

## A NEW *BRACHYCEPHALUS* (ANURA: BRACHYCEPHALIDAE) FROM THE ATLANTIC RAINFOREST OF ESPÍRITO SANTO, SOUTHEASTERN BRAZIL

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**ABSTRACT:** A new species of the family Brachycephalidae, *Brachycephalus alipioi*, is described from the Atlantic forest of the State of Espírito Santo, southeastern Brazil. The new species is characterized by having uniform orange body coloration in life (in preservative cream yellowish); absence of dermal ossification dorsal to the vertebrae; an external trace of a fourth finger; absence of the fifth toe. The discovery of this new species reinforces the importance of the mountain region in Espírito Santo for preservation of the biodiversity, including anurans.

**KEY WORDS:** Anura; Atlantic rainforest; *Brachycephalidae*; *Brachycephalus alipioi*; new species; southeastern Brazil.

### INTRODUCTION

Currently, the family Brachycephalidae contains recognized 16 genera (Frost *et al.*, 2006). The genus *Brachycephalus* is endemic to the Atlantic rainforest in southeastern and southern Brazil (Pombal *et al.*, 1998; Pombal, 2003). Detailed natural history information is restricted to *Brachycephalus ephippium*. This diurnal toadlet lives amidst the forest leaf litter and is active mainly in wet days (see Pombal *et al.*, 1994). The egg clutch is concealed with soil particles under logs and the embryos have direct development; the hatching toadlet possess an egg tooth and a reddish brown coloration that contrast with the pumpkin color of the adults (Pombal *et al.*, 1994; Pombal, 1999). The vivid color of some species has been associated with aposematic coloration given that tetrodotoxin and analogues compounds are found in the skin and liver (Pombal, 2003; Pires *et al.*, 2005).

Ten species of *Brachycephalus* are currently recognized: *B. ephippium* (Spix, 1824), *B. nodoterga* Miranda-Ribeiro, 1920, *B. didactylus* (Izecksohn, 1971), *B. hermogenesi* (Giaretta and Sawaya, 1998), *B. pernix* Pombal, Wistuba, and Bornschein, 1998, *B. vertebralis* Pombal, 2001, *B. izecksohni* Ribeiro, Alves, Haddad, and dos Reis, 2005, *B. brunneus* Ribeiro, Alves, Haddad, and dos Reis, 2005, *B. ferruginus* Alves, Ribeiro, Haddad, and dos Reis, 2006, and *B. pombali* Alves, Ribeiro, Haddad, and dos Reis, 2006. However, the “varieties” described in

*B. ephippium* by Miranda-Ribeiro (1920) and synonymized by Cochran (1955) require taxonomic reevaluation (Pombal *et al.*, 1998; Pombal, 2001).

During a herpetological survey in the mountains of the State Espírito Santo we found an undescribed species of *Brachycephalus*. Herein, we describe this new species.

### MATERIAL AND METHODS

Specimens used in the description are in (CFBH) Célio F.B. Haddad Collection, deposited in the Universidade Estadual Paulista, campus Rio Claro, São Paulo, Brazil, (MBML) Museu de Biologia “Prof. Mello-Leitão”, Santa Teresa, Espírito Santo, Brasil, and (MNRJ) Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil. Other specimens examined are cited in Pombal (2001), in addition to *Brachycephalus brunneus* MNRJ 40289-291 (paratopotypes) and *B. izecksohni* CFBH 7381-82 and 7384 (topotypes).

Abbreviations used are as follow: SVL (snout-vent length), HL (head length), HW (head width), ED (eye diameter), IOD (interorbital distance), END (eye-nostril distance), THL (thigh length), TBL (tibia length), and FL (foot length). For SVL, THL, and TBL the measurements were taken with a caliper with 0.05 mm of precision under a stereomicroscope. For HL, HW, ED, IOD, END, and FL we used an ocular micrometer with an Olympus stereomicroscope. Measurements

follow Cei (1980) and Duellman (2001) and are given in millimeters. Specimens were fixed in 10% formalin and preserved in alcohol 70 GL. Illustrations of the holotype were made using a Zeiss stereomicroscope with a drawing tube. Two paratopotypes (MNRJ 26043 and 26051) were cleared and double stained for osteological analyses, particularly of the pectoral girdle and phalanges. Geographic coordinates were taken with GPS Garmin II plus.

*Brachycephalus alipioi* sp. nov.

(Fig. 1-2)

**Holotype** – MNRJ 26042, apparently adult, collected at “Fazenda Aoki or Fazenda dos Japanese” (20°28’24”S; 41°00’36”W, approximately 915 meters above sea level), municipality of Vargem Alta, State of Espírito Santo, Brazil, on 15 November 2000 by J.P. Pombal Jr., J.L. Gasparini, R. Fernandes, and G.M. Prado.

**Paratopotypes** – CFBH 3566-567; MNRJ 26043-055. All collected along with the holotype. The specimen MNRJ 26045 apparently is a subadult.

**Diagnosis** – A medium-sized species of *Brachycephalus* (SVL 12.5-16.2 mm) characterized by having the color of body orange uniform in life (in preservative cream yellowish); a small pair of postorbital crests,

absence of dermal ossification dorsal to the vertebrae; an external trace of fourth finger; absence of fifth toe. The pectoral girdle is completely ossified; the epicoracoids are contacting closely and articulating throughout their lengths, the omosternum and sternum are absent. The phalangeal formulae is 1-2-3-1 for the anterior limb and 0-2-3-4-1 for the hindlimb (Fig. 3).

**Comparison with other species** – *Brachycephalus alipioi* can be distinguished from *B. brunneus*, *B. didactylus*, and *B. hermogenesi* by its orange coloration in life, turning light cream in preserved specimens (brownish in *B. brunneus*, *B. didactylus*, and *B. hermogenesi*). The new species differs from *B. brunneus*, *B. didactylus*, and *B. hermogenesi* by its larger size (8.6-12.0 combined SVL; Izecksohn, 1971; Giaretta and Sawaya, 1998; Ribeiro *et al.*, 2005). Overall, *B. alipioi* has a rounded, “bufonid-like”, body shape whereas *B. didactylus* and *B. hermogenesi* have a more elongated, “leptodactyloid-like”, body shape. The new species differs from *B. ephippium* by the absence of two bony shields on the dorsum (present in *B. ephippium*) and from *B. ferruginus*, *B. izecksohni*, *B. pernix*, and *B. pombali* by its uniform orange color, head with a small pair of postorbital crests, and a reduced fourth finger (*B. izecksohni*, *B. ferruginus*, *B. pernix*, and *B. pombali* in life have an orange dorsal coloration with olive grey or dark brown lateral sides; lack fourth

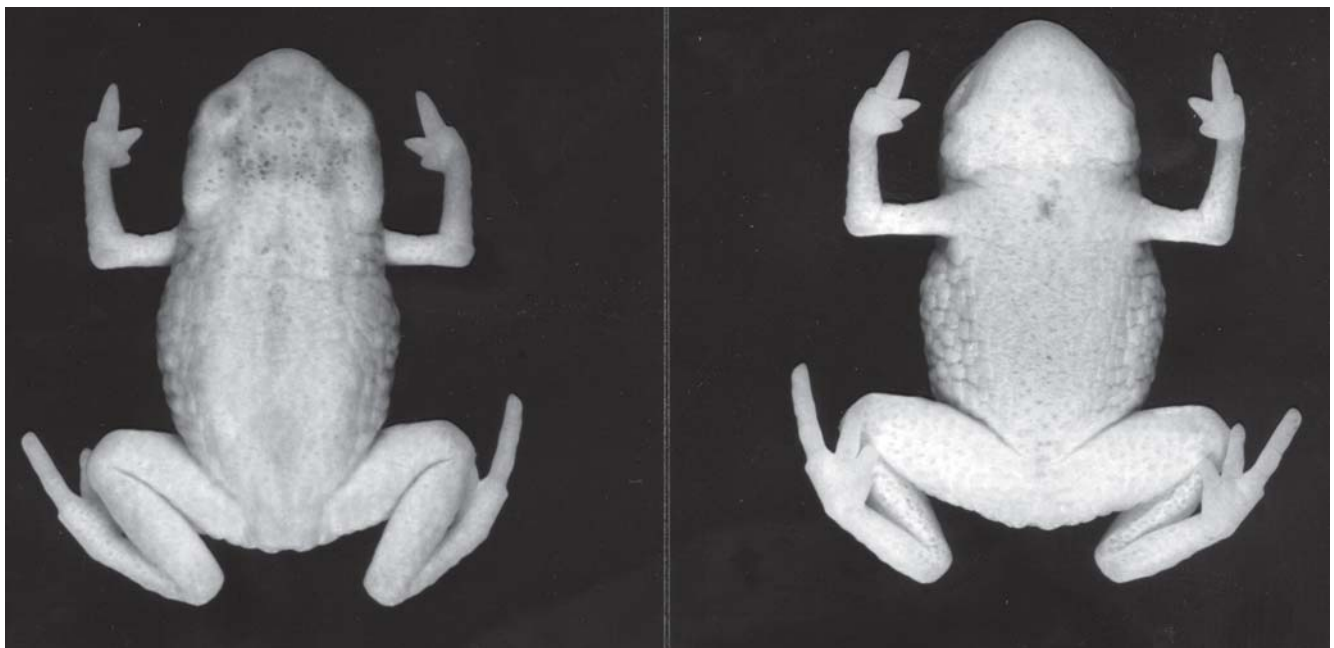


Figure 1. Dorsal and ventral views of the holotype of *Brachycephalus alipioi* (MNRJ 26042).

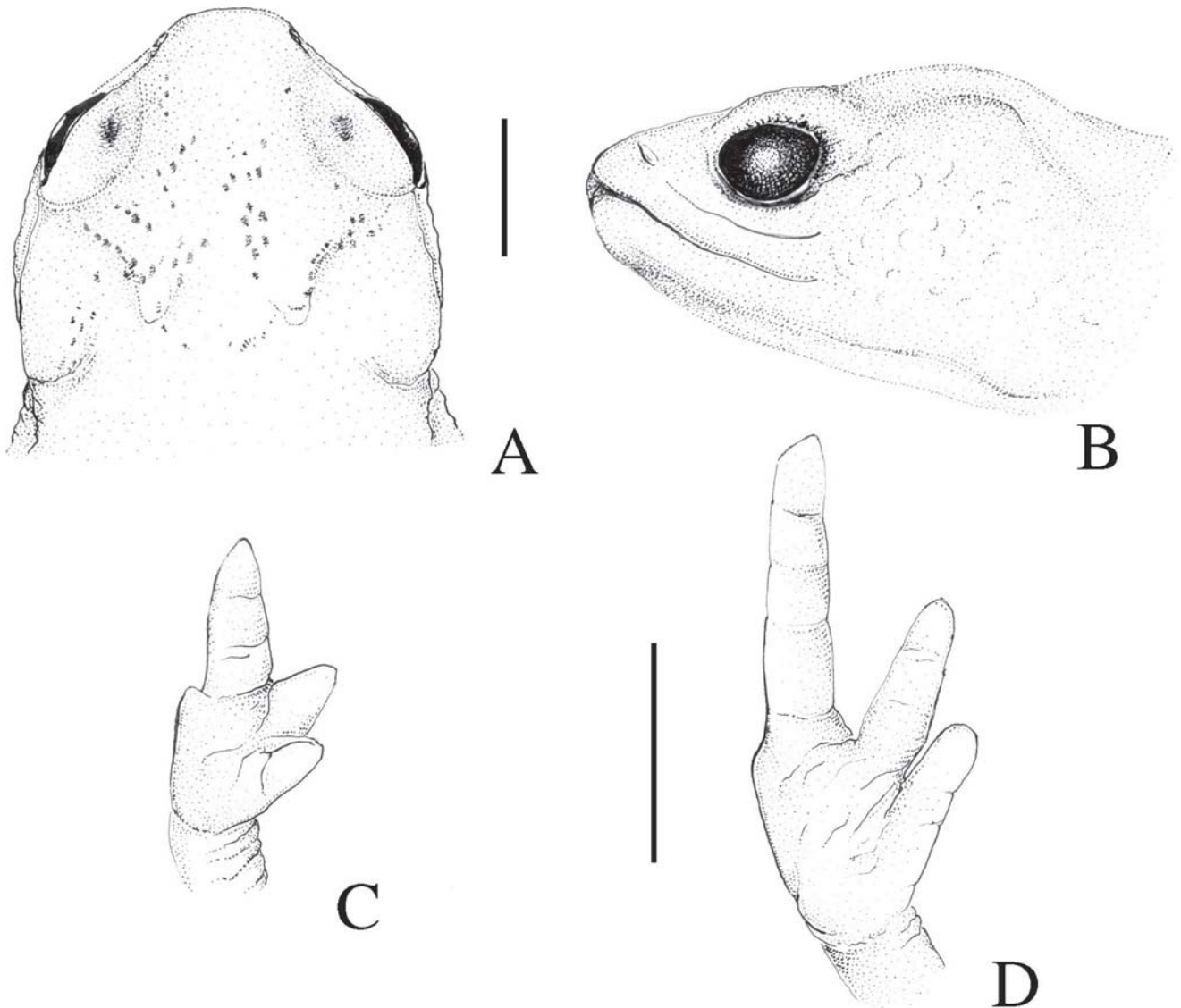


Figure 2. Holotype of *Brachycephalus alipioi* (MNRJ 26042). Dorsal (A) and lateral (B) views of head; ventral views of hand (C) and (D) foot. Scale equal 2.0 mm

finger, and have no head crests; Pombal *et al.*, 1998; Ribeiro *et al.*, 2005; Alves *et al.*, 2006; pers. obs). *Brachycephalus alipioi* is distinguished from *B. nodoterga* and *B. vertebralis* by the absence of dermal ossification dorsal to the vertebrae composed of bulges forming a row (present in *B. nodoterga* and *B. vertebralis*; see figure in Pombal, 2001). In addition, the new species is distinguished from *B. nodoterga* by the absence of developed warts in dorsum and body coloration (developed warts and color in life greenish yellow to dark gray-green in *B. nodoterga*; see color picture in Heyer *et al.*, 1990).

*Description of Holotype* – Body robust, bufoniform (Fig. 1); head large; wider than long; snout very short, shape semicircular in dorsal view and rounded in lateral view (Fig. 2); nostrils small, slit-shaped, not protuberant, directed anterolaterally, almost at end of snout; canthus rostralis distinct, almost straight; loreal region not concave, vertical; eye medium-sized, not protruding dorsally; tympanum not visible; supratympanic fold absent; a small pair of postorbital crests, a small pair of bulges about equidistant between postorbital crests; tongue long and narrow, without indentation on its free posterior border; vomerine teeth absent; pre-maxillary and maxillary teeth absent; choanae small, rounded,

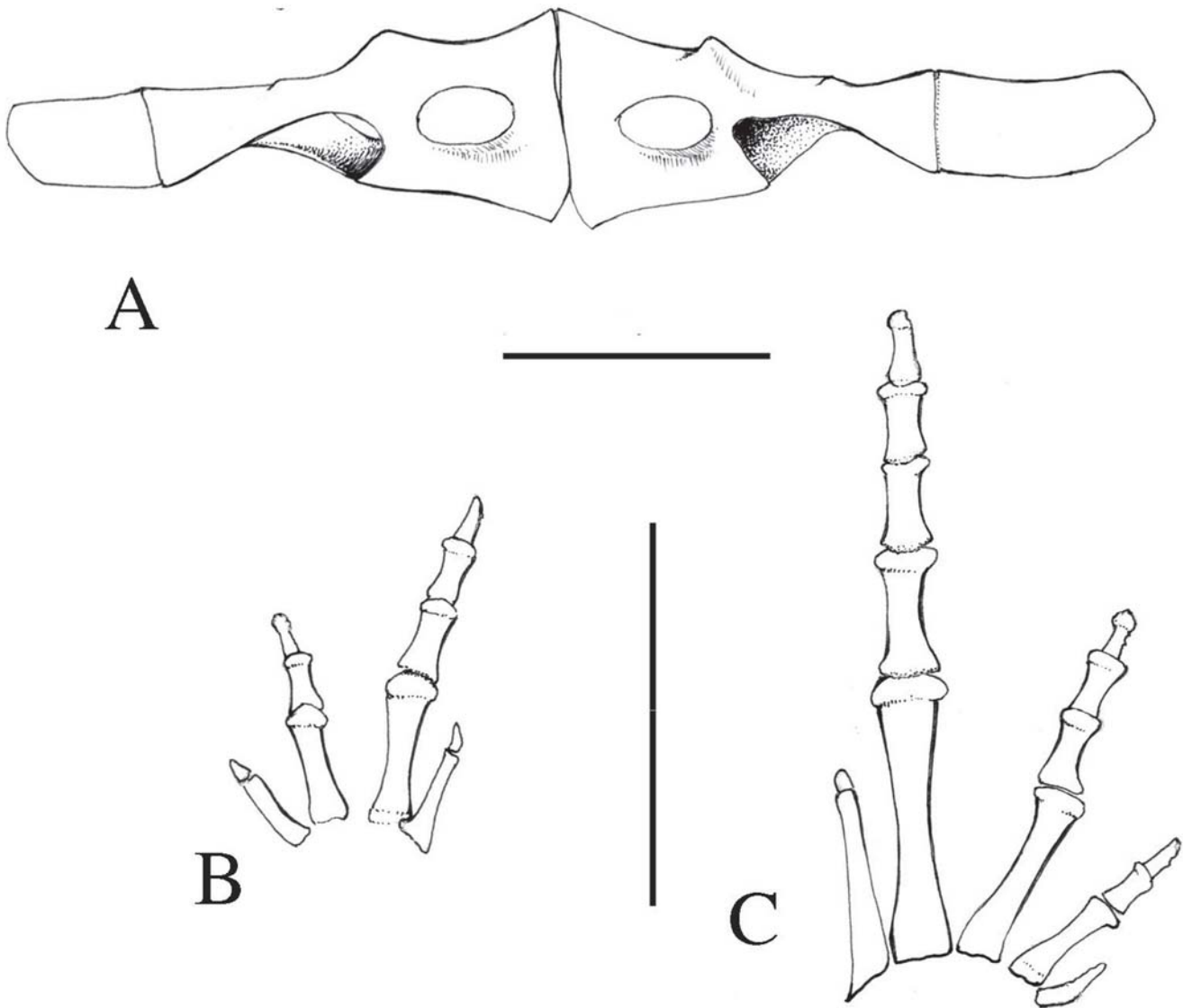


Figure 3. (A) Pectoral girdle, (B) phalanges of hand and (C) foot of *Brachycephalus alipioi* (MNRJ 26042). Scale equal 2.0 mm.

anterior to eye. Dermal ossification dorsal to the vertebrae absent; externally vertebral column slightly protruding. Arms slender, forearm moderately slender; fingers robust; fourth finger very reduced, almost absent; third finger longest, first shortest; second and third finger tips pointed; subarticular tubercles absent; inner and outer metacarpal tubercles absent. Legs short, moderately robust; toes robust; first and fifth toes not visible externally; second and third toe tips rounded, fourth slightly pointed (in the left foot the fourth toe tip is apparently mutilated); subarticular tubercles absent; inner and outer metatarsal tubercles absent; third toe longest, second shortest. Head, throat and chest smooth; dorsum, center of belly, and legs slightly wrinkled; flanks and posterior parts of thighs very wrinkled.

*Color of the holotype* – In life, the holotype had a uniform orange body coloration; eye and a thin line surrounding the eye black (similar to Fig. 4). In preservative, the holotype is uniformly cream yellowish, lighter on the undersurfaces; eyes black; a thin black line surrounding the eye, interrupted at the upper eyelids; brownish small dots on the head.

*Measurements of holotype* – SVL 15.3, HL 6.0, HW 6.8, ED 1.2, IOD 2.5, END 0.8, THL 6.5, TBL 6.8, FL 4.4.

*Variation* – We are unable to determine the sex in most of the specimens of *Brachycephalus alipioi*; however, apparently females are larger and more ro-





Figure 4. *Brachycephalus alipioi* from the type stries in life.

bust. A pair of postorbital crests and a pair of bulges about equidistant between postorbital crests are less developed in small specimens. Measurements are given in Table 1.

**Distribution** – *Brachycephalus alipioi* is known from the type locality and the neighboring Forno Grande and Santa Teresa municipalities (MBML 2850 and MNRJ 25405-407, respectively); the exact place where spec-

imens were collected in Santa Teresa is not known; fieldwork to locate this species in Santa Teresa failed. However, when the specimens were collected (in 1952 by A. Ruschi) the municipality of Santa Teresa was larger than in present time; it is possible that the locality indicated as Santa Teresa is not part of the current municipality. The type locality of *Brachycephalus ephippium* is indicated as Ilhéus, State of Bahia (Bokermann, 1966) but possibly Spix's material was incorrectly labeled and the type locality is in error (Pombal *et al.*, 1998). Thus, *Brachycephalus alipioi* is the northern most record confirmed for the genus.

Table 1: Measurements of *Brachycephalus alipioi* ( $n = 14$ ;  $x$  = mean;  $s$  = standard deviation).

	$x$	$s$	Range
SVL	13.9	1.3	12.5-16.2
HL	5.5	0.5	4.9-6.9
HW	5.6	0.4	5.2-6.8
ED	1.3	0.08	1.2-1.5
IOD	2.2	0.16	2.0-2.5
END	0.7	0.07	0.6-0.9
THL	5.8	0.38	5.3-6.5
TBL	5.4	0.58	4.8-6.8
FL	4.5	0.36	4.2-5.0

**Etymology** – The specific name honors Alípio de Miranda-Ribeiro (1874-1939) for his contribution to the knowledge of the Brazilian vertebrate fauna. Miranda-Ribeiro worked at the Museu Nacional, Rio de Janeiro, and was one of the foremost Brazilian naturalists of his era, publishing extensively on all vertebrate groups, mainly in ichthyology and herpetology (Pombal, 2002). His major publication with Brazilian am-

phibians is the extensive and abundantly color illustrated revision entitled “Notas para servirem ao estudo dos Gymnobatrachios (Anura) Brasileiros” (Miranda-Ribeiro, 1926).

*Natural history* – All specimens were active by day and were found on the forest floor or amidst leaf litter; the individuals were observed walking slowly on the leaf litter. A dissected female (MNRJ 26049) had large unpigmented ovules, which suggest direct development, like other species in the genus (Pombal, 1999; Pombal *et al.*, 1994). In the stomachs of two individuals (MNRJ 26043 and 26051) we found mites and a spider.

### DISCUSSION

The Atlantic rain Forest is the biome with greatest endemism and richness of anurans in the world (Duellman, 1999), being also endangered (Dean, 1997; Morellato and Haddad, 2000). The mountain region in the municipality of Santa Teresa and surrounding areas (including the type locality from *B. alipioi*) shows high levels of endemism and richness of anurans (Pombal *et al.*, 2003). The discovery of this new species reinforces the importance of this region for preservation of the biodiversity, including anurans.

The genus *Brachycephalus* (as currently recognized) is easily recognized by the unique pectoral girdle that is completely ossified. *Psyllophryne* Izecksohn, 1971, was placed in the synonymy of *Brachycephalus* Fitzinger, 1826 (Kaplan, 2002). Diagnoses for the genus *Brachycephalus* and its synonym *Psyllophryne* were provided by Izecksohn (1971). Additional comments on the genus are found in Pombal *et al.* (1998) and Kaplan (2002). Kaplan (2002) synonymized *Psyllophryne* and *Brachycephalus* because they share the same diagnostic synapomorphies (i.e., absence of a sternum, digital reduction, and complete ossification of the epicoracoid cartilages with the coracoids and clavicles). However, Kaplan's (2002) suggestion is based on a small set of characters.

Pombal *et al.* (1998) and Pombal (2001) indicated that a reevaluation of the forms considered as “varieties” of *B. ephippium* by Miranda-Ribeiro (1920) and synonymized by Cochran (1955), is needed to evaluate the species richness in the genus. Heyer *et al.* (1990) resurrected the name *B. nodoterga* as a valid taxon, different from *B. ephippium*. *Brachycephalus vertebralis* was distinguished from *B. ephippium bu-*

*fonoides* by the presence of ossifications dorsal to the vertebrae and forming a row (see Pombal, 2001). Miranda-Ribeiro (1920) did not mention the presence of dermal ossification dorsal to the vertebrae in *B. ephippium bufonoides*; however, the type-specimens have this character. *Brachycephalus alipioi* can be distinguished from all forms considered “varieties” of *B. ephippium* by lacking any dorsal plate or ossification dorsal to the vertebrae.

### RESUMO

Uma nova espécie da família Brachycephalidae, *Brachycephalus alipioi*, é descrito da Floresta Atlântica do Estado do Espírito Santo, sudeste do Brasil. A nova espécie é caracterizada por apresentar o corpo uniformemente com coloração laranja (em líquido conservante creme amarelado); ausência de ossificação dermal sobre as vértebras; externamente quarto dedo vestigial; ausência do quinto artelho externamente. A descoberta desta nova espécie reforça a importância da região serrana do Espírito Santo para preservação da biodiversidade, incluindo anuros.

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