28.1 mm SVL), *S. imbegue,* new species (B; MNRJ 49205; 29.0 mm SVL), and *S. tymbamirim,* new species (C; MNRJ 49188; 27.4 mm SVL).

29308–29319, 29359–29385, 29559–29578, 31231–31257, 31956–31966, 49940–49941; Rio das Ostras: MNRJ 37333, 42501, 47247–47267, 47275; Rio de Janeiro: MNRJ 27051–27053, 37333; Saquarema: MNRJ 30313–30316, 52144–52149; Santa Maria Madalena: MNRJ 51894–51904.

Diagnosis.—Species belonging to the *Scinax ruber* clade (*sensu* Faivovich et al., 2005) and diagnosed by the following combination of characters: (1) moderate size (males 22.5–31.1 mm SVL; females 23.9–31.0 mm); (2) advertisement call with pulse duration 0.010–0.011 s; (3) interval between pulses 0.004–0.006 s; (4) pulse rate 72–74 pulses/s; (5) internal and external dark brown stripes border dorsolateral white stripes; (6) smooth vocal sac; (7) smooth tarsi.

Comparisons.—*Scinax alter* is promptly distinguished from *S. acuminatus*, *S. eurydice*, *S. fuscovarius*, *S. iquitorum,* and *S. granulatus* by the smaller SVL in adult males (22.5–31.1 mm SVL in *S. alter* and 32.4–51.2 mm combined SVL for the other species; Moravec et al., 2009; present study). The dorsal pattern with dorsolateral white stripes bordered by dark brown stripes distinguishes *Scinax alter* from *S. acuminatus* (saddle-shaped or trapezoid-shaped sacral spot on lighter background; Cei, 1980), *S. blairi* (small elongated and fragmented dark blotches, and several small blotches, on lighter background; Fouquette and Pyburn, 1972), *S. cruentommus* (pale, with or without small dark spots; Duellman and Wiens, 1993; Moravec et al., 2009), *S. cuspidatus* (a series of fragmented and elongated dark spots on each side of the trunk, with a margin of darker dots, on a lighter dorsum; Lutz, 1973), *S. eurydice* (a pair of dark sickle-shaped spot, sometimes anastomosed, on a lighter background; Lutz, 1973), *S. funereus* (dark fragmented stripes or series of dashes on a light background; Duellman and Wiens, 1993; Moravec et al., 2009), *S. fuscovarius* (dots and network of dark blotches, sometimes with inverted parenthesis in angled position, on a lighter background; Lutz, 1973), *S. granulatus* (inverted dark parenthesis and a pair of sacral blotches, with small scattered dark spots, on lighter background; Kwet, 2001a), *S. ictericus* (pale, with small round dark spots; Duellman and Wiens, 1993; Moravec et al., 2009), *S. iquitorum* (few dots on a lighter background; Moravec et al., 2009), *S. karenanneae* (mottled dark pattern on lighter background, and dorsolateral white stripe with irregular dark contour; Pyburn, 1993), *S. lindsayi* (dark blotches and punctuations on lighter background; Pyburn,

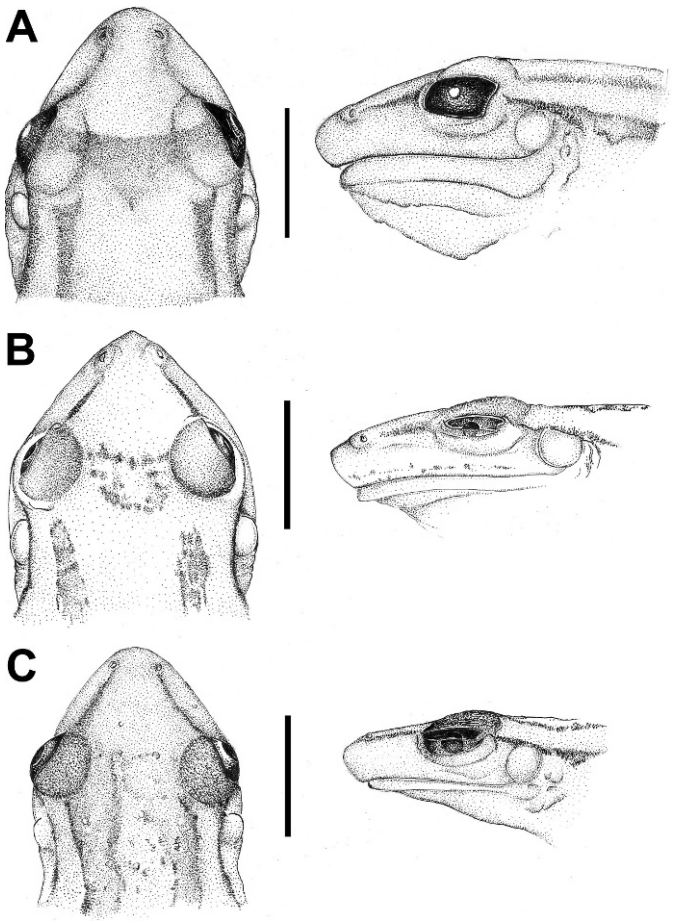

Fig. 6. Dorsal and lateral views of the head of the holotypes of *Scinax alter* (A; MNRJ 4030), *S. imbegue,* new species (B; MNRJ 49205), and *S. tymbamirim*, new species (C; MNRJ 49188).

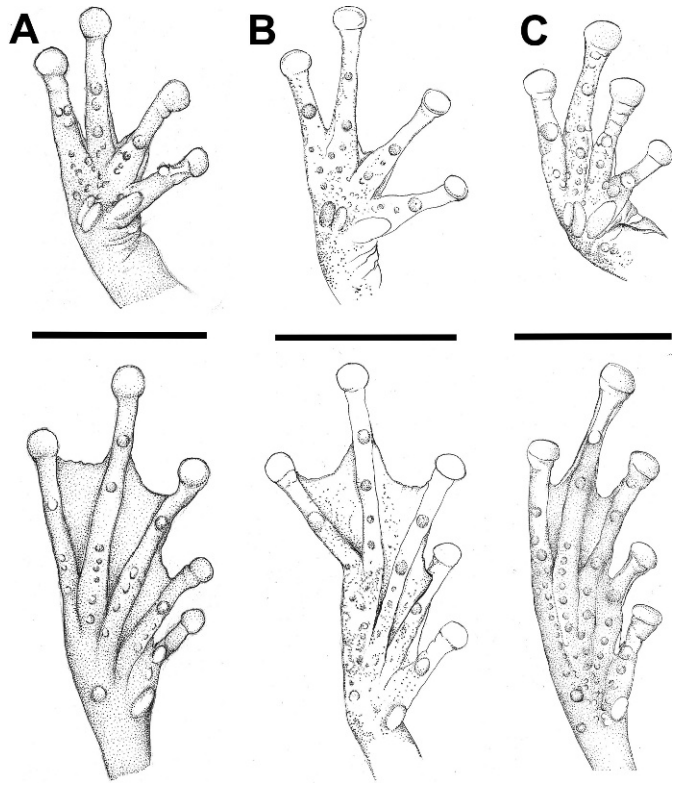

Fig. 7. Hand (top) and foot (below) of the holotypes of *Scinax alter* (A; MNRJ 4030), *S. imbegue*, new species (B; MNRJ 49205), and *S. tymbamirim*, new species (C; MNRJ 49188). The webbing could be little folded in the *S. alter* drawing due to the preservation.

1992), *S. pachycrus* (dark subcanthal line, beginning behind the nostril, widening into a dorsolateral stripe, and ending about the sacral region, on a light background; Lutz, 1973), and *S. similis* (fragmented inverted dark parenthesis on lighter background, and with white dots scattered on dorsum; Lutz, 1973). *Scinax alter* differs from *S. blairi*, *S. cruentommus*, *S. eurydice*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. iquitorum*, and *S. ruber* by the absence of yellow flash coloration on the posterior surfaces of the thighs and/or flanks (present in these species), and from *S. iquitorum* by the absence of black color on the posterior surfaces of the thighs (present in *S. iquitorum*). The dorsal skin texture is smooth in *Scinax alter* and granulose in *S. cruentommus*, *S. funereus*, and *S. granulatus* (Moravec et al., 2009; present study). The webbing formula I 2–2 II 1–2^{+} III 1^{+}–2^{+} IV 2^{+}–1 V in *Scinax alter* differs from that in *S. similis* (webbing formula I 2–2 II 2^{-}–3 III 2–3 IV 2½–1^{+} V). The vocal sac in *Scinax alter* has smooth skin texture, while *S. granulatus* exhibits granulose skin texture. The smooth tarsal region distinguishes *Scinax alter* from *S. cuspidatus*, *S. eurydice*, *S. ictericus*, and *S. iquitorum* (tarsal tubercles present in these species; Duellman and Wiens, 1993; Moravec et al., 2009; present study).

Redescription of holotype.—Body slender (Fig. 5A); moderate size; head slightly longer than wide; snout subovoid in dorsal view, protruding in profile; nostrils dorsolateral, elliptical, on small elevations; canthus rostralis slightly marked, concave; loreal region slightly concave; eyes protuberant; tympanum visible, rounded (Fig. 6A); supratympanic fold slightly evident, extending from the posterior corner of the eye to the shoulder; vocal sac well developed, single, median, subgular; vocal slits laterally on mouth floor; tongue large, cordiform, posteriorly notched, barely free; vomerine teeth below the oval choanae in two straight series, closer to each other. Pectoral fold present. Arm slender, forearm moderately robust; fingers slender, medium-sized, poorly fringed; webbing barely visible; absence of pigmented spicules on the finger I; relative finger lengths I≤II<IV<III; finger disks nearly rounded, medium-sized; inner metacarpal tubercle normal, elliptical; outer metacarpal tubercle divided, both elongated and as big as the inner metacarpal tubercle; subarticular tubercles simple, small, rounded, except tubercle on finger IV that is divided; supranumerary tubercles rounded, small (Fig. 7A). Legs moderately robust; toes slender, long; relative toe lengths I<II<V<III<IV; toe disks medium-sized, nearly rounded; disk of toe III bigger than other toe disks; webbing formula I 2–2 II 1–2^{+} III 1^{+}–2^{+} IV 2^{+}–1 V; foot with normal inner metatarsal tubercle, oval, medium-sized; outer metatarsal tubercle simple, rounded; subarticular tubercles normal, rounded; supranumerary tubercles small, normal, rounded (Fig. 7A). Skin on dorsum, gular region, undersurfaces of arms and tibiae, smooth; skin on venter and thighs strongly granulated.

Measurements of holotype (mm).—SVL 28.1; HL 10.8; HW 9.3; IND 1.9; NSD 1.3; END 3.1; UEW 1.8; ED 3.1; IOD 2.9; TD 1.5; FAL 5.4; HL 7.5; 3FD 1.1; THL 13.0; TL 14.1; FL 19.0; 4TD 1.1.

Color.—General coloration in life light brownish; canthus rostralis marked by a narrow dark brown stripe; a dorsolateral

beige stripe extending from the posterior corner of the eye to the inguinal region; this stripe is bordered by two dark brown longitudinal stripes, with the stripe above broader than that below; an interocular dark brown blotch with inverted triangle shape; a transversal dark-brown stripe, poorly evident, on dorsal surfaces of arms and legs (see color photo in Izecksohn and Carvalho-e-Silva, 2001). Hidden surfaces of the thigh and inguinal regions beige marbled. Ventral region yellowish-beige. Iris brownish-beige. In preservative, the pattern is the same as described, but the colors fade (see black and white photo in Fig. 8A).

Variation.—The measured specimens of *Scinax alter* showed some variation in size (Table 2), with females usually larger than males, as well as differences in development of finger webbing (modal webbing formula I 2–2 II 1–2 III 1–2 IV 2–1 V) and dorsal pattern (patterns A to D; see Fig. 3). The supratympanic fold either reach the shoulder or was restricted to the superior portion of the annulus tympanicus. The finger and toe disks are rounded or elliptical, determining the great amplitude of 3FD and 4TD measurements (see Table 2). Subarticular tubercles of the finger IV are bifid or normal and rounded, but this variation is restricted to few specimens (14%). The snout is subovoid or mucronate, but the mucronate type is restricted to few specimens (20%). The sizes of the outer metacarpal tubercles vary in relation to each other. The interocular blotch can be bordered by a narrow beige stripe; it can be an inverted triangle or Y-shaped. Some specimens have a few dorsal vestigial granules. The population from the south of Espírito Santo has a unique granulose skin texture dorsally.

Vocalization.—Pombal et al. (1995a) was the first to describe the advertisement calls of several species of *Scinax*, including those of *S. alter* (as *S. altera*), based on recordings from the Municipality of Conceição da Barra, Espírito Santo State (260 km from the type locality, Municipality of Santa Leopoldina, Espírito Santo). According to Pombal et al. (1995a), the multi-pulsed advertisement call (Pombal et al., 1995a:fig. 1) has a call duration of 0.38–2.07 s; intercall interval of 0.38–4.69 s; number of notes 1; number of pulses per note 29–152; and dominant frequency 1.3–4.6 kHz. The values obtained from the additional recordings analyzed in this study are in agreement with those published previously.

Tadpole.—The following larval description is based on the description published in Alves and Carvalho-e-Silva (2002). The tadpoles described here were obtained at Magé, Rio de Janeiro, in developmental stages 36–37 (Gosner, 1960). Total length 22.9–32.0 mm; body ovoid in dorsal view, approximately as wide as high; body length 7.6–9.7 mm; nares slightly closer to eyes than to snout; eyes lateral, eye diameter 1.4–1.6 mm; spiracle sinistral, short, located slightly beyond half of body; vent tube short, dextral, attached to ventral fin; tail fins similar in height; oral disc anteroventral, oral disc width 1.4–2.2 mm, with single row of marginal papillae, and with variable number of lateral submarginal papillae; labial tooth row formula 2(2)/3(1); jaw sheaths strong and finely serrated (Alves and Carvalho-e-Silva, 2002:fig. 1).

Natural history.—Species associated with arbustive vegetation at margins of ponds in open areas or at forest edges. *Scinax alter* is also sometimes found in terrestrial or arboreal bromeliads (*Aechmea nudicaulis*, *Neoregelia cruenta*, and *Vriesea friburgensis*) when occurring in ''restinga'' habitats (''restinga'' are sand dunes covered by herbaceous and arbustive-arboreal vegetation near beaches, *sensu* Araújo, 1992; Silva et al., 1988a; Carvalho-e-Silva et al., 2000; Teixeira et al., 2002; Van Sluys et al., 2004; Rocha et al., 2008a). The vocal activity is prolonged and can occur throughout the year (see Silva et al., 1988b).

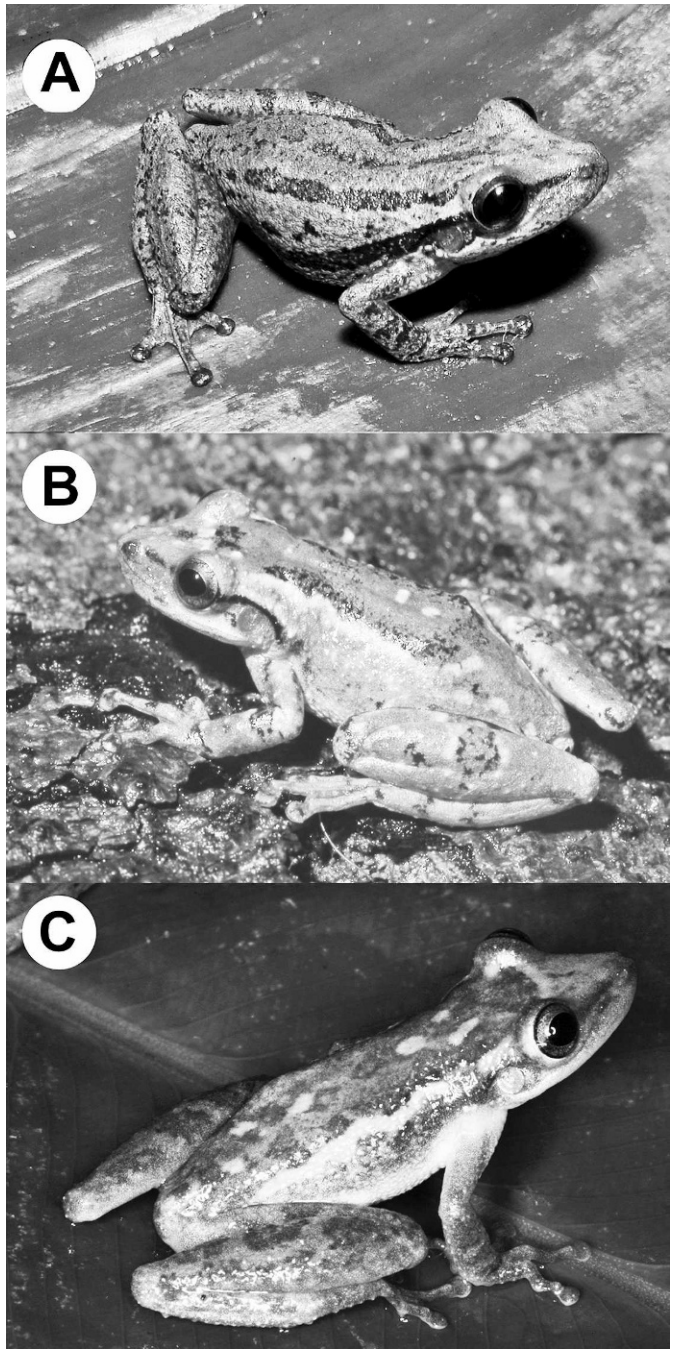

Fig. 8. Photographs of living specimens of *Scinax alter* (A; MNRJ 38347, Santa Teresa, Espírito Santo State, photo by IN), *S. imbegue*, new species (B; adult female from Brusque, Santa Catarina State, MCP 7640, photo by AK), and *S. tymbamirim*, new species (C; adult male from Lagoa do Perí, Santa Catarina Island, Florianópolis, Santa Catarina State, MCP 8263, photo by AK).

Distribution.—*Scinax alter* mainly occurs in lowland coastal areas of eastern Brazil, from southern Bahia (south of the

Table 2. Descriptive Statistics (in millimeters) of *Scinax alter*, *S. imbegue*, New Species, and *Scinax tymbamirim*, New Species. The results are presented as mean ± standard deviation (minimum–maximum).

Measures	*S. alter*		*S. imbegue*, new species		*S. tymbamirim*, new species	
	Males (*n* = 190)	Females (*n* = 29)	Males (*n* = 37)	Females (*n* = 17)	Males (*n* = 148)	Females (*n* = 26)
SVL	27.1±1.7 (22.5–31.1)	28.3±1.8 (23.9–31.0)	29.7±2.0 (25.6–35.0)	32.4±2.9 (28.8–38.0)	24.5±1.2 (20.6–27.4)	26.0±1.8 (22.3–31.2)
HL	9.9±0.7 (8.2–11.6)	10.5±0.6 (9.2–11.6)	10.9±0.8 (9.0–12.6)	11.9±0.9 (10.8–13.4)	9.1±0.5 (7.3–10.2)	9.7±0.6 (8.4–10.8)
HW	8.8±0.6 (7.3–10.5)	9.3±0.7 (7.7–10.6)	9.9±0.6 (8.6–11.6)	10.8±1.0 (9.5–12.6)	8.1±0.5 (6.7–9.0)	8.5±0.7 (6.9–9.6)
ED	2.8±0.2 (1.7–3.7)	3.1±0.2 (2.7–3.4)	3.0±0.3 (2.5–3.8)	3.3±0.4 (2.5–4.0)	2.6±0.2 (2.0–3.1)	2.7±0.3 (2.1–3.1)
END	2.8±0.2 (2.3–3.5)	2.9±0.2 (2.3–3.4)	3.2±0.3 (2.5–3.9)	3.5±0.2 (3.2–3.9)	2.7±0.2 (2.2–3.1)	2.8±0.2 (2.6–3.4)
TD	1.4±0.1 (1.1–1.9)	1.5±0.1 (1.2–1.8)	1.6±0.2 (1.2–2.2)	1.7±0.3 (1.1–2.2)	1.2±0.1 (1.0–1.5)	1.3±0.1 (1.1–1.5)
UEW	2.1±0.3 (1.6–2.9)	2.3±0.2 (1.9–2.8)	2.4±0.4 (1.5–3.2)	2.5±0.3 (1.9–2.8)	2.1±0.2 (1.8–2.5)	2.2±0.2 (1.9–2.6)
IOD	2.8±0.2 (2.2–3.4)	2.9±0.2 (2.3–3.3)	3.1±0.2 (2.8–3.9)	3.3±0.3 (3.0–3.9)	2.6±0.2 (2.2–3.3)	2.9±0.2 (2.5–3.2)
IND	2.0±0.1 (1.6–2.3)	2.0±0.2 (1.7–2.4)	2.1±0.1 (1.9–2.4)	2.2±0.2 (1.9–2.6)	1.6±0.1 (1.4–2.5)	1.7±0.1 (1.5–2.0)
NSD	1.2±0.1 (0.9–1.7)	1.3±0.1 (1.1–1.6)	1.3±0.1 (1.0–1.5)	1.4±02 (1.0–1.7)	1.0±0.1 (0.9–1.3)	1.1±0.1 (0.9–1.4)
FAL	5.3±0.4 (4.1–6.8)	5.7±0.5 (4.8–7.0)	5.9±0.6 (4.8–7.6)	6.6±0.6 (5.8–7.6)	4.9±0.4 (4.0–5.9)	5.1±0.4 (4.3–6.0)
HAL	7.6±0.7 (5.8–9.0)	7.9±0.8 (6.0–9.0)	8.6±0.9 (7.0–11.0)	9.2±1.0 (8.0–10.8)	6.8±0.5 (5.5–8.2)	7.1±0.6 (6.2–8.7)
3FD	1.2±0.2 (0.9–1.6)	1.3±0.2 (0.9–1.6)	1.4±0.2 (0.8–1.9)	1.6±0.3 (1.3–2.2)	1.1±0.1 (0.8–1.4)	1.1±0.1 (0.9–1.4)
THL	12.0±1.0 (9.3–15.6)	12.6±0.9 (10.8–14.3)	13.6±1.1 (11.5–16.3)	14.8±1.4 (13.0–16.8)	11.2±0.8 (8.9–14.4)	11.8±1.0 (9.5–14.4)
TL	13.2±1.1 (10.2–15.9)	14.1±0.9 (11.8–15.5)	14.8±1.0 (13.0–17.6)	16.6±1.4 (14.3–18.7)	12.7±1.0 (10.2–15.0)	13.4±1.1 (11.9–16.4)
FL	18.5±1.6 (14.5–28.8)	19.4±1.4 (16.1–21.5)	21.0±1.7 (18.6–24.8)	23.1±2.2 (20.3–26.6)	17.11±1.3 (13.5–19.9)	18.1±1.6 (15.5–22.6)
4TD	1.2±0.2 (0.9–1.7)	1.3±0.2 (0.9–1.7)	1.4±0.2 (0.9–2.0)	1.6±0.3 (1.3–2.1)	1.1±0.1 (0.8–1.4)	1.1±0.1 (0.9–1.4)

Jequitinhonha River valley) to Rio de Janeiro, with inland populations in the Minas Gerais (associated to the Rio Doce [Doce River] valley) and some highland populations (~600 m a.s.l.) in Espírito Santo (Fig. 9).

Remarks.—Lutz (1973) cited a specimen of *Scinax alter* (as *Hyla rubra altera*) from Tapera, a locality in the Pernambuco State (the same information is found on the label of the cited specimen AL–MN 2234), indicative of a disjunct distribution. However, in the registration book, the following is written: ''procedência: E. Rio, Rio Branco (D. Caxias). B. Lutz det.'' We reexamined this specimen, regarded as a specimen of *S. alter*, and did not find any other specimen from the Pernambuco State in the AL–MN or MNRJ collections. This suggests that the geographic record of *S. alter* from Tapera was an error. Bastazini et al. (2007) cited *Scinax* aff. *alter* from the Municipality of Mata de São João in the northeastern coast of Bahia. The specimens in question were subsequently named *Scinax cretatus* Nunes and Pombal, and belongs to the *S. auratus* species complex (see Nunes and Pombal, 2011).

***Scinax imbegue*, new species**

Figures 5B, 6B, 7B

Hyla rubra altera B. Lutz, 1973 (part).
Scinax altera.—Pombal et al. (1995b; part).
Scinax sp. I (aff. *alter*, large form).—Kwet and Márquez (2010).

Holotype.—MNRJ 49205, adult male, Brazil, Santa Catarina State, Municipality of Blumenau, Parque das Nascentes, 27°03′S, 49°05′W, 412 m a.s.l., Paulo C. A. Garcia, 14 April 1990.

Paratopotypes.—MNRJ 49203–49204, adult males, collected with the holotype; MCP 8675–8676, female and male adults, respectively, Axel Kwet, Fabiana Dallacorte, Mirco Solé, and Rodrigo Lingnau, 21 January 2006.

Non-type material.—Brazil, Paraná, Antonina: MHNCI 1395, 1397; Morretes: MHNCI 505, 1357, 1359, 1363, 1371–1372, 1377, 1395, 1397–1398, 1827; Paranaguá: MHNCI 4324; Pontal do Paraná: MHNCI 2519, 3020. Santa Catarina: Brusque: MCP 7640, 7642–7643; Guaramirim: MNRJ 1670, 8593–8598; Itajaí: MNRJ 38249–3859; Piçarras: MCP 3517. São Paulo, Bertioga: ZUEC 13608, 13612, 13616, 13621, 13626; Cananéia: CFBH 10691, ZUEC 7725–7726, 7789; Eldorado: CFBH 10664, MNRJ 45169–45171; Iguape: CFBH 10681, 15944–15945; Santo André: ZUEC 6019.

Diagnosis.—A species belonging to the *Scinax ruber* clade (*sensu* Faivovich et al., 2005), diagnosed by the following combination of characters: (1) moderate size (males 25.6–35.0 mm SVL; females 28.8–38.0 mm SVL); (2) advertisement call with pulse duration 0.005–0.008 s; (3) interval between pulses 0.020–0.025 s; (4) slow pulse rate with 33–34 pulses/s; (5) dorsal pattern with dorsolateral white stripe, with dark brown stripes bordering the internal and external portions of each dorsolateral white stripe; (6) smooth vocal sac; (7) smooth tarsi.

Comparisons.—*Scinax imbegue* is promptly distinguished from *S. cuspidatus* by its larger size of adult males (25.6–35.0 mm SVL in *S. imbegue* and 21.4–25.0 mm SVL in *S.*

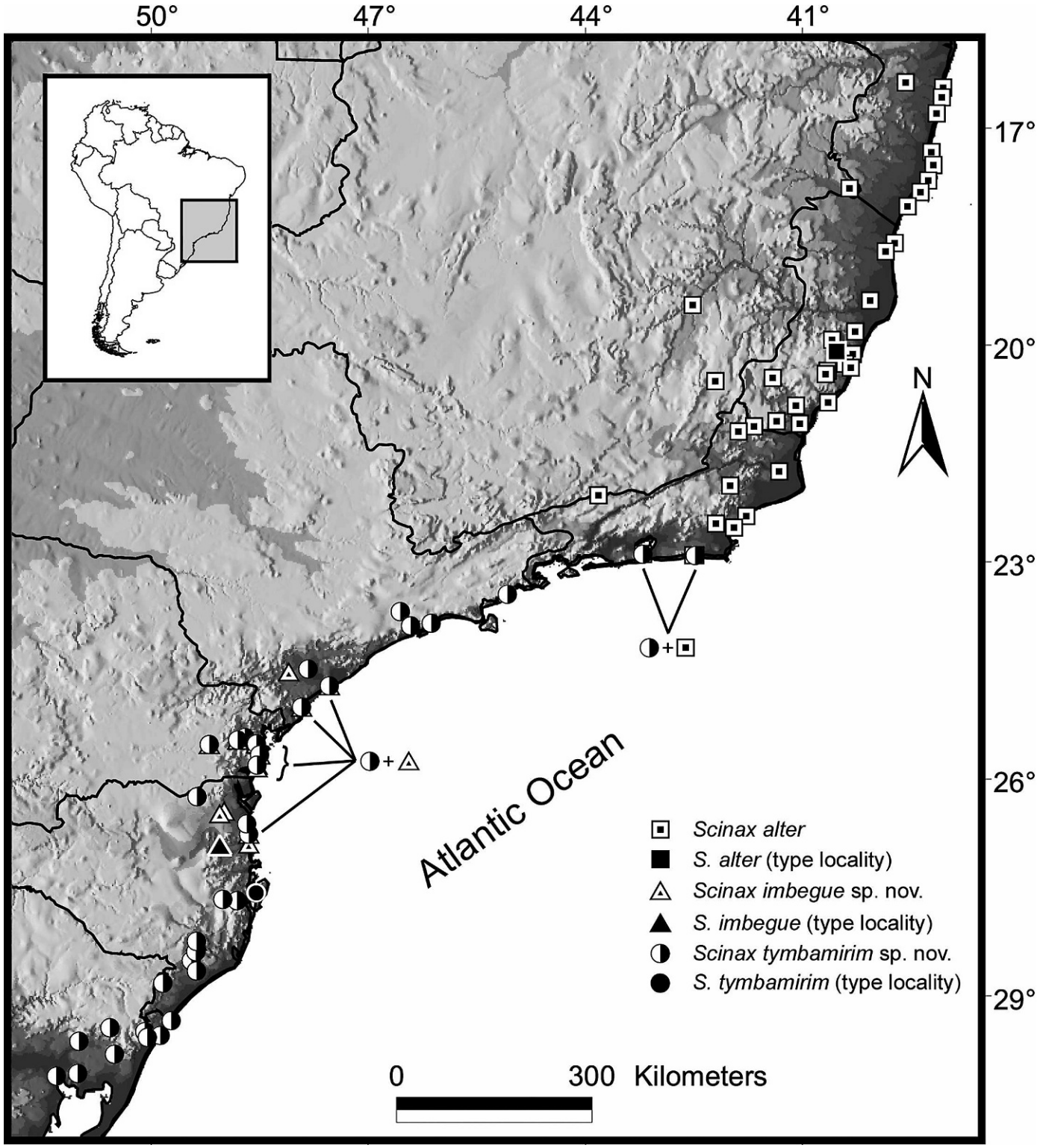

Fig. 9. Map with known geographic distribution of *Scinax alter*, *S. imbegue,* new species, and *S. tymbamirim,* new species, along the Brazilian Atlantic coast.

cuspidatus), and from *S. eurydice*, *S. fuscovarius*, and *S. granulatus* by its smaller size of adult males (combined 35.6–51.2 mm SVL in these species). The dorsal pattern does not always contain a dorsolateral white stripe on either side, but dark brown stripes border the internal and external portions of this white stripe. This distinguishes *Scinax imbegue* from *S. acuminatus*, *S. blairi*, *S. cruentommus*, *S. cuspidatus*, *S. eurydice*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. ictericus*, *S. iquitorum*, *S. karenanneae*, *S. lindsayi*, and *S. similis* because these species lack a dorsolateral striped pattern (see specific pattern descriptions in comparisons of *S. alter*), and from *S. pachycrus* by the different pattern (see specific pattern description in comparisons of *S. alter*). *Scinax imbegue* further differs from *S. blairi*, *S. cruentommus*, *S. eurydice*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. iquitorum*, and *S. ruber* by the absence of yellow flash color on the

posterior surfaces of the thighs and/or flanks (present in these species; Fouquette and Pyburn, 1972; Lutz, 1973; Duellman and Wiens, 1993; Kwet, 2001a; Moravec et al., 2009; present study), and from *S. iquitorum* by the absence of black color in the posterior surfaces of the thighs (present in *S. iquitorum*; Moravec et al., 2009). The webbing formula I 2–2 II 1–2^{+} III 1–2^{+} IV 2^{+}–1 V differentiates *Scinax imbegue* from *S. similis* (with webbing formula I 2–2 II 2-$^{-}$-3 III 2–3 IV 2½ – 1^{+} V). The vocal sac of *Scinax imbegue* exhibits smooth skin texture, while *S. granulatus* has vocal sac with granulose skin texture. The dorsal skin texture is smooth in *Scinax imbegue*, but granulose in *S. cruentommus*, *S. funereus*, and *S. granulatus* (Moravec et al., 2009; present study). The smooth tarsal region distinguishes *Scinax imbegue* from *S. cuspidatus*, *S. eurydice*, *S. ictericus*, and *S. iquitorum* (having many tarsal tubercles; Duellman and Wiens, 1993; Moravec et al., 2009; present study). *Scinax imbegue* has a metacarpal tubercle that is lower than in *S. alter*.

Description of holotype.—Body slender; moderate size; head slightly longer than wide; snout rounded in dorsal view, protruding in profile; nostrils dorsolateral, elliptical, on small elevations; canthus rostralis slightly marked, concave; loreal region slightly concave; eyes protuberant; tympanum visible, rounded (Fig. 6B); supratympanic fold evident, from the posterior corner of the eye to the shoulder; vocal sac moderately developed, single, median, subgular; vocal slits laterally on mouth floor; tongue large, rounded, posteriorly notched, barely free; vomerine teeth between oval choanae in two straight series closer to each other. Pectoral fold present. Arms slender, forearms moderately robust; fingers slender, medium-sized, poorly fringed; webbing barely visible; absence of pigmented spicules on the finger I; relative finger lengths I≤IV<II<III; finger disks nearly rounded, medium-sized; inner metacarpal tubercle normal, elliptical, bigger than the outer ones; outer metacarpal tubercle divided, both elongated and with the same size; subarticular tubercles normal, small, rounded; supranumerary tubercles rounded, vestigial (Fig. 7B). Legs moderately robust; toes slender, long; relative toe lengths I<II<V<III<IV; toe disks nearly rounded, medium-sized; disk of toe III bigger than other toe disks; webbing formula I 2–2 II 1–2^{+} III 1–2^{+} IV 2^{+}–1 V; foot with normal, oval, medium-sized inner metatarsal tubercle; outer metatarsal tubercle simple, rounded, small; subarticular tubercles normal, rounded; supranumerary tubercles normal, rounded, vestigial (Fig. 7B). Skin on dorsum smooth; skin on gular region, undersurfaces of arms and tibiae smooth; skin on venter and thighs is strongly granulated.

Measurements of holotype (mm).—SVL 29.0; HL 10.4; HW 9.4; IND 2.1; NSD 1.3; END 3.0; UEW 2.3; ED 2.6; IOD 3.2; TD 1.7; FAL 5.8; HAL 8.4; 3FD 1.2; THL 13.2; TL 14.5; FL 19.8; 4TD 1.1.

Color.—In life, general dorsal coloration light brownish; canthus rostralis marked by a narrow dark brown stripe; a conspicuous whitish dorsolateral stripe extending from the posterior corner of the eye to the inguinal region; this stripe is bordered above by a dark brown fragmented stripe; a dark brown interocular blotch with inverted triangle shape; transversal dark brown stripes, poorly developed, on dorsal surfaces of upper arms and legs (see color photo in Pombal and Gordo, 1994). Hidden surfaces of thighs and inguinal region beige, marbled. Ventral region yellowish-beige. Iris brownish-beige. In preservative, same pattern as described above, but the colors fade (see black and white photo in Fig. 8B).

Variation.—Measurements of *Scinax imbegue* revealed body size variation, with females usually larger than males (Table 2). Differences in the development of finger webbing (modal webbing formula I 2–2 II 1–2 III 1–2 IV 2–1 V) and in dorsal pattern (patterns B or D; see Fig. 3) were also evident. The supratympanic fold can either reach the shoulder or can be restricted to the superior portion of the annulus tympanicus. The finger and toe disks can be rounded or elliptical, determining the great amplitude of 3FD and 4TD measurements (see Table 2). The nostrils can be more or less protruding and the snout can be rounded or mucronate, but this variation was only observed in a few specimens. The outer metacarpal tubercles vary in size relative to each other, and lengths in relation to the inner metacarpal tubercle. The interocular spot can be bordered by a narrow beige stripe, and it can take the form of a stained, inverted triangle or a Y-shaped blotch. Some specimens have a few vestigial granules on the dorsum.

Vocalization.—Pombal et al. (1995a) was the first to describe the advertisement call of *Scinax imbegue* (as *Scinax altera*) based on recordings from the Municipality of Ubatuba, São Paulo. According to Pombal et al. (1995a), the multi-pulsed advertisement call has a call duration of 0.23–38 s; one note; 9–14 pulses per note; and dominant frequency between 1.2–5.0 kHz. In addition, Kwet and Márquez (2010) published the call of *Scinax imbegue* in a compact disk form (CD), as *Scinax* sp. I (aff. *alter*, large form). The values of both studies match with the additional recordings analyzed here.

Tadpole.—Unknown.

Natural history.—According to Pombal and Gordo (1994), *Scinax imbegue* (called *S. altera*) is widespread and easily collected at the Estação Ecológica Juréia-Itatins particularly in restinga environments (sand-banks), and calls at night on arbustive vegetation or bromeliads near ponds. In addition, we observed large populations of this new species at the type locality Parque das Nascentes and near Brusque (both in Santa Catarina). On the outskirts of Brusque on the night of 15 November 2003, several males were observed calling from vertical plant stems in a small flood plain on semi-open grassland; at this locality, the males called syntopically with the new species described below. On the grassy margins of a nearby artificial water reservoir, we found many individuals of *Scinax imbegue* in syntopy with *Hypsiboas albomarginatus* (Spix) and several individuals of two additional species of *Scinax*: *S. fuscovarius* and *S. granulatus*.

Distribution.—Occurs in semi-open forested lowlands and on plateau slopes of the Atlantic rain forest domain below 700 m a.s.l., from southern São Paulo to Santa Catarina states (Fig. 9).

Etymology.—The specific epithet *imbegue*, an adjectival word (from a polysynthetic language), given from the terms of the Tupí-guarani language *i* (=it is) and *mbegue* (=slow), in allusion to the pulse rate, which is much slower than that of *Scinax alter*. Thus, it is an indeclinable epithet.

***Scinax tymbamirim*, new species**
Figures 5C, 6C, 7C

Hyla fuscomarginata (non A. Lutz, 1925).—Bokermann (1967).
Hyla altera Lutz, 1973 (part).
Hyla rubra altera.—Braun and Braun (1980).
Scinax spec. nov.—Kwet and Di-Bernardo (1999).
Scinax sp.—Kwet (2001a, 2001b).
Scinax cf. *alter*.—Rocha et al. (2008b).
Scinax sp. aff. *alter*.—Kwet et al. (2010).
Scinax sp. II (aff. *alter*, small form).—Kwet and Márquez (2010).

Holotype.—MNRJ 49188, adult male, Brazil, Santa Catarina, Municipality of Florianópolis, Córrego Grande, 27°35′S, 48°31′W, at sea level, Paulo C. A. Garcia, 22 November 1989.

Paratopotypes.—MCP 6345–6346, 6348, 3 adult males, Marcos Di-Bernardo and Axel Kwet, 10 October 2002; MCP 6350–6352, 3 adult males, Marcos Di-Bernardo and Axel Kwet, 15 October 2002; MCP 6354, adult female, Marcos Di-Bernardo and Axel Kwet, 7 October 2002; MNRJ 49187, 49189–49190, adult males, collected with the holotype; MNRJ 49208, adult male, Paulo C. A. Garcia, 18 September 1993; MNRJ 49215, adult male, Paulo C. A. Garcia, 4 March 1991; MZUSP 137306, 137308, adult males, MZUSP 137307, adult female, Paulo C. A. Garcia, 9 November 1989.

Non-type material.—Brazil, Paraná, Antonina: MHNCI 1396, 4796, 4802–4803; Guaraqueçaba: MHNCN 2471–2472; Matinhos: CFBH 7576, 7585–7586, 7590–7591; Morretes(CFBH 60–63, MHNCI 484, 988, 1369, 1373–1374, 1382, 1394, 1821–1827, 4795, 4802–4803; Pontal do Paraná: MHNCI 2291–2295, 2297–2298, 2303, 2319–2320, 2325, 2522; São José dos Pinhais: MHNCI 2153, 2291–2299, 2303, 2319–2320, 2325, 2519–2522, 4734–4735. Rio de Janeiro, Maricá: MNRJ 28989–29016, 29033–29049, 29089–290101, 29123–29137, 29247–29251, 33582–33588, 35683–35692, 49037–49040, 49044–49046; Rio de Janeiro: MNRJ 49037–49040, 49044–49046. Rio Grande do Sul, Arroio do Sal: MCP 1464, 3637; Guaíba: MCP 3738; Itati: UFRGS 2316–2318; Santo Antônio da Patrulha: MCP 9172; São Francisco de Paula: MCP 2506, 3224, 3435, 3717, 3744; Sapiranga: CFBH 12414; Terra de Areia: MCP 3273, 5199, UFRGS 1990–1992, 2038, 2223; Torres: MCP 8460, UFRGS 1882, 1897, 1900–1002, 2322–2323, 2064, 2068–2070; Viamão: MCP 3411, 2504–2505. Santa Catarina, Águas Mornas: MCP 8171; Barra Velha: CFBH 11001; Brusque: MCP 7644; Criciúma: UFRGS 2401–2402; Florianópolis: MCP 6334, 6385, 7676, 7699–7703, 8214, 8263, MZUSP 136361–13662, 136369–13675; Lauro Müller: CFBH 9007; Piçarras: MCP 3517; Rancho Queimado: CFBH 13588; São Bento do Sul: CFBH 3018; Timbé do Sul: UFBA 5006–5010; Treviso: CFBH 9850. São Paulo, Bertioga: CFBH 10515–10516; Cananéia: CFBH 4905–4906, 6352; Cubatão: CFBH 11377–11378; Iguape: CFBH 733–735, 830–832, MNRJ 39916–39919, 52354; Jacupiranga: MNRJ 32057–32061; Registro: CFBH 6981; São Bernardo do Campo: MZUSP 126140–12644; Ubatuba: ZUEC 543–544, 3195, 5160, 5884–5889, 6872–6873, 7970, 8958.

Diagnosis.—A species belonging to the *Scinax ruber* clade (*sensu* Faivovich et al., 2005), diagnosed by the following combination of characters: (1) small to moderate size (males 20.6–27.4 mm SVL; females 22.3–31.2 mm SVL); (2) advertisement call with pulse duration 0.018–0.020 s; (3) interval between pulses 0.007–0.008 s; (4) pulse rate 39–40 pulses/s; (5) dorsal pattern consisting of two poorly defined, white dorsolateral stripes separating a dark brown mid-dorsal area from light brown flanks, and a dark interocular blotch with the approximate shape of a pentagon; (6) smooth vocal sac; (7) presence of a tubercle on tarsi.

Comparisons.—*Scinax tymbamirim* is promptly distinguished from *S. acuminatus*, *S. blairi*, *S. eurydice*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. ictericus*, *S. iquitorum*, *S. pachycrus*, *S. ruber,* and *S. similis* by its smaller size of adult males (20.6–27.4 mm SVL in *S. tymbamirim* and 27.8–51.2 mm combined SVL in the other species; Fouquette and Pyburn, 1972; Duellman and Wiens, 1993; Moravec et al., 2009; present study). The dorsal pattern consisting of two poorly defined dorsolateral white stripes separating a dark-brown dorsolateral area from the light brown flanks and an interocular blotch with the approximate shape of a pentagon, surrounded by a yellowish contour, distinguishes *Scinax tymbamirim* from *S. acuminatus*, *S. blairi*, *S. cruentommus*, *S. cuspidatus*, *S. eurydice*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. ictericus*, *S. iquitorum*, *S. karenanneae*, *S. lindsayi*, and *S. similis* because these species lack a dorsolateral striped pattern (see specific descriptions in comparisons of *S. alter*), and from *S. pachycrus* by the different pattern (see specific description in comparisons of *S. alter*). *Scinax tymbamirim* further differs from *S. blairi*, *S. cruentommus*, *S. eurydice*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. iquitorum*, and *S. ruber* by the absence of yellow flash colors on the posterior surfaces of the thighs and/or flanks (present in these species; Fouquette and Pyburn, 1972; Lutz, 1973; Duellman and Wiens, 1993; Kwet, 2001a; Moravec et al., 2009; present study), and from *S. iquitorum* by the absence of black color in the posterior surfaces of the thighs (present in *S. iquitorum*; Moravec et al., 2009). The dorsal skin texture is smooth in *Scinax tymbamirim* and granulose in *S. cruentommus*, *S. funereus*, and *S. granulatus* (Moravec et al., 2009; present study). The webbing formula I 2–2 II 1–2^+ III 1^+–2^+ IV 2^+–1 V distinguishes *Scinax tymbamirim* from *S. similis* (with webbing formula I 2–2 II 2-$^-$-3 III 2–3 IV 2½ –1^+ V). The presence of a single tarsal tubercle distinguishes *Scinax tymbamirim* from *S. cuspidatus*, which have many tarsal tubercles, and from *S. alter*, *S. acuminatus*, *S. blairi*, *S. cruentommus*, *S. funereus*, *S. fuscovarius*, *S. granulatus*, *S. imbegue*, *S. karenanneae*, *S. lindsayi*, *S. pachycrus*, *S. ruber,* and *S. similis*, which exhibit a smooth tarsal region (Fouquette and Pyburn, 1972; Lutz, 1973; Pyburn, 1992, 1993; Duellman and Wiens, 1993; Kwet, 2001a; Moravec et al., 2009; present study). *Scinax tymbamirim* further differs from *S. alter*, *S. cuspidatus*, *S. eurydice*, *S. fuscovarius*, *S. granulatus*, *S. imbegue*, and *S. similis* in its smaller finger and toe disks.

Description of holotype.—Body slender; moderate size; head slightly longer than wide; snout ovoid in dorsal view and protruding in profile; nostrils dorsolateral, elliptical, not elevated; canthus rostralis slightly marked, concave; loreal region slightly concave; eyes protuberant; tympanum visible, rounded (Fig. 6C); supratympanic fold evident, from the posterior corner of the eye to the shoulder; vocal sac moderately developed, single, median, subgular; vocal slits laterally on mouth floor; tongue large, cordiform, posteriorly notched, barely free; vomerine teeth between oval choanae in two straight series closer to each other. Pectoral

fold present. Arms slender, forearms moderately robust; fingers slender, medium-sized, poorly fringed, webbing barely visible, absence of pigmented spicules on finger I, relative finger lengths I≤IV<II<III; finger disks nearly rounded, wider than long, medium-sized; inner metacarpal tubercle normal, elliptical, elongated; outer metacarpal tubercle smaller, divided, ovoid; subarticular tubercles simple, medium-sized, rounded; supranumerary tubercles rounded, vestigial (Fig. 7C). Legs moderately robust; toes slender, long; relative toe lengths I<II<V<III<IV; toe disks nearly rounded, wider than long, medium-sized; 4TD 48% of ED; webbing formula I 2–2 II 1–2^{+} III $1^{1/2}$–2^{+} IV 2^{+}–1 V; foot with normal inner metatarsal tubercle, oval, medium-sized; outer metatarsal tubercle simple, rounded; subarticular tubercles normal, rounded; supranumerary tubercles normal, rounded (Fig. 7C). Smooth skin on dorsum, with only a few granules; smooth skin of gular region, arms, and tibiae; strongly granulated skin on venter and thighs.

Measurements of holotype (mm).—SVL 27.4; HL 9.8; HW 8.8; IND 1.7; NSD 1.2; END 3.0; UEW 2.3; ED 2.6; IOD 2.7; TD 1.3; FAL 5.0; HAL 7.2; 3FD 1.3; THL 10.8; TL 13.8; FL 18.8; 4TD 1.2.

Color.—In life, brown or orange-brown dorsal background; two poorly defined dorsolateral white stripes separating a dark-brown mid-dorsal area from the light brown flanks, and an interocular blotch with the approximate shape of a pentagon, surrounded by a yellowish contour; longitudinal brown line covering the canthus rostralis; sometimes with small beige blotches irregularly distributed on the dark brown dorsal region; uniform light brown blotches diffusely scattered on the thighs and feet; transversal dark brown stripes on dorsal surfaces of legs and arms, with one stripe on each arm and three stripes on each leg (see color photos in Kwet et al., 2010). Hidden surfaces of thighs and inguinal region beige marbled. Ventral surface beige. Iris brownish-beige. In preservative, the general pattern is as described above, but the colors fade (see black and white photo in Fig. 8C).

Variation.—The measurements revealed some variation in the body size of *Scinax tymbamirim* (Table 2), with females usually bigger than males, in development of finger webbing (modal webbing formula I 2–2 II 1–2 III 1–2 IV 2–1 V) and pattern of dorsal drawing (patterns E to G; see Fig. 3). The nostrils can be more or less protruding, and the snout can be subovoid or mucronate, but this second snout type is common only in populations of Rio de Janeiro. The finger and toe disks can be rounded or elliptical, determining the great amplitude of 3FD and 4TD measurements (see Table 2). The outer metacarpal tubercles vary their size in relation to each other, and their relative lengths in relation to the inner metacarpal tubercle. A population from restinga habitats on the island of Santa Catarina (''Dunas da Joaquina,'' Municipality of Florianópolis, Santa Catarina state) is distinguished by the presence of very small specimens, where adult males present SVL range 19–23 mm.

Vocalization.—Bokermann (1967) was the first to describe the advertisement call of *Scinax tymbamirim* (as *Hyla fuscomarginata*; see Pombal et al., 1995a, for comments about *S. alter* in Bokermann's paper) based on records from the Municipality of Rio de Janeiro, Rio de Janeiro. According to Bokermann (1967), the multi-pulsed advertisement call (Bokermann, 1967:fig. 4) had a call duration 0.6 s; the number of notes was given as 2 (actually it is only one note, because the ''initial note'' described by Bokermann, 1967, is a territorial call); and the frequency amplitude as 1.5–5.0 kHz. Kwet (2001b) described the advertisement call of *Scinax tymbamirim* (as *Scinax* sp.; Kwet, 2001b:Son. 37) from northeastern Rio Grande do Sul (Araucaria plateau, Municipality of São Francisco de Paula). Call duration in Kwet (2001b) was 0.4–1.3 s, pulse rate (given as note rate) was 22–26 pulses/s, and dominant frequency ranged between 2–5.9 kHz, with a maximum of 4–4.3 kHz. In addition, Kwet and Márquez (2010) published the call of *Scinax tymbamirim* from several localities in the Santa Catarina State in CD form, including the ''dwarf form'' from ''Dunas da Joaquina,'' as *Scinax* sp. II (aff. *alter*, small form). The values of these studies matches with the additional recordings here analyzed.

Tadpole.—Unknown.

Natural history.—This new species is found in habitats containing arboreal and shrub vegetation but is not abundant in forests. During the breeding season, individuals are found along the margins of ponds and lakes located in open areas and forest edges (Kwet and Di-Bernardo, 1999; Kwet, 2001b; Kwet et al., 2010). *Scinax tymbamirim* is also abundant in terrestrial or arboreal bromeliads (e.g., *Aechmea nudicaulis*, *Neoregelia cruenta*), especially when inhabiting restinga environments (Carvalho-e-Silva et al., 2000; Van Sluys et al., 2004; Rocha et al., 2008b; present work). A ''dwarf population'' of *S. tymbamirim* from restinga habitats on the island of Santa Catarina (''Dunas da Joaquina,'' Municipality of Florianópolis, Santa Catarina) is bromelicolous, living in terrestrial bromeliads, i.e., *Vriesea friburguensis* (AK, unpubl. data). *Scinax tymbamirim* has a year-round breeding season, except during the cold winter months; the clutch, comprising 150–250 small eggs, is deposited in lentic water bodies (Kwet and Di-Bernardo, 1999; Kwet et al., 2010). The diet of this hylid is diversified, formed mainly by various arthropod groups (Van Sluys et al., 2004).

Distribution.—Occurs in coastal lowlands, hillsides, and highlands (up to 1,000 m a.s.l.), from southern Rio de Janeiro to Rio Grande do Sul states (Fig. 9).

Etymology.—The specific epithet *tymbamirim*, an adjectival word (from a polysynthetic language), given from the terms of the Tupí-guarani language *tymba* (=animal) and *mirim* (=small), in allusion to the SVL amplitude smaller than in *Scinax alter*. Thus, it is an indeclinable epithet.

MATERIAL EXAMINED

Additional specimens.—*Scinax acuminatus* (n = 10): Argentina, San Fernando, Antequera: MNRJ 39649. Brazil, Mato Grosso, Cuiabá: MNRJ 34752–34754; Cáceres: MNRJ 2370. Paraguay, Presidente Hayes, Pozo Colorado: MNRJ 34744–34748.

Scinax cuspidatus (n = 21): Brazil, Rio de Janeiro, Rio de Janeiro: AL-MN 299–302, USNM 96139, 96147–96149, 96370, syntypes, MNRJ 27092–27099, 27100, 73332–73334, topotypes.

Scinax eurydice (n = 41): Brazil, Bahia, Maracás: MNRJ 4050, paratype, MNRJ 16021–16034, 22656–22660, UFBA 2360–2376, 2916–2918, 48669, topotypes; Feira de Santana:

MZUEFS 1743; Morro do Chapéu: MZUEFS 1811–1812, 1833.

Scinax fuscovarius (*n* = 16): Brazil, Minas Gerais, João Pinheiro: MNRJ 38834–38835; Juiz de Fora: AL-MN 76, holotype, USNM 96988, 96992–96994, 97001–97005, paratypes, MNRJ 34957–34960, topotypes.

Scinax granulatus (*n* = 22): Brazil, Santa Catarina, Humboldt: MNRJ 233; Palhoça: MNRJ 74439, 74440, 74441, 74442, 74443, 74444–74446, 74447–74448, 74449, 74451; Queimado: MNRJ 72239–72246; Santo Amaro da Imperatriz: MNRJ 74450.

Scinax pachycrus (*n* = 11): Brazil, Bahia, Feira de Santana: MNRJ 47795–47798; Paraíba, Boqueirão: MNRJ 32843–32844; Pernambuco, Caruaru: MNRJ 38661–38665.

Scinax similis (*n* = 52): Brazil, Rio de Janeiro, Grussaí: MNRJ 35131–35160, 47848; Mangaratiba: MNRJ 47848; Rio de Janeiro: MNRJ 3756, 26918–26927, 35681–35682, topotypes; São Paulo, Quiririm: MNRJ 35153–35157.

Sound recordings examined.—*Scinax alter*: Brazil, Bahia, Porto Seguro: B. V. S. Pimenta tape 2 cut 12–13, 3 April 2001, 1900/1915 h, RPPN Estação Veracel, recorded by BVS Pimenta; B. V. S. Pimenta tape 3 cut 37, 23 August 2001, 1900 h, RPPN Estação Veracel, recorded by BVS Pimenta; B. V. S. Pimenta tape 3 cut 39–40, 11 September 2001, 1910/1940 h, RPPN Estação Veracel, recorded by BVS Pimenta; B. V. S. Pimenta tape 3 cut 43, 15 September 2001, 1850 h, Parque Nacional do Pau Brasil, recorded by BVS Pimenta; MNVOC 26 cut 3, 17 August 2006, 2140 h, RPPN Estação Veracel, recorded by I. Nunes; Prado: B. V. S. Pimenta tape 3 cut 46, 20 September 2001, 1910 h, Parque Nacional do Descobrimento, Municipality of Prado, recorded by BVS Pimenta; B. V. S. Pimenta tape 4 cut 56, 24 April 2002, 1815 h, Parque Nacional do Descobrimento, Municipality of Prado, recorded by BVS Pimenta. Espírito Santo, Aracruz: CFBH tape 48 cut 11, 25 October 1996, 2130 h, air temperature 23.5°C, water temperature 25°C, Brejo dos Taxistas; Cariacica: G. M. Prado, two unvouchered records, 19 January 2002, 1900 h, air temperature 24°C, duet singers, Reserva Biológica de Duas Bocas; Conceição da Barra: JPPJ tape 6 cut 9, 30 January 2004, 1940 h, air temperature 26°C, water temperature 32°C; Itaúnas Village, Santa Teresa: UFBA unvouchered record, 13 January 2001, 2215 h, air temperature 22.5°C, water temperature 25°C; Rio de Janeiro, Bom Jesus do Itabapoana: B. V. S. Pimenta tape 4 cut 67, 1 December 2002, 2105 h, recorded by BVS Pimenta; Rio das Ostras: MNVOC 22 cut 5–8, 23 January 2007, 2015/2100 h, air temperature 26°C, Reserva Biológica União, recorded by J. P. Pombal, Jr.; MNVOC 24 cut 6, 23 January 2007, 2015 h, air temperature 26°C, Reserva Biológica União, recorded by I. Nunes; MNVOC 25 cut 1, 23 January 2007, 2000 h, air temperature 26°C, Reserva Biológica União, recorded by I. Nunes.

Scinax imbegue: Brazil, Santa Catarina, Blumenau: AK 22B15, 12 December 2004, 2130 h, air temperature 29°C, Parque das Nascentes, recorded by Axel Kwet; Jaraguá do Sul: AK 22A07-09, 30 November 2004, 2230 h/2240 h, air temperature 20°C, recorded by Axel Kwet.

Scinax tymbamirim: Brazil, Paraná, Rio Negro: C. E. Conte unvouchered record, 1 December 1996, recorded by C. E. Conte; Rio de Janeiro, Rio de Janeiro: UFBA unvouchered record, 15 September 1989, 1830 h, Bosque da Barra; Rio Grande do Sul, São Francisco de Paula: AK 8A11, 4 December 1997, 2230 h, air temperature 19°C, centro de pesquisas Pró-Mata, recorded by Axel Kwet; Viamão: AK 5B26, 5 October 1996, 2300 h, air temperature 20°C, recorded by Axel Kwet; Santa Catarina, Brusque: AK 20A08, 15 November 2003, 2100 h, air temperature 23°C, near Municipality of Brusque, 28°15′S, 49°22′W, recorded by Axel Kwet; Florianópolis: AK 14B13, 10 October 2002, 2100 h, air temperature 21.5°C, Córrego Grande, recorded by Axel Kwet; AK 15B18, 19 October 2002, 2100 h, air temperature 21.5°C; Praia dos Náufragos, recorded by Axel Kwet; AK 22B18, 13 December 2004, 2210 h, air temperature 20°C, Praia da Joaquina, recorded by Axel Kwet; São Martinho: AK 14A05, 3 October 2002, 2300 h, air temperature 20°C, recorded by Axel Kwet; São Paulo, Ubatuba: CFBH tape 29 cut 4, 17 January 1992, 1915 h, air temperature 23°C; Itaguá: CFBH tape 30 cut 8, 31 July 1992, 2000 h, air temperature 15.5°C, water temperature 21°C; Picinguaba.

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