

## A New Species of Brachycephalid (Anura) from the Atlantic Rain Forest of Brazil

JOSÉ P. POMBAL, JR.,<sup>1</sup> ELOISA M. WISTUBA,<sup>2</sup> AND MARCOS R. BORNSCHEIN<sup>3</sup>

<sup>1</sup>Departamento de Vertebrados, Museu Nacional, Quinta da Boa Vista,  
20940-040 Rio de Janeiro, RJ, Brasil

<sup>2</sup>Pós-Graduação em Zoologia, Centro Politécnico, Universidade Federal do Paraná,  
81531-970 Curitiba, Paraná, Brasil

<sup>3</sup>Museu de História Natural "Capão da Imbuia", Rua Prof. Benedito Conceição,  
407, 82810-080 Curitiba, Paraná, Brasil

**ABSTRACT.**—A new species of the genus *Brachycephalus* is described from the State of Paraná, Southern Brazil. The new species is characterized by black coloration on the flanks, orange dorsum, and absence of dermal ossification dorsal to the vertebrae. We suggest that the reduction of number of phalanges in hands and feet is related to the distinctive walking behavior in the genus *Brachycephalus*.

Two genera are recognized in the family Brachycephalidae Günther, 1858, endemic to the Atlantic Rain Forest of Brazil: *Brachycephalus* Fitzinger, 1826, and *Psyllophryne* Izecksohn, 1971 (Frost, 1985). Diagnoses for these two genera were provided by Izecksohn (1971). The genus *Brachycephalus* occurs from the state of Espírito Santo to the state of Paraná, Brazil (southeastern to southern Brazil), with two recognized species: *B. ephippium* (Spix) and *B. nodoterga* Miranda-Ribeiro (Frost, 1985; Duellman, 1993). Life history information for the species in this family is scarce; breeding behavior in *B. ephippium* was recently reported by Pombal et al. (1994).

Herein we describe a new species of the genus *Brachycephalus* from the Atlantic Rain Forest of the state of Paraná, southern Brazil.

### MATERIALS AND METHODS

Specimens used in the description or examined for comparisons are in ALMN (Adolpho Lutz collection, deposited in the Museu Nacional, Rio de Janeiro, Brazil), CFBH (Célio F. B. Haddad collection, deposited in the Universidade Estadual Paulista, campus de Rio Claro, São Paulo, Brazil), MHNCI (Museu de História Natural Capão da Imbuia, Curitiba, Paraná, Brazil), MNRJ (Museu Nacional, Rio de Janeiro, Brazil), and ZUEC (Museu de História Natural, Universidade Estadual de Campinas, São Paulo, Brazil).

Measurements were made with calipers or with a micrometric ocular in a stereomicroscope. Abbreviations used are as follows: SVL (snout–vent length), HL (head length), HW (head width), IND (internostril distance), IOD (interorbital distance), ED (eye diameter), END (eye–nostril distance), THL (thigh length), TBL (tibia length), and FL (foot length). All measurements are expressed in millimeters and fol-

low Duellman (1970) and Cei (1980). Measured specimens were fixed in 10% formalin and preserved in 70% ethyl alcohol. Two specimens (MNRJ 17429–30) were cleared and stained for observation of the pectoral girdle and phalanges.

*Brachycephalus pernix* sp. nov.  
(Figs. 1–4)

**Holotype.**—MNRJ 17349, adult male, collected at Morro Anhangava, in Serra da Baitaca, Conjunto Marumbi (between 25°21'S and 25°26'S, 49°05'W; approximately 1400 m above sea level), Municipality of Quatro Barras, State of Paraná, Brazil, on 12 September 1994 by M. R. Bornschein and M. Pichorin.

**Paratopotypes.**—Collected on 17–18 October 1994 by M. R. Bornschein, M. Pichorin, and B. L. Reinert: CFBH 2597–98, female and male, respectively; MHNCI 3000–04, three unsexed and two males, respectively; MNRJ 17328–42, thirteen males and two females, respectively; MNRJ 17427–28, two males; ZUEC 9433–37, two females and three males, respectively. Two females, MHNCI 1818–19, collected on 6 November 1988 by M. R. Bornschein.

**Diagnosis.**—A small-sized species of *Brachycephalus* (SVL males 12.0–13.3 mm; females 14.1–15.8 mm SVL), characterized by having the body with two colors in life, black on the flanks, and orange on the dorsum (in preservative, orange parts are pale cream), absence of dermal ossification dorsal to the vertebrae, and absence of external trace of fifth toe.

The pectoral girdle is completely ossified; the epicoracoids are closely juxtaposed and articulating throughout their lengths, and an omosternum and sternum are absent (Fig. 2A). The phalangeal formulae in the hands is 1-2-3-1, and in the feet is 1-2-3-4-0 (Fig. 2B, C).



FIG. 1. Holotype of *Brachycephalus pernix* (MNRJ 17349) in life.

**Comparison with Other Species.**—*Brachycephalus pernix* is distinguished from *B. ephippium* and *B. nodoterga* by its color pattern, orange on the dorsum and black on the flanks (*B. nodoterga* is dark gray and *B. ephippium* is orange; see color pictures in Heyer et al., 1990, and Haddad and Sazima, 1992, respectively). Furthermore, the new species differs from *B. ephippium* by its small size (SVL males 13.2–15.4 mm, and females 16.0–17.9 mm in *B. ephippium*; Pombal et al., 1994), dermal ossification dorsal to the vertebrae absent, and absence of external trace of fifth toe (present in *B. ephippium*; see figures in Izecksohn, 1971, 1988 for *B. ephippium*). *Brachycephalus pernix* differs from *B. nodoterga* by lacking warts on the body (present in *B. nodoterga*; Miranda-Ribeiro, 1920). *Brachycephalus pernix* is distinguished from *Psyllophryne didactyla* by its larger size (in *P. didactyla*, maximum SVL 8.6 mm in males and 10.2 mm in females), color pattern (dark brown to pale brown in *P. didactyla*), and lacking an omosternum (present in *P. didactyla*) (see Izecksohn, 1971).

**Description of Holotype.**—Body robust, bufoniform; dermal ossification dorsal to the vertebrae absent; head large, slightly wider than long; snout short, its shape semicircular in dorsal view, and rounded in lateral view (Fig. 3A, B); nostrils not protuberant, directed anterolaterally; canthus rostralis faintly distinct; loreal region slightly concave; eye medium-sized, not protruding dorsally; tympanum not visible; vocal sac not expanded; mouth nearly sigmoid; vocal slits small; tongue long; vomerine teeth absent; choanae small, ovoid, anterior to eye. Arm slender and forearm moderately slender; fingers robust and short; fourth finger greatly reduced, almost not visible externally; subarticular tubercles absent; inner and outer metacarpal tubercles absent; finger lengths  $IV < I < II < III$ ; finger tips pointed (Fig. 3C). Legs short,

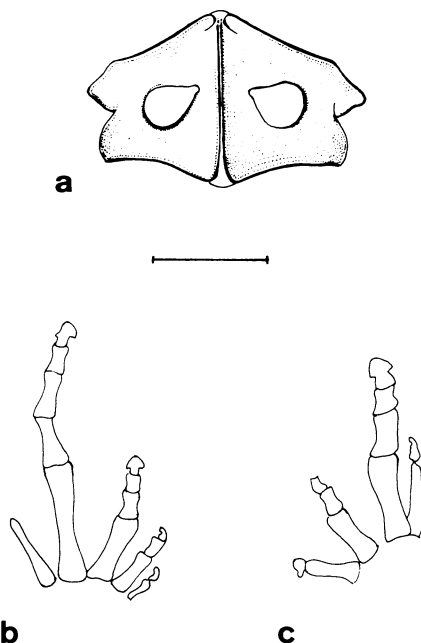


FIG. 2. (A) Pectoral girdle, (B) phalangae of foot and (C) hand of *Brachycephalus pernix* (scale = 1.0 mm).

moderately robust; toes robust; first and fifth toes not visible externally; subarticular tubercles absent; inner and outer metatarsal tubercles absent; toe lengths  $II < III < IV$ ; toe tips pointed (Fig. 3D). Head, dorsum and undersurfaces, smooth; flank surfaces wrinkled.

**Color of Holotype.**—Head orange with black blotches; eyes and surrounding region black; dorsum of body, forearm, arm, knee, heel and foot, orange; lateral surfaces of body, anal region and legs, black; black stain on arms. In preservative, the orange parts become pale cream.

**Measurements of Holotype.**—SVL 13.1; HL 4.6; HW 5.4; IND 1.4; ED 1.1; IOD 2.3; END 0.3; THL 4.5; TBL 3.8; FL 3.3.

**Variation.**—The extension of the black coloration on the body is variable (Fig. 4), but all specimens show the same basic black and orange color pattern. Measurements are in Table 1.

**Distribution.**—The new species is known only from the type locality and from Morretes, State of Paraná, Brazil. *Brachycephalus pernix* represents the southernmost record for the genus *Brachycephalus*, and by consequence for the family Brachycephalidae.

**Etymology.**—The specific name, a Latin substantive masculine (*pernix* = good walker), is an allusion to the characteristic mode of locomotion.

**Natural History.**—The ground in the Atlantic Rain Forest at the type locality is very shady

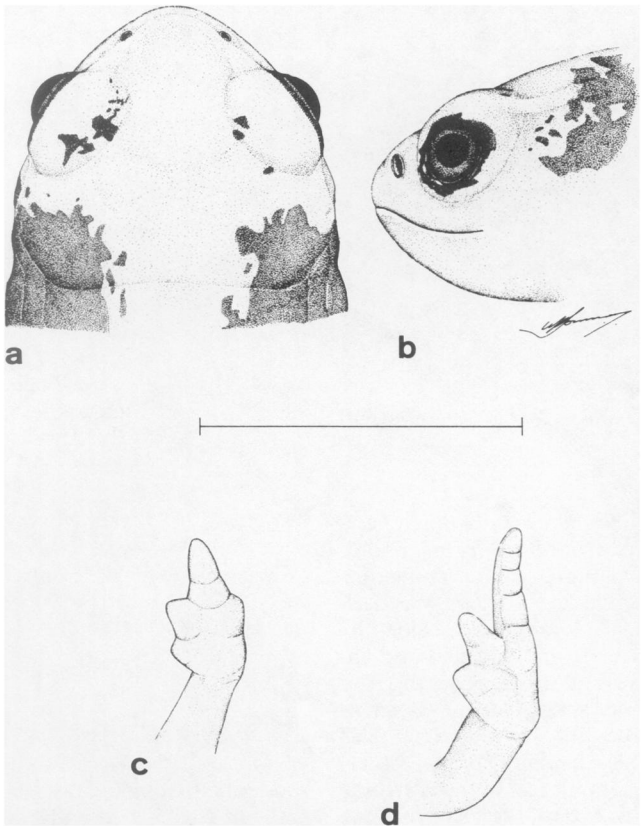


FIG. 3. Holotype of *Brachycephalus pernix* (MNRJ 17349). (A) Dorsal and (B) lateral views of head; ventral views of (C) hand and (D) foot (scale = 5.0 mm).

with a thick layer of leaf litter. From January to December of 1993 the means of the maximum and minimal air temperatures were respectively, 16.7 C (range 12.5–22.2 C) and 10.9 (range 7.5–16.4 C), and the mean air humidity was 91.5% (range 79.9–96.9%) (Roderjan, 1994). *Brachycephalus pernix* were active by day. Males and females were found on the forest floor or amidst leaf litter (10–15 cm under the surface). Gener-

ally, individuals were observed walking slowly on the leaf litter (Fig. 1). The clutch and vocalization are unknown. Direct development is known in *B. ephippium* (Pombal et al., 1994), and probably also occurs in *B. pernix*. The tadpole of *B. ephippium* described by Cochran (1955) belongs to the genus *Hyalinobatrachium*, Centrolenidae (Heyer, 1985).

*Remarks.*—The two genera of *Brachycephali-*

TABLE 1. Measurements of type specimens of *Brachycephalus pernix* ( $\bar{x}$  = mean; SD = standard deviation).

|     | Males (N = 23) |      |           | Females (N = 5) |      |           |
|-----|----------------|------|-----------|-----------------|------|-----------|
|     | $\bar{x}$      | SD   | Range     | $\bar{x}$       | SD   | Range     |
| SVL | 12.53          | 0.44 | 12.0–13.3 | 14.90           | 0.60 | 14.1–15.8 |
| HL  | 4.56           | 0.90 | 4.2–5.0   | 5.06            | 0.48 | 4.2–5.5   |
| HW  | 5.36           | 0.23 | 5.0–5.7   | 5.94            | 0.15 | 5.7–6.0   |
| IND | 1.28           | 0.06 | 1.2–1.4   | 1.35            | 0.06 | 1.2–1.4   |
| ED  | 1.14           | 0.07 | 1.0–1.2   | 1.21            | 0.09 | 1.0–1.3   |
| IOD | 2.40           | 0.13 | 2.1–2.5   | 2.48            | 0.13 | 2.3–2.5   |
| END | 0.48           | 0.07 | 0.3–0.5   | 0.55            | 0.07 | 0.5–0.6   |
| THL | 4.21           | 0.22 | 3.8–4.5   | 5.03            | 0.16 | 4.8–5.2   |
| TBL | 3.66           | 0.19 | 3.2–4.0   | 4.15            | 0.33 | 3.5–4.4   |
| FL  | 2.83           | 0.25 | 2.3–3.3   | 3.46            | 0.09 | 3.3–3.5   |

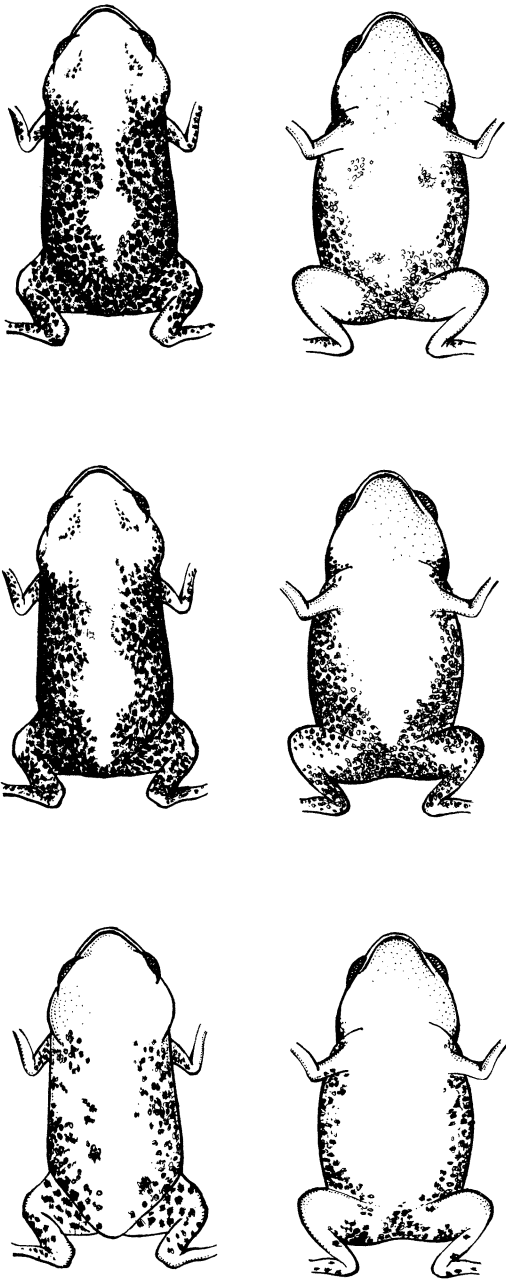


FIG. 4. Color variation of *Brachycephalus pernix* in dorsal and ventral views (top MNRJ 17349; middle MHNCI 1819; bottom MNRJ 17338).

dae recognized, *Brachycephalus* and *Psyllophryne*, have a completely ossified pectoral girdle, and the epicoracoids are closely juxtaposed and articulated throughout their lengths (Izecksohn, 1971; Trueb, 1973). Izecksohn (1971) compared *Psyllophryne* and *Brachycephalus* and provided the following distinctive characteristics for the

genus *Psyllophryne*: omosternum present, dermal ossification dorsal absent, head relatively smaller, and shady color. With the revalidation of *B. nodoterga* (Heyer et al., 1990) and the discovery of *B. pernix*, the only distinctive feature between *Brachycephalus* and *Psyllophryne* is the presence of an omosternum in *Psyllophryne*. Also, the fenestrae (between clavicle and coracoid) are larger in *Psyllophryne* (Izecksohn, 1971).

All specimens known of the genus *Brachycephalus* have been collected in forests up to 750 m elevation (Sebben et al., 1986; Haddad and Sazima, 1992). Specimens of the genus are known from the state of Espírito Santo to the state of Paraná (southeastern and southern Brazil), occurring in the Atlantic Rain Forest (sensu Ab'Saber, 1977). The type locality of *B. ephippium* is Ilhéus, state of Bahia (Bokermann, 1966); however, the species is represented from northeastern Brazil only by Spix's type (W. C. A. Bokermann, pers. comm.; pers. obs.). *Brachycephalus ephippium* is common in the mountains of Rio de Janeiro city, where Spix also collected (Spix and Martius, 1823). Possibly Spix's material was incorrectly labeled and the type locality is in error.

*Brachycephalus pernix* and *B. ephippium* have a reduced phalangeal formula (for *B. ephippium*, see illustration in Izecksohn, 1988). Similar reduction in *Osornophryne* (Bufonidae) was regarded as an adaptation for terrestrial habitats (Ruíz-Carranza and Hernández-Camacho, 1976). However, *Osornophryne antisana* Hoogmoed lives in arboreal bromeliads and thereby weakens this suggestion (Hoogmoed, 1987). We think that reduction of the number of phalanges or reduction of fingers and toes may be related to the distinctive walking behavior found in the anuran genera *Euparkerella* (Leptodactylidae), *Brachycephalus*, *Psyllophryne* (Izecksohn, 1971, 1988; Pombal et al., 1994; this study), and *Osornophryne* (Duellman and Trueb, 1986; Gluesenkamp, 1995). The similar reduction of the number of phalanges is found in other anurans and also may be related with walking behavior, e.g., leaf litter frogs genera *Phyllonastes* and *Adelophryne* (see Lynch, 1976, where *Phyllonastes* was called of *Euparkerella*; Duellman and Mendelson, 1995). However, the observation of the walking behavior is necessary in the species that show phalangeal reduction.

Three species are currently recognized in the genus *Brachycephalus*, but additional species will likely be added as systematic studies of the genus progress (Heyer et al., 1990; Haddad and Sazima, 1992). The status of the "varieties" *B. ephippium* (i.e., *B. ephippium atelopoides*, *B. e. garbeana*, and *B. e. bufonoides*) described by Miranda-Ribeiro (1920) require reevaluation.

**Acknowledgments.**—We thank R. P. Bastos, U. Caramaschi, W. E. Duellman, C. F. B. Haddad, W. R. Heyer, E. Izecksohn, and E. L. A. Monteiro Filho for suggestions on the manuscript. P. R. Nascimento (Figs. 2 and 4) and J. Somera (Fig. 3) made the line drawings. M. Pichorin, and B. L. Reinert helped in the fieldwork. I. Sazima developed the black and white photo. A. J. Cardoso, C. F. B. Haddad, C. Morato, and I. Sazima loaned material under their responsibility. The authors are grateful to the CNPq for fellowships.

#### LITERATURE CITED

- AB'SABER, A. N. 1977. Os domínios morfoclimáticos na América do Sul. Primeira aproximação. *Geomorfologia* 52:1–21.
- BOKERMANN, W. C. A. 1966. Lista Anotada das Localidades Tipo de Anfíbios Brasileiros. RUSP, São Paulo.
- CEI, J. M. 1980. Amphibians of Argentina. *Monit. Zool. Ital. (N.S.) monogr.* 2:1–609.
- COCHRAN, D. M. 1955. Frogs of southeastern Brazil. *Bull. U.S. Nat. Mus.* 206:1–423.
- DUELLMAN, W. E. 1970. The Hylid Frogs of Middle America. *Monogr. Mus. Nat. Hist. Univ. Kansas*, Lawrence.
- . 1993. Amphibian species of the world: additions and corrections. *Special Publ. Mus. Nat. Hist. Univ. Kansas* 21:1–372.
- DUELLMAN, W. E., AND J. R. MENDELSON III. 1995. Amphibians and reptiles from northern Departamento Loreto, Peru: taxonomy and biogeography. *Univ. Kansas Sci. Bull.* 55:329–376.
- DUELLMAN, W. E., AND L. TRUEB. 1986. *Biology of Amphibians*. McGraw-Hill, New York.
- FROST, D. R. (ed.). 1985. *Amphibian Species of the World, A Taxonomic and Geographical Reference*. Allen Press Inc., and The Association of Systematics Collections, Lawrence, Kansas.
- GLUESENKAMP, A. G. 1995. A new species of *Osornophryne* (Anura: Bufonidae) from Volcán Sumaco, Ecuador with notes on other members of the genus. *Herpetologica* 51:268–279.
- HADDAD, C. F. B., AND I. SAZIMA. 1992. Anfíbios anuros da serra do Japi. In L. P. C. Morellato (ed.), *História Natural da Serra do Japi: Ecologia e Preservação de uma Área Florestal no Sudeste do Brasil*, pp. 188–211. Editora da Unicamp/FAPESP, Campinas.
- HEYER, W. R. 1985. Taxonomic and natural history notes on frogs of the genus *Centrolenella* (Amphibia: Centrolenidae) from southeastern Brazil and adjacent Argentina. *Pap. Avulsos Zool.* 36:1–21.
- , A. S. RAND, C. A. G. CRUZ, O. L. PEIXOTO, AND C. E. NELSON. 1990. Frogs of Boracéia. *Arq. Zool. (S. Paulo)* 31:231–410.
- HOOGMOED, M. S. 1987. New *Osornophryne* (Amphibia: Anura: Bufonidae) from the Atlantic versant of the Andes in Ecuador. *Zoologische Mededelingen* 61:209–242.
- IZECKSOHN, E. 1971. Novo gênero e nova espécie de Brachycephalidae do Estado do Rio de Janeiro, Brasil. *Bol. Mus. Nac. (Zool.)* 280:1–12.
- . 1988. Algumas considerações sobre o gênero *Euparkerella*, com a descrição de três novas espécies (Amphibia, Anura, Leptodactylidae). *Rev. Brasil. Biol.* 48:59–74.
- LYNCH, J. D. 1976. Two new species of frogs of the genus *Euparkerella* (Amphibia: Leptodactylidae) from Ecuador and Perú. *Herpetologica* 32:48–53.
- MIRANDA-RIBEIRO, A. 1920. Os brachycephalídeos do Museu Paulista. *Rev. Mus. Paulista* 12:306–318.
- POMBAL, JR., J. P., I. SAZIMA, AND C. F. B. HADDAD. 1994. Breeding behavior of the pumpkin toadlet, *Brachycephalus ephippium* (Brachycephalidae). *J. Herpetol.* 28:516–519.
- RODERJAN, C. V. 1994. O gradiente da floresta ombrófila densa no Morro Anhangava, Quatro Barras, PR. Aspectos climáticos, pedológicos e fitossociológicos. Unbl. Ph.D. Thesis. Universidade Federal do Paraná, Curitiba.
- RUÍZ-CARRANZA, P. M., AND J. I. HERNÁNDEZ-CAMACHO. 1976. *Osornophryne*, género nuevo de anfibios bufónidos de Colombia y Ecuador. *Caldasia* 11:93–148.
- SEBBEN, A., C. A. SCHWARTZ, D. VALENTE, AND E. G. A. MENDES. 1986. Tetrodotoxin-like substance found in the Brazilian frog *Brachycephalus ephippium*. *Toxicon* 24:799–806.
- SPIX, J. B. VON, AND C. F. P. VON MARTIUS. 1823. *Reise in Brasilien auf Befehl Sr. Majestät Maximilian Joseph I. Königs von Baiern in den Jahren 1817 bis 1820 gemacht und beschrieben*. Erster Theil. (vol. 1; translated into Portuguese).
- TRUEB, L. 1973. Bones, frogs, and evolution. In J. L. Vial (ed.), *Evolutionary Biology of the Anurans. Contemporary Research on Major Problems*, pp. 65–132. University of Missouri Press, Columbia.

Accepted: 23 October 1997.

#### APPENDIX I

**Additional Specimens Examined.**—*Brachycephalus ephippium*: Rio de Janeiro: Angra dos Reis MNRJ 17458–59; Itatiaia AL-MN 2178, MNRJ 2155, 10789, 17455, 17556–57, ZUEC 0008, 7149–54; Mangaratiba MNRJ 578, 2542, 3072, 11574–83, 13264–72; Nova Friburgo MNRJ 17433, 17440–41; Parati MNRJ 632, 2435, 10731; Paulo de Frontin MNRJ 1495, 8158–69; Petrópolis AL-MN 1344–46, 1362–66, 1367–68, 4141–42; Rio de Janeiro AL-MN 78–78A, 313–18, 2197, 2515–15A, 3696–98, MNRJ 640, 1725, 1870, 3327, 3959, 9388–416, 10205, 10215, 13818–19, 15332, 17431, 17451, 17453, ZUEC 971; Teresópolis MNRJ 2091, 2764, 3311, 12471–72, 17434–35, 17436–37, 17438–39, 17445, 17447–48, 17449, 17450, 17452, 17454, ZUEC 8099–100. São Paulo: MHNCI 2495–504; Campinas CFBH 374, 994–97, 1343, 2565–69, ZUEC 5992, 6866, 6889, 9002, 9149–58; Cotia MHNCI 2611–16, ZUEC 1457–58, 1496–97; Jundiá CFBH 1070–71, ZUEC 6852; São José do Barreiro AL-MN 894–95, 2261–300, 2516 (3 specimens), MNRJ 2143, 10783–86.

*Brachycephalus* cf. *nodoterga*.—São Paulo: Boracéia ZUEC 6073.

*Brachycephalus pernix*.—Paraná: Morretes MHNCI 0125, 0128.

*Psyllophryne didactyla*.—Rio de Janeiro, Paulo de Frontin MNRJ 4062–73 (paratypes), 17460–63 (topotypes).