

A NEW SPECIES OF *ISCHNOCNEMA* (ANURA) FROM THE SÃO FRANCISCO BASIN KARST REGION, BRAZIL

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ABSTRACT: We describe a new species of *Ischnocnema* from the municipality of Arcos, in the karst region of the upper Rio São Francisco basin, State of Minas Gerais, Brazil. The new species is diagnosed by the possession of a W-shaped mark on the back, at the level of the shoulder, with one tubercle at each posterior point, red iris in life, and moderate-sized discs on fingers III and IV. These characteristics resemble those of *Ischnocnema manezinho* and *I. sambaqui* (from the *I. lactea* series) but also that from the species in the *I. verrucosa* series.

RESUMO: Uma nova espécie de *Ischnocnema* é descrita, procedente do Município de Arcos, região cárstica do alto curso da bacia do rio São Francisco, Estado de Minas Gerais, Brasil. A nova espécie é diagnosticada por apresentar uma marca em forma de W entre os ombros, com um tubérculo em cada uma das bases; íris vermelha em vida; discos com tamanhos moderados nos dedos III e IV. Tais características assemelham-se às apresentadas por *I. manezinho* e *I. sambaqui* (da série de *I. lactea*), mas também àquelas apresentadas pelas espécies da série de *I. verrucosa*.

Key words: Amphibia; Anura; Brachycephalidae; *Ischnocnema*; Taxonomy

THE GENUS *Ischnocnema* Reinhardt and Lutken, 1862 was removed from the synonymy of *Eleutherodactylus* on the basis of molecular evidence (Heinicke et al., 2007). Currently, *Ischnocnema* contains 35 species (Canedo and Pimenta, 2010; Frost, 2011) distributed in central and eastern Brazil, adjacent northern Argentina, and possibly into adjacent Paraguay (Brusquetti and Lavilla, 2006; Frost, 2011).

There are five species series in this genus: *Ischnocnema guentheri*, *I. lactea*, *I. parva*, *I. ramagii*, and *I. verrucosa* (Hedges et al., 2008). Currently, the *I. verrucosa* species series includes *I. juipoca*, *I. octavioi*, *I. penaxavantinho*, *I. surda*, and *I. verrucosa*, and it is mainly characterized by the shank length less than 55% snout–vent length (SVL), tuberculate dorsum, finger I approximately the same length as finger II, and digital discs small (Hedges et al., 2008; Canedo et al., 2010). They also share a variably conspicuous W-shaped mark on the back on the shoulders

with one tubercle at each posterior point, and three species (*I. octavioi*, *I. surda*, and *I. verrucosa*) have a red iris in life (Canedo et al., 2010).

The *I. lactea* species series is mainly characterized by shank length usually less than 50% SVL; dorsum smooth, rugose, or tuberculate; finger I usually shorter than finger II (as long as finger II in some species); at least the outer finger discs moderate to large (Hedges et al., 2008). Four species in the *I. lactea* series also present a tuberculate dorsum and a W-shaped mark on the shoulders with one tubercle at each posterior point: *I. holti*, *I. manezinho*, *I. sambaqui*, and *I. vizottoi* (Canedo et al., 2010), although *I. holti* and *I. vizottoi* present a less-tuberculate dorsum and a less-evident W-mark pattern, the last one presenting it more anterior, between the eyes and with no evident tubercles.

Herein, we describe a new species with shank length less than 55% SVL, moderately tuberculate dorsum, finger I as long as finger II, moderate-sized discs on fingers III and IV, a W-shaped mark on the back, at the level of

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the shoulder, with one tubercle at each posterior point, and red iris in life.

MATERIALS AND METHODS

Specimens examined for comparison are listed in the Appendix. Institutional abbreviations are as listed at Sabaj Pérez (2010), except for UFMG (Universidade Federal de Minas Gerais) instead of DZUFMG (Departamento de Zoologia, Universidade Federal de Minas Gerais)

The following measurements (in millimeters) were employed for descriptions and comparative analysis: SVL, head length (HL), head width (HW), tympanum diameter (TD), eye diameter (ED), interorbital distance (IOD), internostril distance (IND), eye–nostril distance (END), thigh length (THL), shank length (SHL), and foot length (FL). Measurements were taken with a digital caliper with 0.1 mm of precision, as in Cei (1980) and Duellman (2001). Morphological nomenclature generally follows the first proposal in the literature on related species (e.g., Heyer, 1984; Hedges et al., 2008), except the snout pattern nomenclature that follows Lynch and Duellman (1997) and the digital disc nomenclature that follows Savage (2002).

SPECIES DESCRIPTION

Ischnocnema karst sp. nov.
(Figs. 1–4)

Holotype.—CFBH 25506, adult male, collected on 26 September 2005, Municipality of Arcos (45°35'13"W, 20°19'34"S, 755 m above sea level [a.s.l.]; datum = WGS84), state of Minas Gerais, Brazil, by Felipe S. F. Leite. (Figs. 1 and 2).

Paratypes.—CFBH 25505, 25507–09, 29128–32, MNRJ 64138–42, adult males collected with the holotype; and UFMG 3433–37, adult males collected on 17 October 2009 at the same locality.

Diagnosis.—*Ischnocnema karst* sp. nov. is here included in the *I. verrucosa* species series. This new species is distinguished from the other species in the genus by the following combination of characters: (1) moderately tuberculate dorsum, with a W-shaped mark on the back, at the level of the shoulder, with

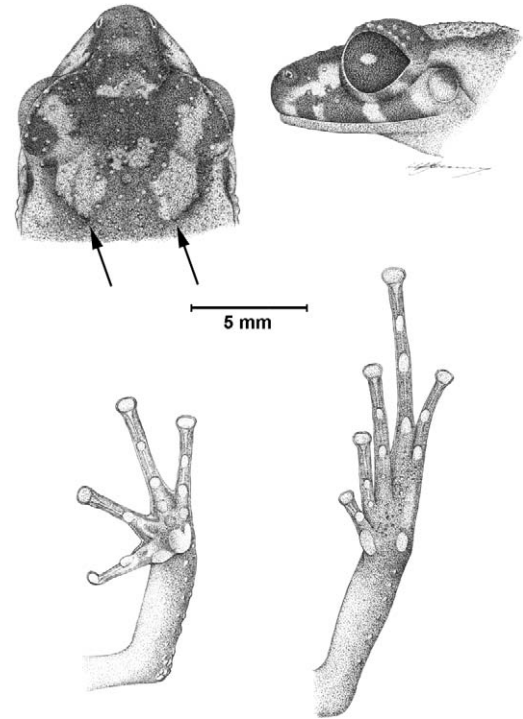


FIG. 1.—*Ischnocnema karst* sp. nov.; dorsal and lateral views of head and ventral views of hand and foot of the holotype (CFBH 25506). Arrows indicate the tubercles in the posterior points of the W-shaped mark.

one tubercle at each posterior point (Figs. 1 and 2); (2) short legs, SHL < 55% SVL; (3) finger I the same length as finger II; (4) moderate-sized discs in fingers III and IV emarginate and truncate (Fig. 1); (5) faint, translucent glandular-appearing nuptial pads; (6) red iris in life; (7) predominant pale yellow general color pattern (Fig. 4).

Comparisons with other species.—*Ischnocnema karst* sp. nov. mainly differs from the species of *I. guentheri* series by having shorter legs with SHL < 55% SVL and snout rounded to subacuminate in dorsal view (long legs with SHL > 60% SVL and acuminate snout in dorsal view in *I. guentheri* series; Hedges et al., 2008); outer digital discs moderately expanded, emarginate and truncate (discs usually small or slightly expanded in the species of the *I. guentheri* series; large in *I. hoehnei* and *I. vinhai*); and faint, translucent glandular-appearing nuptial pads (usually conspicuous white glandular-appearing nup-

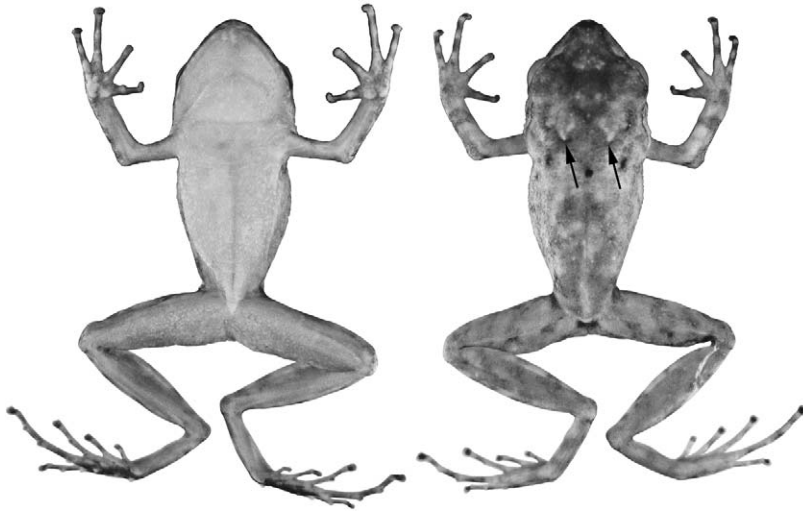


FIG. 2.—*Ischnocnema karst* sp. nov.; dorsal and ventral views of the holotype (CFBH 25506, 24.1 mm snout-vent length). Arrows indicate the tubercles in the posterior points of the W-shaped mark.

tial pads in *I. guentheri* series; unknown in *I. vinhai*; Heyer, 1984; Canedo et al., 2010).

The new species mainly differs from the *I. parva* series by having slender body; tuberculate dorsum; digital discs moderately expanded, emarginated and truncate or small and rounded (body robust; dorsum smooth; digital discs small and spatulate in *I. parva* series). *Ischnocnema karst* also differs from the species of this series by having faint, translucent glandular-appearing nuptial pads (conspicuous white glandular-appearing nuptial

pads in the *I. parva* series, although defined as absent by Hedges et al., 2008).

Ischnocnema karst differs from the *I. ramagii* series mainly by having finger I the same length as finger II and moderately short legs with $SHL < 55\%$ SVL (finger I longer than finger II and legs moderately long in *I. ramagii* series).

Ischnocnema karst differs from the species of the *I. lactea* series by presenting a tuberculate dorsum and W-shaped mark on the back, at the level of the shoulder with one tubercle at each posterior point (no such



FIG. 3.—Dorsal view of finger disc: *I. karst* (A; CFBH 29130, paratype), *I. verrucosa* (B; CFBH 2272), and *I. sambaqui* (C; CFBH 2934, paratype). Scale bar: 200 μ m.



FIG. 4.—*Ischnocnema karst* sp. nov.; in life.

dorsal pattern in the other species of the *I. lactea* series, except for *I. holti*, *I. manezinho*, and *I. sambaqui*; and *I. vizottoi*, where the mark is more anterior and between the eyes); it also differs from all species of the *I. lactea* series (except *I. bilineata* and *I. bolbodactyla*) in that finger I is the same length as finger II (finger I smaller than finger II in most species of the *I. lactea* series).

Last, *I. karst* is most similar to the species of the *I. verrucosa* series as well as *I. holti*, *I. sambaqui*, and *I. manezinho* from the *I. lactea* series, and differs from all other species in the genus, by the possession of tuberculate dorsum with a W-shaped mark on the shoulders with one tubercle at each posterior point. *Ischnocnema karst* mainly differs from all species in the *I. verrucosa* series and from *I. holti*, *I. manezinho*, and *I. sambaqui* by having moderately sized, expanded, emarginate, truncate discs on fingers III and IV (Fig. 3A) and predominant pale yellow general color pattern (Fig. 4); rounded, small discs (Fig. 3B); predominant brown to dark gray general color pattern in the other species in the *I. verrucosa* series; large-sized discs (Fig. 3C) and predominant brown general color in *I. holti*, *I. sambaqui*, and *I. manezinho*.

In addition, the new species also differs from *I. juipoca* and *I. penaxavantino* of the *I. verrucosa* series, and from *I. holti* and *I. sambaqui* of the *I. lactea* series by having a red iris in life (Fig. 4; greenish iris with dark dots in *I. holti*, Targino and Carvalho-e-Silva, 2008; cupreous iris in *I. sambaqui*, Castanho and Haddad, 2000; cupreous iris in *I. manezinho*, personal observation; gray to cupreous iris in *I. juipoca* and *I. penaxavantino*, Giarretta et al., 2007; Fig. 4; iris is also red in the other species of *I. verrucosa* series: *I. verrucosa*, *I. octavioi*, and *I. surda*; Canedo et al., 2010).

Description of holotype.—Moderate size (24.1 mm SVL); head longer than wide; snout rounded in dorsal and lateral views; upper jaw projecting beyond lower (Fig. 1); nostrils elliptical, protruding, laterally directed; IND distance smaller than ED and END distance, corresponding to 25% of HW; canthus rostralis distinct, slightly curved; loreal region dorsolaterally directed, concave; eyes large, prominent, diameter slightly smaller than IOD, and 42% of HW; tympanum distinct, rounded on the right side and elliptical on the left side, its diameter corresponding to 31% of ED; tympanic annulus and membrane distinct, partially covered in the posterodorsal region; supratympanic fold very distinct,

originating from the lower eyelid, extending posterodorsally through the upper margin of the tympanum and falling abruptly posteroventrally to the shoulder; three postcommissural tubercles between tympanum and shoulder on the right side, on the left side fused, forming a keel; vocal sac not expanded externally; vocal slits present, posterolaterally located on the mouth floor, posterior to the tongue; choanae small, nearly rounded, distant from each other; prevomerine odontoid in two elliptical patches between and very posterior to the choanae, narrowly separated; premaxillary and maxillary teeth present and small; tongue moderately sized, elongated, not notched posteriorly. Arms slender; disc cover of finger I unexpanded and even, disc pad even and ovoid; fingers II–IV with disc covers expanded, emarginated, and truncate, and disc pads even and broadened; fingers faintly fringed; relative length of fingers $I \approx II < IV < III$; finger I with faint, rounded translucent glandular-appearing nuptial pads, dorsal to the subarticular tubercle; thenar tubercle ovoid and well developed; palmar tubercle large, completely bifid on the right hand, almost separated in the left hand, the elongated inner part larger than the outer one; supernumerary tubercles well developed, globular or conical; subarticular tubercles well developed, projecting, and conical (Fig. 2C). Legs slender, moderately short, thigh and shank together practically equal to SVL; thigh slightly shorter than shank, corresponding to 95% of shank; SHL corresponding to 55% of SVL; foot not webbed, corresponding to 53% of SVL; toes slightly fringed; toe I with disc cover expanded, even, and round, toe V with disc cover expanded, indented, and round; toe II–IV with disc covers expanded, emarginate and truncate; all disc pads are even and broadened; relative length of toes $I < II < V < III < IV$; inner metatarsal tubercle large, protruding, ovoid; outer metatarsal tubercle conical, projecting, and of moderate size; supernumerary metatarsal tubercles very small and not abundant; subarticular tubercles well developed, conical, and projecting forward (Fig. 2D); calcar tubercle absent. Dorsal surface of body, including eyelids, with sparse granules, less abundant on arms and limbs; side of body and arms more granulated; dorsal

pattern with a faintly W-shaped light mark on the back, at the level of the shoulder, with one tubercle at each posterior point, the one of the right side is not very evident; ventral surfaces smooth, areolate near the vent and posterior portion of thighs. SVL 24.1; HL 9.9; HW 9.2; TD 1.2; ED 3.9; IOD 3.8; END 2.8; IND 2.3; THL 12.7; SHL 13.3; FL 12.7.

Color in preservative.—General dorsum color with a brown and beige variegated pattern with a conspicuous light brown W-shaped mark on shoulders; three dark brown dots just posterior to the W-shaped mark; area internal to the W-shaped mark dark brown; dorsally snout darker than loreal region; dark brown bar between eyes; dorsum of legs, feet, arms, and digits with light brown transverse bars over beige background; black blotch surrounding cloacal opening. Laterally head brown with beige bars originating from the margin of maxilla to each eye; sparse beige blotches in the margin of maxilla; dark brown stripe in supratympanic fold area. Generally ventral surfaces beige to light brown without evident pattern. Plantar view of feet dark brown. Palmar view of hand weakly pigmented. Posterior region of thighs next to knees dark brown. The inguinal region dark but not very distinct.

Variation.—The snout shape in dorsal view can be less rounded in smaller specimens, almost subacuminate. The HW varies from 83 to 97% of HL. The supratympanic fold may be less evident, or more curved with no accentuated angle, or it may be not directed posteriorly to the shoulder, or it may occur on the tympanic annulus ventrally. The postcommissural tubercles vary from one to four, three being the most common situation, two aligned just before the mouth edge and one dorsal to them, at the end of the supratympanic fold. The two ventral tubercles may fuse to form a keel or fold from the tympanum to the shoulder, below the supratympanic fold. The prevomerine odontoids are generally very distinct (with few exceptions); one of the patches may be more developed than the other. The tongue may be slightly notched posteriorly in some individuals. All individuals are male and present vocal slits. Females and possible sexual dimorphism are unknown. All males present nuptial pads,

TABLE 1.—Mean, standard deviation (SD), and range (millimeters) of measurements of 15 males of the type series of *Ischnocnema karst* sp. nov. (including the holotype).

Measurements	Mean	Standard deviation	Range
Snout–vent length	23.2	2.22	19.5–26.7
Head length	9.4	0.88	7.8–10.7
Head width	8.6	1.05	6.9–10.4
Tympanum diameter	1.2	0.17	0.9–1.5
Eye diameter	3.5	0.39	2.9–4.3
Interorbital distance	2.6	0.44	2.1–3.8
Eye–nostril distance	2.6	0.27	2.1–3.0
Internostril distance	2.0	0.20	1.7–2.3
Thigh length	11.5	1.33	9.1–13.2
Shank length	12.2	1.30	9.9–14.0
Foot length	11.2	1.39	9.1–12.9

some more developed than others. The two parts of the palmar tubercle may be in contact or not. The granularity of the dorsum varies, but granules are always present. Generally, the specimens have a loose skin that forms in the venter a lateral and posterior body fold and axillary membrane. The dorsal coloration may vary from lighter to darker, variegated to a more uniform pattern. The W-shaped mark varies from evident to barely conspicuous. The two halves from the W may not be in contact. The area internal to the W-shape mark may fuse with the dark mark between the eyes and form a big dark square or triangular area. The three brown dots on the dorsum may be not well defined, but appearing as brown blotches. Some specimens may present a dark ill-defined mask on the canthus rostralis. The snout dorsum may have the same color as the loreal region. The dark brown blotch in the posterior region of the thighs next to the knees may be elongated but never reach the cloacal region. The transverse stripes vary in definition. The venter may have many little brown speckles. The dark blotches in the inguinal region may be very conspicuous. Measurements of 15 male paratypes are given in Table 1. The TD varies from 26% to 41% of ED, with 34% as mean value. Thighs are always slightly shorter than the shank, varying from 87% to 99% of shank, with mean value of 94%. The SHL varies from 48% to 55% of SVL (mean 52%). The foot varies from 45% to 62% of SVL (mean 49%).

Color in life (Fig. 4, in color on-line).—Based on photographs, the beige color of the

dorsum in preservative is yellowish orange in life, uniformly yellow, or yellow variegated with dark brown or dark green. The bar between the eyes, mask in the canthus rostralis, transverse stripes, and blotches in the inguinal region and in the posterior surface of thighs vary from dark brown or green to light brown. Light yellow sparse blotches are on the maxilla. The tympanic membrane is light brown. The ventral surfaces are cream, with some transparency and white speckles. The iris is red with some dark vermiculations; the red color is stronger in the superior half of the eye; the inferior half, next to the iris is light brown. Yellow borders the ovoid iris. A dark vertical bar is on the inferior portion of the iris, a less conspicuous bar is on the superior portion.

Etymology.—The specific name is a noun in apposition and refers to the geologic characteristics of the type locality, a typical karst formation of the upper Rio São Francisco basin.

Remarks.—The type locality is in the Municipality of Arcos, in the karst region of the upper Rio São Francisco basin, State of Minas Gerais. *Ischnocnema karst* is the only Brazilian amphibian species known to be restricted to a karstic habitat.

The region is in a transitional zone between the Atlantic Forest and Cerrado biomes. The new species inhabits semideciduous to deciduous seasonally dry tropical forest patches associated with carbonatic outcrops. Such outcrops are mined for limestone and dolomite, which has resulted in forest destruction in many areas. The soil, usually fertile because of its basic properties and high to moderate nutrient status, has also contributed to deforestation, as the soil is very suitable for agriculture. The naturally fragmented distribution of the carbonatic outcrops (as well as the seasonally dry tropical forests) associated with landscape and mining use over the past decades has resulted in a highly fragmented forest and probably habitat loss. Despite of the high degree of threat to the biota, there are no protected areas in the region.

The presence of endemic anuran species highlights the urgency of considering the uniqueness of the karst region of the upper Rio São Francisco basin and its seasonally dry

tropical forest and their importance for biodiversity conservation. The establishment of natural parks and corridors, and biodiversity inventories in the area should both be considered.

DISCUSSION

There is no unambiguous morphological synapomorphy supporting the genus *Ischnocnema*, and most of the genera in Terrarana (Hedges et al., 2008). We tentatively assign this new species to *Ischnocnema* based on its overall similarity to the species of the *I. lactea* and *I. verrucosa* species series.

The species series established by Hedges et al. (2008) are a combination of elements of previous species group definitions (Lynch 1968, 1976; Heyer, 1984) with some differences in characters and content. Some modifications of the content of two species series were made based on morphological similarities (Canedo et al., 2010). However, the monophyly of the species series and the validation of its diagnostic character as synapomorphies were never tested. Based on Hedges et al. (2008), the only character that really differs from the *I. verrucosa* to the *I. lactea* series is the size of the digital disc. Despite the condition of moderately expanded finger discs, *I. karst* is here allocated in the *I. verrucosa* series because of shared characters such as W-shaped mark, tuberculate dorsum, and red iris in life, with this last feature absent in only two species of this series. The W-shaped mark is also present in four species of the *I. lactea* series, *I. holti*, *I. manezinho*, *I. sambaqui*, and *I. vizottoi*, the last one presenting the mark more anterior and between the eyes, but the development of the digital disc in these species is much greater than in *I. karst* (Fig. 3). The set of characters in *I. karst* puts in doubt the validity of the condition of expanded finger discs as a diagnostic character to the *Ischnocnema* series and its contents.

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LITERATURE CITED

- Brusquetti, F., and E.O. Lavilla. 2006. Lista comentada de los anfibios de Paraguay. Cuadernos de Herpetología 20:1–79.
- Canedo, C., and B.V.S. Pimenta. 2010. New species of *Ischnocnema* (Anura, Brachycephalidae) from the Atlantic rainforest of the state of Espírito Santo, Brazil. South American Journal of Herpetology 5:199–206.
- Canedo, C., B.V.S. Pimenta, F.S.F. Leite, and U. Caramaschi. 2010. New species of *Ischnocnema* (Anura, Brachycephalidae) from the state of Minas Gerais, Southeastern Brazil, with comments on the *I. verrucosa* species series. Copeia 2010:629–634.
- Castanho, L.M., and C.F.B. Haddad. 2000. New Species of *Eleutherodactylus* (Amphibia: Leptodactylidae) from Guaraquegaba, Atlantic Forest of Brazil. Copeia 2000:777–781.
- Cei, J.M. 1980. Amphibians of Argentina. Monitore Zoologico Italiano (N. S.) Monograph 2:1–609.
- Duellman, W.E. 2001. Hylid Frogs of Middle America, Volumes 1 and 2. Society for the Study of Amphibians and Reptiles, USA.
- Frost, D.R. 2011. Amphibian species of the world: An online reference. Version 5.5 (31 January 2011). Available at: <http://research.amnh.org/herpetology/amphibia/index.php>. American Museum of Natural History, USA.
- Giarretta, A.A., D. Toffoli, and L.E. Oliveira. 2007. A new species of *Ischnocnema* (Anura: Eleutherodactylinae) from open areas of the Cerrado Biome in southeastern Brazil. Zootaxa 1666:45–51.
- Hedges, S.B., W.E. Duellman, and M.P. Heinicke. 2008. New World direct-developing frogs (Anura: Terrarana): Molecular phylogeny, classification, biogeography, and conservation. Zootaxa 1737:1–182.
- Heinicke, M.P., W.E. Duellman, and S.B. Hedges. 2007. Major Caribbean and Central American frog faunas originated by ancient oceanic dispersal. Proceedings of the National Academy of Sciences 104:10092–10097.
- Heyer, W.R. 1984. Variation, systematics, and zoogeography of *Eleutherodactylus guentheri* and closely related species (Amphibia: Anura: Leptodactylidae). Smithsonian Contributions to Zoology 402:1–42.
- Lynch, J.D. 1968. The status of the nominal genera *Basanitia* and *Phrynanodus* from Brazil (Amphibia: Leptodactylidae). Copeia 1968:875–876.
- Lynch, J.D. 1976. The species groups of the South American frogs of the genus *Eleutherodactylus* (Leptodactylidae). Occasional Papers of the Museum of Natural History, University of Kansas 61:1–24.
- Lynch, J.D., and W.E. Duellman. 1997. Frogs of the genus *Eleutherodactylus* in western Ecuador. University of Kansas Special Publication 23:1–236.
- Sabaj Pérez, M.H. (Ed.). 2010. Standard symbolic codes for institutional resource collections in herpetology and ichthyology: An online reference. Version 2.0 (8 November 2010). Available at <http://www.asih.org/>.

American Society of Ichthyologists and Herpetologists, USA.

Savage, J.M. 2002. The Amphibians and Reptiles of Costa Rica. The University of Chicago Press, USA.

Targino, M., and S.P. Carvalho-e-Silva. 2008. Redescricao de *Ischnocnema holti* (Amphibia: Anura: Brachycephalidae). Revista Brasileira de Zoologia 25:716–723.

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APPENDIX

Additional Specimens Examined

Ischnocnema abdita: State of Espírito Santo: Municipality of Cariacica CFBH 2268–2270, 2278–2279, 22521–22522; Municipality of Mimoso do Sul CFBH 22296–22298; Municipality of Santa Teresa CFBH 10840–10841, 10878–10879.

Ischnocnema bilineata: State of Bahia: Municipality of Boa Nova MNRJ 46476, 52873; Municipality of Canavieiras MNRJ 40293; Municipality of Ilhéus MNRJ 23776.

Ischnocnema bolbodactyla: State of Rio de Janeiro: Municipality of Angra dos Reis AL-MN 445 (lectotype); Municipality of Parati MNRJ 24131–24132, MNRJ 43390–93. State of São Paulo: Municipality of Natividade da Serra CFBH 11639; Municipality of Ubatuba CFBH 1400, CFBH 1509–10, CFBH 1551, CFBH 3965, CFBH 5785, CFBH 7779–80, CFBH 13119–27, CFBH 17620, CFBH 19934, CFBH 19936–37, CFBH 19953.

Ischnocnema concolor: Parque Nacional do Itatiaia MNRJ 57648.

Ischnocnema gehrti: State of São Paulo: Alto da Serra (= Paranapiacaba; MNRJ 0105, holotype).

Ischnocnema hoehnei: BRAZIL: State of São Paulo: Municipality of Santo André, Paranapiacaba AL-MN 2525–2526 (respectively holotype and paratype), MZUSP 11000 (paratype).

Ischnocnema holti: Parque Nacional do Itatiaia MNRJ 57639, 57644–57645.

Ischnocnema juipoca: BRAZIL: State of São Paulo: Municipality of Campinas, Souza MNRJ 4103 (holotype), Observatório de Capricórnio, Joaquim Egídio CFBH 1341; Municipality of Jundiá, Açude da Ermida, Serra do Japi CFBH 709–11; Municipality of Itatiba CFBH 8612; Municipality of Campos de Jorão, Retiro CFBH 9904; Municipality of São Luís do Paraitinga CFBH 7239, 18641; Municipality of Caieiras CFBH 19697. State of Minas Gerais: Municipality of Araxá CFBH 11584; Municipality of Poços de Caldas, Morro do Ferro CFBH 4450; Municipality of Camanducaia, Monte Verde CFBH 17574.

Ischnocnema lactea: State of São Paulo: Iguape MZUSP 828 (lectotype).

Ischnocnema manezinho: State of Santa Catarina: Municipality of Florianópolis MNRJ 17478–79 (paratypes), ZUEC 9547 (paratype), CFBH 2979; Municipality of Corupá CFBH 3157; Municipality of São Bento do Sul CFBH 3158. State of Paraná: Municipality of Guaratuba CFBH 5481.

Ischnocnema melanopygia: State of Minas Gerais: Municipality of Itamonte CFBH 16512, 16697.

Ischnocnema nigriventris: State of São Paulo: Alto da Serra de Cubatão (= Paranapiacaba) AL-MN 719 (lectotype).

Ischnocnema octavioi: BRAZIL: State of Rio de Janeiro, Municipality of Rio de Janeiro: Tijuca MZUSP 73670 (holotype), MZUSP 73591–94, 73560–62, 73604–08, 73630–35, 73637–39, 73672, 74425, 74475–77 (paratypes).

Ischnocnema parva: State of São Paulo: Campo Grande MZUSP 504 (paralectotype of *Basanitia lactea*).

Ischnocnema penaxavantino: State of Minas Gerais: Municipality of Uberlândia ZUEC 13639 (holotype), ZUEC 13640–49 (paratypes).

Ischnocnema pusilla: State of São Paulo: Municipality of São José do Barreiro MZUSP 73692 (holotype), MZUSP 73595–73599 (paratypes), ZUEC 7594 (paratype).

Ischnocnema randorum: State of São Paulo: Municipality of Salesópolis, Boracéia (approximately 23°38'S 45°50'W) MZUSP 59936 (holotype), MZUSP 36865 (paratype).

Ischnocnema sambaqui: State of Paraná, Municipality of Guaraqueçaba MNRJ 21735 (holotype), CFBH 2934–36 (paratypes), MNRJ 21733–34 (paratypes).

Ischnocnema spanios: State of São Paulo: Municipality of Salesópolis, Boracéia (approximately 23°38'S 45°50'W) MZUSP 23664 (holotype).

Ischnocnema venancioi: State of Rio de Janeiro: Municipality of Teresópolis MNRJ 44113, 44564, 53567, 53569–71, 53590–98, 53932, 56191–215.

Ischnocnema verrucosa: BRAZIL: State of Minas Gerais: Municipality of Juiz de Fora: ZMK 1180 (holotype of *Leiuperus verrucosus*), UFJF 648–49, 664–65, 668–69, 671, 679–80, 685–90, 701–02, 755. State of Espírito Santo: Municipality of Colatina, Rio Mutum MNRJ 121 (holotype of *Eupsophus verrucosus*, junior synonym of *Leiuperus verrucosus*); Municipality of Santa Teresa MNRJ 16137, 28338–41, 34899–901; Municipality of Cariacica CFBH 2272–73, MNRJ 28413, ZUEC 9188–89; Municipality of Aracruz CFBH 2180, 4183, 4492–94, MNRJ 17746–47.