

New Species of *Anops* Bell, 1833 (Squamata, Amphisbaenia) from Jalapão Region in the Brazilian Cerrado

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ABSTRACT.—A new species of keel-headed amphisbaenian of the genus *Anops* is described from the Cerrado of the Jalapão region, Tocantins state, Brazil. This new species of *Anops* is described from a single specimen, which may be easily distinguished from the other species of the genus, *Anops bilabialatus* and *Anops kingii*, by showing an extremely narrow head (37.2% head length); a row of eight occipitals anterior to the first body annulus; temporal present; mental and postmental fused; four postgenial rows located between the malars; and two malars posterior to the second infralabial. The new species is the first of the genus found in the Cerrado core area, and, based on the available records, the single species in the genus may be restricted to this region.

RESUMO.—Uma nova espécie de anfisbênio com cabeça quilhada do gênero *Anops* é descrita para o Cerrado da região do Jalapão, Tocantins, Brasil. Essa nova espécie de *Anops* é descrita com base num único espécime, facilmente distinguida das outras espécies do gênero, *Anops bilabialatus* e *Anops kingii*, por apresentar a cabeça extremamente afilada (37,2% do comprimento da cabeça), uma fileira de oito occipitais anterior ao primeiro anel corporal, temporal presente, mental e pós-mental fusionados, quatro fileiras de pós-geniais localizadas entre os malares e dois malares posteriores ao segundo infralabial. A nova espécie é a primeira do gênero encontrada na porção central do Cerrado, e, baseado nos registros disponíveis, a única espécie que pode ser restrita para essa região.

Species of the amphisbaenid genus *Anops* Bell, 1833 are small to medium-sized legless fossorial squamates, with a robust body, short and cylindrical tail, head compressed laterally with a sharp and elevated rostral scale (Vanzolini, 1999). Currently the genus includes two species: *Anops kingii* Bell, 1833, ranging from southern Brazil, Argentina and Uruguay to Bolivia (Gans and Rhodes, 1964; Vanzolini, 1999; Gonzales and Sosa, 2005), and *Anops bilabialatus* Stimson, 1972, known from only two localities in the northeastern portion of Mato Grosso state, Brazil, in the contact zone between Cerrado savannas and Amazonia (Vanzolini, 1999) (Fig. 1).

The relationships of *Anops* with the remaining amphisbaenians remain unclear (Vanzolini, 1999). Apart from occurring in extremely

disjunct regions, the two known species of the genus can be diagnosed by morphological differences. Although the habitat and distribution of *A. kingii* are relatively well known (see Vanzolini, 1999; Gonzales and Sosa, 2005), with the species being found mostly in open grasslands of the Pampas and Chaco regions, habitat use by *A. bilabialatus* remains poorly documented, hampering interpretations of the evolutionary events that led to the disjunction between the two species (Vanzolini, 1999). The known range of the two currently recognized *Anops* species is separated by at least 1,000 linear km, and this distribution gap is covered mainly by open landscapes. Although the genus has never been found at relatively well-studied sites between Bolivia and Mato Grosso (see Vitt, 1991; Gainsbury and Colli 2003), vast areas between the ranges of these two species have never been properly sampled, including large areas in the Cerrado and the Chaco regions (Vanzolini, 1988; Colli et al., 2002).

Recent herpetofaunal inventories, including studies on squamate diversity in central Brazil (see partial results in Nogueira and Rodrigues, 2006; Costa et al., 2007), harboring one of the

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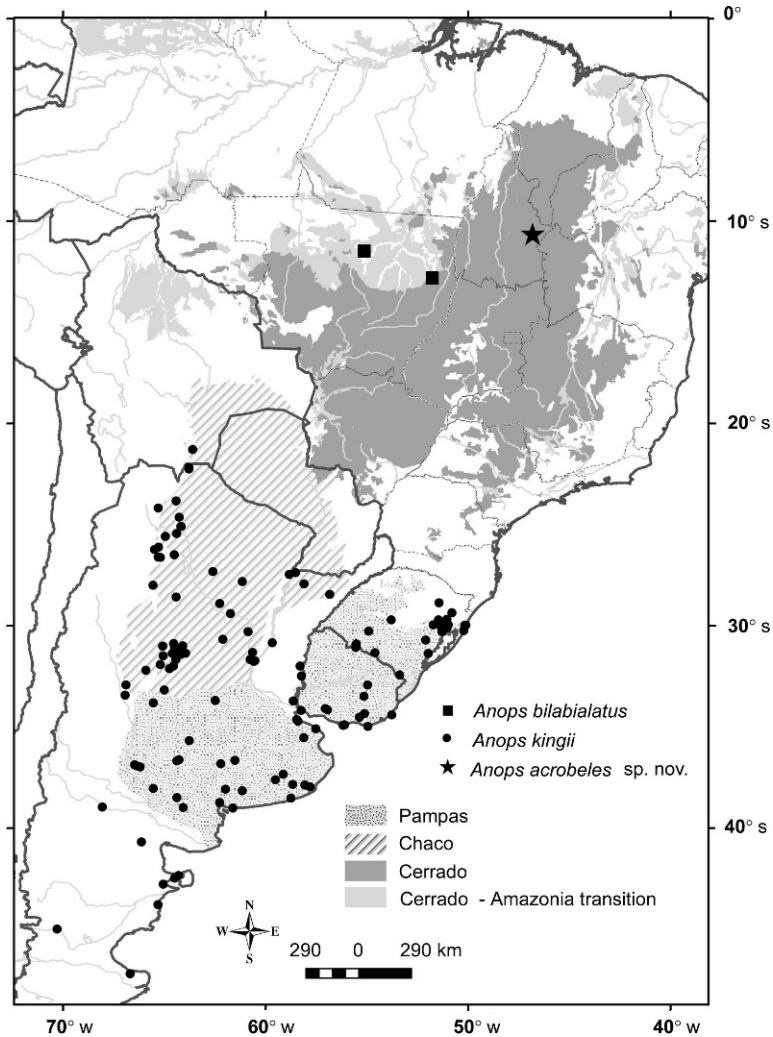


FIG. 1. Geographic distribution of the species of *Anops* in major biomes of eastern South America.

most poorly studied Neotropical herpetofaunas (Vanzolini, 1988; Colli et al., 2002), resulted in the collection of the first specimen of the genus *Anops* in the core area of the Cerrado, east of the Araguaia drainage, some 600 km from the nearest locality record of *A. bilabialatus*. Herein, we describe this remarkably distinctive specimen as a new species.

MATERIALS AND METHODS

Specimens used in the comparisons are housed in the herpetological collection of Universidade de São Paulo (MZUSP) and Museu de Zoologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP) and are listed in Appendix 1. Morphological descriptions follow Gans and Alexander (1962) and Vanzolini

(1999), and distribution records from *A. kingii* and *A. bilabialatus* were obtained from Gans and Rhodes (1964), Vanzolini (1999), and Gonzales and Sosa (2005). Morphometric data were taken from the right side of the specimens. Linear measurements were taken with a digital caliper, to the nearest 0.1 mm, except snout–vent length, which was taken with a flexible ruler to the nearest millimeter.

Anops acrobeles sp. nov.

Figures 2, 3

Holotype.—MZUSP 96337 (field number CN 1034), specimen (sex undetermined, specimen with posteriormost section of body mutilated) from a pit-fall trapping site covered with typical Cerrado savannas, close to the northern limits of Serra Geral do Tocantins Ecological Station,

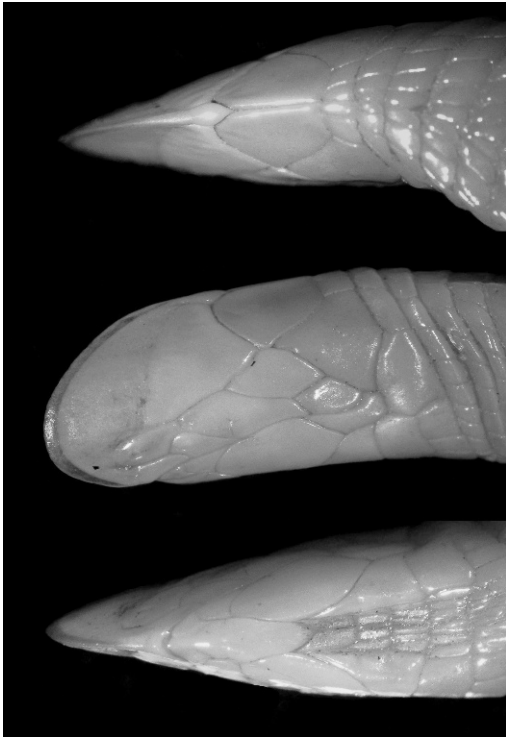


FIG. 2. *Anops acrobeles* sp. nov. (Holotype, MZUSP 96337). Dorsal, lateral, and ventral view of the head.

(10°35'42"S; 46°46'16"W), Ponte Alta municipality, Jalapão region, Tocantins state, Brazil, collected 29 March 2003 by Cristiano Nogueira.

Diagnosis.—This new species of *Anops* may be distinguished from *A. bilabialatus* and *A. kingii* by showing an extremely narrow head (37.2% head length vs. 62.5–77.6% head length; Fig. 4); a row of eight occipitals anterior to the first body annulus (Fig. 3A; vs. scutes absent); temporal present (Fig. 3B; vs. absent); mental and postmental fused (vs. distinct); four rows of postgenials located between malars (Fig. 3C; vs. one); two malars posterior to the second infralabial (Fig. 3C; vs. one).

Additionally, *A. acrobeles* differs from *A. bilabialatus* by showing an elongate rostral in contact with the frontals (vs. rostral relatively short and separated from the frontals); frontal longer than wide (vs. frontal wider than long); ocular relatively elongate, representing 27.7% of head length (vs. short ocular, 12.5–14.7% of head length); three supralabials (vs. two); postsupralabial absent (vs. present); three infralabials (vs. two). It further differs from *A. kingii* by not showing a preocular and a postsupralabial (vs. present). Moreover, second supralabial in the new species is ca. two times longer than the other supralabials (vs. supralabials with

similar proportions); second supralabial longer than high (vs. second supralabial higher than long); 296 + n (specimen mutilated, missing posterior third of body) body annuli (vs. 214–244 body annuli).

Description of Holotype.—Snout-vent length 174 + n mm, specimen mutilated, missing posterior third of body; midbody diameter 3.9 mm. Head laterally compressed, 65.1% narrower than the body, length 6.7 mm, anterior width 1.3 mm, and posterior width 2.5 mm. Rostral elongated (64.9% of head length) and extremely compressed at dorsal part, covered by a layer of keratin forming a sharp and prominent keel; in contact with prefrontals and frontals dorsally, prefrontals and nasals laterally, and first supralabial ventrally. Prefrontals paired, irregularly polygonal, vertically elongate, in contact with the frontals, ocular and second supralabial laterally, and nasals posteriorly. Frontal paired, relatively large (29.6% of head length), 1.4 times longer than wide, in contact with ocular and postocular laterally, and parietals posteriorly. Nasal relatively elongate, 2.1 times longer than high, in contact with the first and second supralabials posteriorly. Nostril narrow and elongate placed at anterior portion of nasal scute. Ocular 2.1 times longer than high, in contact with second and third supralabials laterally, and postocular posteriorly. Eye not visible. Postocular relatively large (25.4% of head length), almost as long as high, in contact with third supralabial and third infralabial laterally, and temporal posteriorly. Temporal relatively large (18.1% head length), almost as long as wide, in contact the occipital and postmalar laterally, and first body annulus posteriorly. Mental narrow and elongate, 3.2 times longer than wide, fused with postmental, posterior portion anvil-shaped, in contact with first and second infralabials laterally, and first row of postgenials posteriorly.

Parietals four, rectangular and very small (7.6% of head length), the two central parietals narrower and the two laterals wider, in contact with occipital row posteriorly. Eight occipitals in a row, narrow at dorsal portion of head and wider at lateral portion, the row is in contact with the first body annulus posteriorly. Supralabials three, irregularly polygonal, first and third small and longer than high; second relatively elongated (32.4% of head length), 2.5 times longer than high. Infralabials three, first smallest (11.6% of head length); second largest (35.0% of head length), 2.2 times longer than wide, in contact with first row of postgenials laterally, and anterior malar posteriorly; the third small and narrow, approximately three times longer than wide, extending beyond the commissure of the mouth, and in contact with

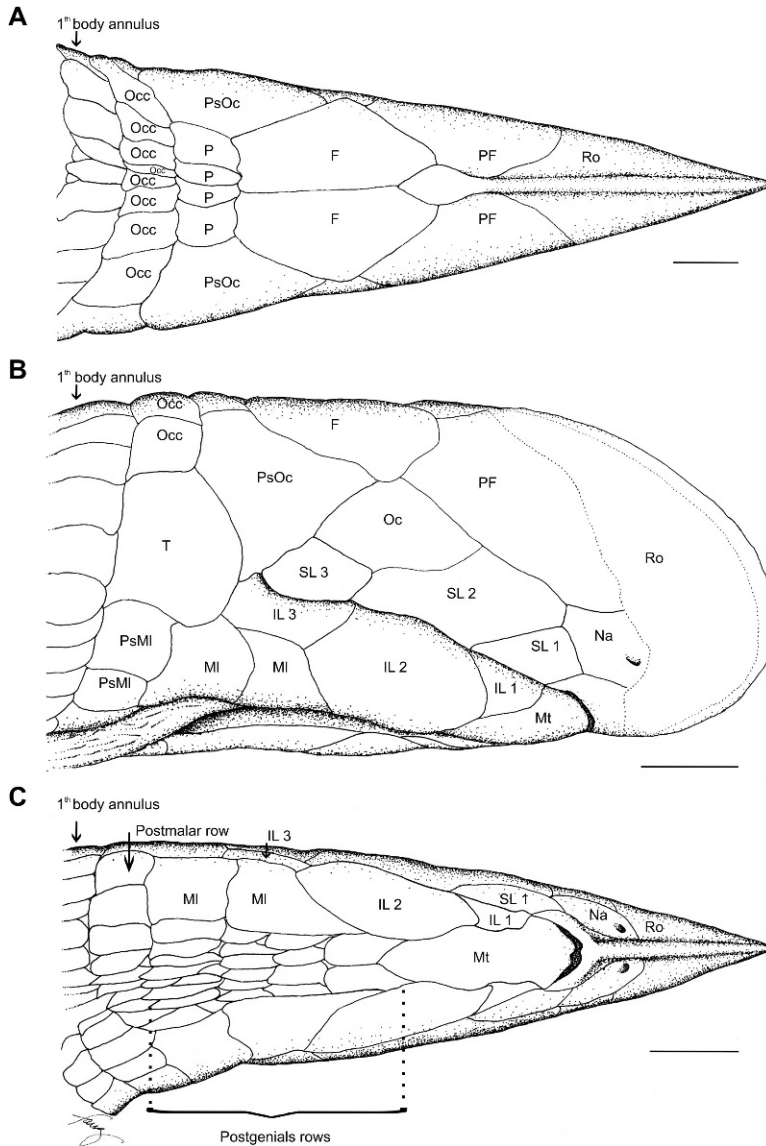


FIG. 3. *Anops acrobeles* sp. nov. (holotype, MZUSP 96337). (A) Dorsal, (B) lateral, and (C) ventral view of the head. Scale bar = 1 mm. Scutes identified by abbreviations: rostral (Ro), prefrontal (PrF), frontal (F), parietal (P), postocular (PsOc), occipital (Occ), nasal (Na), ocular (Oc), first supralabial (SL1), second supralabial (SL2), third supralabial (SL3), temporal (T), mental (Mt), first infralabial (IL1), second infralabial (IL2), third infralabial (IL3), malar (MI), and postmalar (PsMI).

malars laterally. Two large malars between infralabials and postgenial rows; anterior malar larger, two times longer than wide, in contact with third row of postgenials laterally; posterior malar almost as long as wide, in contact with fourth row of postgenials laterally and postmalar row posteriorly. Four postgenial rows anterior to the postmalar row; the first with two postgenials longer than wide; the second and

third with four and six scales, respectively; the fourth with eight scales contacting the postmalar row. Twelve postmalars in a row, medial ones narrower, and laterals broader, in contact with first body annulus posteriorly. Body annuli 296 + n (specimen mutilated, missing posterior third of body); dorsal and ventral segments at midbody 20 and 22, respectively. Lateral sulci apparent from the 53rd body annulus.

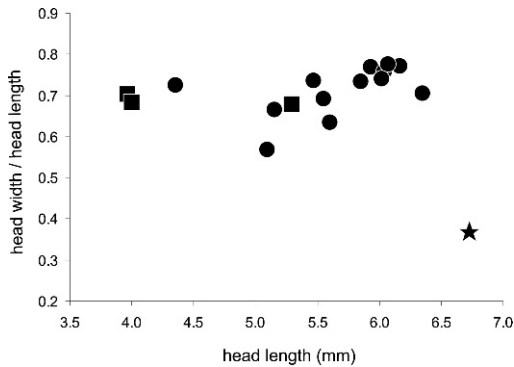


FIG. 4. Relationship between head width / head length ratio and head length in *Anops* species. *Anops acrobeles* sp. nov. (★), *Anops bilabialatus* (■), and *Anops kingii* (●).

Color in Preservative.—Creamish color throughout body. On dorsal portion of the body, the posterior border of segments in each annulus is bordered by minute dark markings.

Color in Life.—Light tan and creamish throughout body, with posterior part of body slightly darker because of very scattered pigmentation on the posterior border of segments. Pinkish areas near head and rostral because of lack of pigmentation.

Etymology.—The name “*acrobeles*,” from the Greek *ákros* = distal portion, and, *beles* = pointed. The specific epithet is a reference to the extremely acute rostral of the new species,

much more pronounced than in the other two species of the genus.

Geographic Distribution, Habitat, and Natural History.—The new species was found while one of the authors (CN) was digging a pitfall-trap at a site located at 10°35'42"S; 46°46'16"W, 430 m elevation (Fig. 5) close to the northern borders of Serra Geral do Tocantins Ecological station, in cerrado savannas close to the Curicaca headwaters, west of Rio Novo, in Tocantins state, central Brazil. The specimen was collected during an inventory of the herpetofauna in the Serra Geral do Tocantins Ecological Station, Jalapão region, central Brazil.

The Jalapão region, comprising at least 54,000 km² of preserved habitats, is the largest continuous block of original Cerrado, and is recognized as a priority area for Cerrado conservation (Cavalcanti and Joly, 2002). The Jalapão region is located on the watershed separating the headwaters of the Tocantins and São Francisco drainages, in the states of Tocantins, Piauí, Maranhão, and Bahia. The region is characterized by the contact between two contrasting relief components: the elevated Serra Geral plateaus (and occasional isolated, outlying portions of tableland, ranging from 700–1,000 m), and depositional plains (300–600 m) covered with quartzitic sands, formed by the erosion of the sandstone plateaus (locally called “chapadas” or “morros testemunhos,” in the case of isolated portions of the formerly continuous plateaus). These two geomorpho-



FIG. 5. Cerrado site where the holotype of *Anops acrobeles* sp. nov. was collected, close to the northern borders of Serra Geral do Tocantins Ecological Station, in cerrado savannas close to the Curicaca headwaters, west of Rio Novo, in Tocantins state, central Brazil.

logical units are separated by steep arenitic cliffs and escarpments.

The collection site was covered by typical Cerrado savanna vegetation, composed of two major layers: a discontinuous arboreal stratum of low, contorted, thick-barked trees, and a lower, sparse layer of grasses and herbs, growing over deep, well drained, depositional arenitic sandy soils, typical of the Jalapão region. The site is located within the Rio Novo drainage, in sandy depositional interfluvial plains covered by open savannas. Scattered palm marshes (veredas), dominated by the Buriti palm, *Mauritia flexuosa* (Arecaceae), and gallery forests are restricted to riparian areas close to the collection site. Dominant arboreal species at the collection site include *Caryocar brasiliense* (Caryocaraceae), *Pterodon emarginatus* (Leguminosae) and *Curatella americana* (Dilleniaceae). The specimen was buried in a narrow gallery, some 60 cm below the soil surface, and was damaged during the operation. No other specimen was found at the study site, regardless of intensive sampling with pit-fall traps, indicating that this is either a relatively rare species or a species which is seldom active on the soil surface or topsoil, when it would probably be collected by pit-fall traps, as the drift fences were buried some 10 cm below the surface. Stomach contents of the holotype included termites of the subfamily Nasutitermitinae and ants of the genus *Solenopsis*.

DISCUSSION

Vanzolini (1999), based mostly on skull morphology, diagnosed the genus *Anops* with the following combination of characters: laterally compressed snout, with a keel formed by the vertical process of the premaxilla which entirely separates the nasal bones; an angle between maxilla and premaxilla; basypterigoid process and choanarum posterior portion absent; rodlike quadrate; premaxillary teeth 5–7, maxillary 3–4, mandibular 6–7, pleurodont dentition; rostral pronounced forming a vertical blade. No differentiated segments in the body annuli.

The pronounced lateral compression of head, the keratinized rostral, and the head scutellation pattern characterize the new species as an *Anops* (sensu Vanzolini, 1999). However, *A. acrobeles* shows some probable autapomorphies in head scutellation (e.g., row with eight occipitals, temporals, elongated mental, two malars, four postmental rows, and postmalar row), that, despite the current generic placement within *Anops*, deserve new studies, currently impossible because of the lack of information on skull morphology and intraspecific variation. The collection and analysis of new specimens will

surely aid in the understanding of morphological variation and diagnosis of *Anops* and the new species.

The distribution pattern of *Anops*, including the new species described herein, deserves further comment, based mostly on the synthesis provided by Vanzolini (1999). According to Vanzolini (1999), the two previously described species of *Anops* were known from widely disjunct localities, showed ample morphological differences, and had strikingly different ecological preferences. All these conditions were pointed out as obstacles to plausible and parsimonious biogeographical scenarios to explain speciation in the genus.

The finding of a third species of keel-headed amphisbaenians in the core of the Cerrado region, covered by open habitat superficially similar to that of *A. kingii* (grasslands and open areas of the Pampas and Chaco region) can be an indication that *Anops* species are primarily found in open, nonforested environments. Although *A. bilabialatus* is found in semideciduous dry forests (in Claudia, Mato Grosso state; see Vanzolini, 1999), the type locality of the species lies in the contact area between open Cerrado domain and deciduous forests of the southern Amazonian border. Despite the difficulties in collecting fossorial species, further studies and samplings in the Cerrado/Amazonia contact areas (localities of *A. bilabialatus*) could help clarify habitat use and possible speciation scenarios for these species.

Unfortunately, original habitats in the northern range of the genus are rapidly vanishing. The Cerrado region, where the type locality of the new species (and also that of *A. bilabialatus*) is located, is currently left with only approximately 20% of its original vegetation cover, a situation that led to its recognition as a global biodiversity hotspot (Myers et al., 2000; Machado et al., 2004). Recent collections in the Jalapão region, one of the best preserved (but still largely undersampled) portions of the Cerrado biome, yielded so far four sympatric species of amphisbaenians (Vitt et al., 2002, 2005): *Amphisbaena alba* Linnaeus, 1758, *Bronia kraoh* Vanzolini, 1971, *Leposternon polystegum* (Duméril, 1851), and the species described herein. With the exception of *B. kraoh*, found only in nearby sites in the northern portion of the Cerrado, all other amphisbaenians found in the region are relatively widely distributed. Whether the new species shares its distribution with *B. kraoh* in other parts of the northern portion of the Cerrado, or is restricted to the Jalapão region (a probable center of endemism for Cerrado herpetofauna; see Colli et al., 2002), remains unclear. The scarce available evidence shows that the new species is absent from other

well-sampled localities (Uruçuí-Una Ecological Station, Palmas region, MZUSP collection data) in the nearby northern part of the Cerrado. However, lack of collecting in surrounding areas close to the type locality prevents a clear picture of the distribution of the new species.

According to Vanzolini (1999), the best explanation for the scattered and apparently disjunct distribution of *Anops* is that its extant forms are end products of an ancient lineage which has now become rarified due to widespread extinction. Despite the difficulties in sampling fossorial squamates and the apparent rarity of the new species, the distance from other known *Anops* records and its absence from other well sampled Cerrado areas may support the relictual hypothesis. However, the available evidence must be interpreted with caution, because the genus remains poorly studied in most basic zoological and ecological aspects. New specimens and locality records are badly needed, as well as a better synthesis of distribution patterns and taxonomy of Central Brazilian amphisbaenians, based on the recent and highly informative material accumulated in recent collections in the Cerrado.

KEY TO THE GENUS *ANOPS*

- 1a. Three supralabials; three infralabials; frontal longer than wide; ocular relatively elongate, representing more than 19% of head length 2
 1b. Two supralabials; two infralabials; frontal wider than long; short ocular, representing 12.5–14.7% of head length . . . *A. bilabialatus*
 2a. Preocular present; occipital absent; temporal absent; mental and postmental distinct; postsupralabial present; two postgenial rows *A. kingii*
 2b. Preocular absent; eight occipitals; temporal present; mental and postmental fused; post-supralabial absent; four postgenial rows *A. acrobeles*

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APPENDIX 1

Specimens Examined for Comparisons

Anops bilabialatus ($N = 3$): BRAZIL: Mato Grosso: Xavantina (MZUSP 21276 [holotype], 21777 [paratype]); Cláudia (MZUSP 81777).

Anops kingii ($N = 13$): BRAZIL: Rio Grande do Sul (MCP 15052, 15056, 15057, 15106, 15403, 15407, 15408, 16181, 16186, 16724, 17708, 17769, 17771).