REDESCRIPTION OF APOSTOLEPSIS LONGICAUDATA (SERPENTES: XENODONTINAE) WITH COMMENTS ON ITS HEMIPENIAL MORPHOLOGY AND NATURAL HISTORY

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ABSTRACT: We redescribe the rare elapomorphine snake Apostolepis longicaudata Gomes in Amaral on the basis of a detailed examination of the holotype and comparisons with new specimens from the Cerrado of Central Brazil. The new data include information on coloration in life, hemipenial morphology, and natural history. Two specimens identified as A. quinquelineata by previous authors are now attributed to A. nelsonjorgei, which seems to be the only species in the genus with subcaudal counts overlapping those of A. longicaudata.

RESUMO: Apresentamos a redescricao da rara especie de serpente Apostolepis longicaudata Gomes in Amaral com base no exame do holotipo e em comparacoes com treos novos exemplares do Cerrado do Brasil Central. O trabalho inclui dados ineditos sobre a coloracao em vida, morfologia hemipeniana e historia natural. Dois espeimes lineados previamente identificados como A. quinquelineata por outros autores sao redeterminados aqui como A. nelsonjorgei, que parece ser a unica especie do gênero cujas contagens de subcaudais se sobrepõem às de A. longicaudata.

Key words: Apostolepis nelsonjorgei; Apostolepis nigrolineata; Apostolepis quinquelineata; Cerrado; Elapomorphini; Snakes; Taxonomy

The snake genus Apostolepis includes more than 30 small to medium-size fossorial species widely occurring in cis-Andean South America (Ferrarezzi et al., 2005; Harvey, 1999; Lema, 2001). Along with the genera Elapomorphus and Phalotris, it is allocated to the tribe Elapomorphini and is characterized by lack of distinct internasals (possibly fused to their respective frontal shields) and a black band on the tip of the tail (Boulenger, 1896; Ferrarezzi, 1994; Harvey, 1999; Zaher et al., 2009).

Because of their cryptozoic nature mostly associated with fossoriality, several species of Apostolepis are rare and known from few specimens (Harvey, 1999). Small sample sizes hinder assessment of geographic variations and make it difficult to diagnose species in this genus.

Apostolepis longicaudata is an example of such a rare species. Its brief description (Gomes in Amaral, 1921a) was solely based on the holotype and included data on scalation and coloration, complemented by illustrations of the head, fore trunk, and ventral surface of the tail (Fig. 1). As suggested by the specific epithet, the high number of subcaudals is the most remarkable diagnostic feature of this species when compared with the lower counts of most congeners.

After the original description, A. longicaudata has only been mentioned in passing (e.g., Lema, 2001; Peters and Orejas-Miranda, 1970) and, besides the holotype, no new specimens were reported. During surveys preceding construction of a railroad in the Rio Tocantins Depression, municipality of Guaraı, state of Tocantins, we obtained three specimens of A. longicaudata. On the basis of these new specimens, as well as on direct examination of the holotype, we provide a redescription containing data on hemipenial morphology, distribution, and natural history. In the context of this study, we also discuss some confusing information from the literature regarding other striped Apostolepis, as well as the taxonomic significance of two specimens of uncertain identity that are possibly related to A. longicaudata.
MATERIALS AND METHODS

Specimens examined and data on localities are listed in Appendix I. Institutional acronyms are IBSP (Instituto Butantan, São Paulo), CHUNB (Coleção Herpetológica da Universidade de Brasília, Distrito Federal), MPEG (Museu Paraense Emílio Goeldi, Belém, Pará), and MZUSP (Museu de Zoologia da Universidade de São Paulo, São Paulo). The collection permit was provided by the Instituto Nacional do Meio Ambiente e Recursos Naturais Renováveis (193/2001-DIFAS; Processo IBAMA nº 02001.003451/93-13).

To the nearest 1 mm, we measured snout–vent length (SVL) and tail length with a graduated ruler. To the nearest 0.01 mm with a digital caliper, we measured head length (from the rostral to the quadrate-mandibular articulation), head width (at widest point), eye–nostril distance (on the right side of the head), mid-body diameter, mid-tail diameter, and eye diameter (measured only on the right side of head in all specimens, except that we measured both eyes on the holotype of *A. longicaudata*). Nomenclature of scalation and color features are those of Harvey (1999). Ventral scale counts were performed using the wider-than-long system (Peters, 1964). Tooth counts were taken on the right maxillary bone only. The diagnosis of *A. longicaudata* was reconstructed according to the standardized numbered system introduced by Harvey (1999).

The hemipenis of MZUSP 12694 was prepared following procedures described by Manzani and Abe (1988), subsequently modified by Pesantes (1994) and Zaher (1999). Hemipenial calcareous structures were stained in an alcoholic solution of alizarin red (adapted from Harvey and Embert, 2008; Harvey et al., 2008; Uzzell, 1973). Nomenclature regarding hemipenial morphology follows Dowling and Savage (1960) and Zaher (1999).

To test for sexual dimorphism in numbers of subcaudals, ventrals, and relative tail lengths, we tested for normality (Shapiro–Wilk test) and homogeneity of variance (Levene’s test). Since our data for the first two characters did not satisfy these assumptions, we used Welch’s non-parametric t-test to compare means for the sexes. For relative tail lengths, we used analysis of covariance, treating SVL as a covariate. An F-test for equality of the regression slopes was used to test the assumption of parallelism. We used the PAST (Hammer et al., 2001) software program for these statistical analyses.
Apostolepis longicaudata Gomes in Amaral (Figs. 2–4)

Apostolepis longicaudata: Gomes in Amaral, 1921a. Santa Filomena, Piauí, Brasil.

Holotype.—IBSP 1684 (not labeled in field, destroyed by fire in 2010), an adult male from Engenheiro Dodt, municipality o Santa Filomena, state of Piauí, northeastern Brazil, collected by Francisco de Assis Iglesias between 1916 and 1918 (the “n” in the collector’s surname is a typographic error; the correct spelling is “Iglesias”). Originally described in 1919, by J. Florencio Gomes, formally published by Amaral (1921a).


Diagnosis.—A small species of Apostolepis, SVL up to 254 mm, differing from all congeners by the following combination of characters: (1) snout rounded or slightly acuminate, length of rostral visible from above slightly more than one-third its distance to frontal; (2) six supralabials; (3) preocular–nasal contact present (i.e., nasal and preocular not separated by prefrontal); (4) temporals absent (0+0), fifth and sixth supralabials in contact with parietals; (5) four infralabials contacting first pair of chin shields on each side of head; (6) ventrals 234–244 and subcaudals 49–52 in males (females unknown); (7) dorsal head plates uniformly dark brown, except for small irregular white blotches on anteriomedial surface of prefrontals; (8) light supralabial blotch large, covering posterior margin of third and almost whole area of fourth supralabial; (9) white and black nuchal collars completely absent; (10) five dorsal stripes similar in width (as wide as, or slightly wider than, one dorsal scale row); (11) dorsum

Fig. 2.—Dorsal (A), lateral (B), and ventral (C) views of the head of the holotype of Apostolepis longicaudata (IBSP 1684). Scale bar: 2.0 mm.

Fig. 3.—Apostolepis longicaudata from Guaraí, Tocantins (MZUSP 12693), showing general dorsal coloration and detail of head in life (Photo: Otávio A. V. Marques).
Specimens with five dorsal stripes that are most likely to be confused with *A. longicaudata* are the predominantly Amazonian species *A. nigrolineata* and *A. quinquelineata* and the Cerrado species *A. nelsonjorgei*, but overlapping values of subcaudal counts are only present in *A. nelsonjorgei*. Nonetheless, *A. longicaudata* is unambiguously distinguishable from these three species by a suite of characters: (1) condition of the white nuchal collar: A well-developed white nuchal collar is present in *A. nelsonjorgei* (Lema and Renner, 2004a) and entirely lacking in *A. longicaudata*. Most specimens of *A. nigrolineata* have rudiments of a white nuchal collar, peculiarly expressed as two well-defined pale blotches on each side of the nape (Lema and Renner, 1998:107, 118). However, a few specimens have complete white collars (e.g., MPEG 16137, 17671). Lema and Renner (1998) suggest that juveniles of *A. quinquelineata* may have rudiments of a white nuchal collar. In our comparative material, none of the specimens of this species can be considered a juvenile, but no traces of such a structure were present even in the smaller individual (e.g., MPEG 17817; SVL = 226 mm, tail length = 15 mm). (2) Condition of the black nuchal collar: A distinctive black nuchal collar up to two dorsal scales long is present in *A. quinquelineata* (Ferrarezzi, 1993; Harvey, 1999; Lema and Renner, 1998) and absent in *A. longicaudata*. (3) Temporal formulae: Usually 0+1, rarely 0+0 in *A. nigrolineata* (Ferrarezzi, 1993; Harvey, 1999; Lema and Renner, 1998), contrasting with 0+0 in all known specimens of *A. longicaudata*. Boulenger’s (1896) original description mentions no temporals in the holotype of *A. quinquelineata* (fifth and sixth supralabials contact parietals), but this character is apparently variable in this species, because there are specimens with 0+1 temporals. Thus, we do not recognize this character as informative for distinguishing *A. quinquelineata* from *A. longicaudata*. (4) Black caudal band: In *A. quinquelineata* the black caudal band is restricted to the dorsal and dorsolateral surface of the tail (Ferrarezzi, 1993; Lema and Renner, 1998), contrasting with the complete black band of *A. longicaudata*. (5) Width of the lateral stripe: The lateral stripes of *A. quinquelineata* (covering first–fourth dorsal rows) are distinctively wider than the paravertebral and vertebral ones (Lema and Renner,
Apostolepis vittata—third–sixth supralabials—than in A. striata (third and fourth supralabials), and the only known specimen has 202 ventrals (234–244) and 26 subcaudals (Lema, 2004). Apostolepis phillipsi has narrow but distinctive white and black nuchal collars (lacking), a pointed snout, and 24 subcaudals (Harvey, 1999). Apostolepis vittata has up to 28 subcaudals, a pointed and strongly projecting snout, five supralabials (six), and only three infralabials contacting the first pair of chin shields (four; Harvey, 1999).

Redescription of holotype.—A slender Apostolepis (mid-body diameter/SVL = 0.012), small in size; tail relatively long, 15.9% of total length; tail cylindrical, its diameter roughly uniform throughout its length, slightly smaller than mid-body diameter (mid-tail/mid-body diameter = 0.79); head subcylindrical, longer than wide (head width/head length = 0.58), not distinct from neck; eyes small, eye diameter approximately one-tenth of head length and slightly shorter than distance from its anterior margin to nostril (eye diameter/eye–nostril distance = 0.75); pupil subelliptical; rostral rounded, not projecting over lower jaw, length of its portion visible from above slightly more than one-third its distance to anterior border of frontal; internasals absent; prefrontals paired, longer than wide, their largest width two-thirds of largest length; frontal roughly hexagonal, longer than wide, its largest width three-quarters of largest length, anterior border contacting posteromedial borders of prefrontals, lateral borders contacting medial margins of supraoculars and lateroposterior borders contacting anteromedial borders of parietals; supraoculars large, roughly trapezoidal, slightly longer than wide, contacting lateral posterior border of prefrontal and upper posterior border of preocular anteriorly, lateral border of frontal medially, upper border of postocular posteromedially, and anterior border of parietal posteriorly; parietals paired, longer than wide, largest width of each approximately two-thirds the length of their mutual suture, anterior margin contacting posterior margin of supraocular and upper posterior margin of postocular, anteromedial margins contacting lateroposterior borders of frontal, lateral margins contacting upper borders of
fifth and sixth supralabials; two enlarged occipitals, one on each flank of nape, clearly distinguishable in size and shape from dorsals; occipitals roughly rectangular, obliquely oriented, twice as long as wide, largely separated by three interoccipitals (dorsal scales of vertebral and both paravertebral rows); occipitals anteriorly contacting lateroposterior margins of parietals and upper posterior margin of sixth supralabial; nasal entire, roughly triangular, posterior vertex broadly contacting preocular; nostril positioned in anterior third of nasal, partly visible from above and slightly directed anteriorly; preocular roughly pentagonal, in wide contact with nasal and forming an orthogonal directed suture with it; postocular roughly “C” shaped, with feeble posterior vertex; postocular contacting third and fourth supralabials ventrally, fifth supralabial posteriorly, parietal dorsoventrally, and supraocular dorsally; temporals 0+0; six supralabials, second and third contacting orbit, sixth largest, approximately as high as fifth; fifth and sixth contacting parietals; mental subtriangular, twice as wide as long; two pairs of chin shields, first pair distinctly longer; seven infralabials, first pair in contact immediately behind mental, widely separating it from chin shields; first–fourth infralabials contacting first pair of chin shields, four and five contacting second pair; fifth infralabial largest, roughly trapezoidal; 15 dorsal scale rows without reductions near vent; anal plate divided; 241 ventrals; 52/52 subcaudals; trunk broken at level of 84th ventral shield; terminal scale acuminate, directed ventrally; maxillary teeth 5+2, fourth tooth missing on right maxillary bone; head light brown; brown cap covering whole dorsal and lateral surfaces of head, spondiically extending posteriorly over one or two dorsal scales and downward to upper half of second dorsal scale row, slightly below level of seventh infralabial; snout mostly brown, with small irregular light spots on anteromedial surface of prefrontals; two pale supralabial blotches; first supralabial blotch covering almost whole area of first supralabial; second supralabial blotch covering posterior margin of third and almost whole area of fourth supralabial; white and black nuchal collars absent; chin and gular region immaculate cream; first–sixth infralabials also immaculate; up to two-thirds of seventh infralabial marked by brown cap; mental immaculate; dorsal ground color light tan, with five brown stripes similar in width (one vertebral, one paravertebral pair, and one lateral pair); all but vertebral stripe extending to posterior margin of brown cap; vertebral stripe separated from brown cap by almost whole length of one dorsal scale; lateral stripes light brown, mostly cohesive, more distinctive in first third of trunk, covering central area of fourth row; paravertebral stripes light brown, diffuse, distinctively lighter than lateral stripes, covering upper margin of fourth, virtually whole area of fifth and lower margin of sixth rows; vertebral stripe cohesive, dark brown, covering central area of eighth (vertebral) row, also marking upper vertexes of contiguous (seventh) rows; ventrals and subcaudals immaculate cream; terminal caudal band dark brown, 10/11 subcaudals in length; terminal scale almost entirely white, with dark brown pigment extending slightly above its dorsal surface.

Measurements of the holotype.—SVL 227 mm, tail length 43 mm, head length 4.90 mm, head width 2.85 mm, mid-body diameter 2.81 mm, mid-tail diameter 2.22 mm, eye-diameter 0.54/0.57 mm, eye–nostril distance 0.80 mm (only right side measured).

Variation and coloration in life.—Descriptive statistics on scale counts and measurements for the four known specimens of A. longicaudata are shown in Table 1. The largest specimen is a male (MZUSP 12692; SVL = 254 mm, tail length = 43); ventral and subcaudal counts range respectively from 235 to 244 and 49 to 52; no females are known. The snouts of MZUSP 12692–12694 are slightly pointed (Fig. 5A) in comparison with the holotype (Fig. 2A). Head scalation shows no variation in the four specimens. Coloration of the holotype has considerably faded because of preservation, but MZUSP 12692–12694 show minor differences between their coloration in life (Fig. 3) and after preservation in 70% ethanol. Their brown head caps are considerably darker when compared with the tonality present in the holotype. The caps extend downward on both sides of the head, achieving the level of the second row of dorsals (MZUSP 12693 and 12694) or further, almost to the midventral line of the neck (MZUSP 12692). The connections of the body stripes to the head cap are also variable: the
Table 1.—Variation in some selected characters of striped-patterned *Apostolepis* examined herein (means ± standard deviation and sample size follow ranges in parentheses).

<table>
<thead>
<tr>
<th>Character</th>
<th><em>Apostolepis longicaudata</em></th>
<th><em>Apostolepis aff. longicaudata</em></th>
<th><em>Apostolepis aff. longicaudata</em></th>
<th><em>Apostolepis nelsonjorgei</em></th>
<th><em>Apostolepis nigrolineata</em></th>
<th><em>Apostolepis quinquelineata</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tail length/snout–vent length</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>0.15–0.16</td>
<td>0.17 (n = 1)</td>
<td>0.14–0.16</td>
<td>0.13–0.16</td>
<td>0.09 (n = 1)</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>—</td>
<td>0.13 (n = 1)</td>
<td>0.12–0.14</td>
<td>0.08–0.16</td>
<td>0.07–0.08</td>
<td></td>
</tr>
<tr>
<td>Light snout spot</td>
<td>Absent, or small when present</td>
<td>Large, well defined</td>
<td>Large, well defined, possibly paired</td>
<td>Usually small</td>
<td>Large, well defined</td>
<td></td>
</tr>
<tr>
<td>Ventral</td>
<td>234–244</td>
<td>229 (n = 1)</td>
<td>221–226</td>
<td>208–227</td>
<td>228 (n = 1)</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>(238.5 ± 4.80)</td>
<td></td>
<td>(238 ± 17.52, n = 3)</td>
<td>(213.5 ± 4.65, n = 21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>—</td>
<td>237 (n = 1)</td>
<td>260–261</td>
<td>214–239</td>
<td>231–243</td>
<td></td>
</tr>
<tr>
<td>Subcaudal</td>
<td>49–52</td>
<td>54 (n = 1)</td>
<td>41–53</td>
<td>33–41</td>
<td>31 (n = 1)</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>(50.5 ± 1.29)</td>
<td></td>
<td></td>
<td>(37.5 ± 0.48, n = 0.48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>—</td>
<td>41 (n = 1)</td>
<td>37–46</td>
<td>27–43</td>
<td>21–25</td>
<td></td>
</tr>
<tr>
<td>Preocular nasal contact</td>
<td>Present</td>
<td>Lacking</td>
<td>Lacking</td>
<td>Variable</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>White nuchal collar</td>
<td>Present</td>
<td>Lacking</td>
<td>Vestigial in adults</td>
<td>Present (usually vestigial; rarely complete)</td>
<td>Present (only adults examined)</td>
<td></td>
</tr>
<tr>
<td>Black nuchal collar</td>
<td>Lacking</td>
<td>Lacking</td>
<td>Lacking</td>
<td>Present</td>
<td>Lacking</td>
<td>Present</td>
</tr>
</tbody>
</table>

1. MZUSP 16615
2. MZUSP 2465
vertebral and lateral stripes of MZUSP 12692
and 12694 are not in contact with the brown
head cap, but the same stripes are connected
to its posterior border in MZUSP 12693.
Paravertebral stripes contact the brown head
cap in all specimens; snout spots are virtually
lacking in MZUSP 12693, restricted to sparse
light brown marks on the anterolateral surface
of the prefrontals in MZUSP 12692 and
represented by paired well-defined small light
tan spots on the anterior area of the prefrontals
in MZUSP 12694. The first light supralabial
blotch is cream and occupies most of the first
supralabial; the second light supralabial blotch
covers almost the whole area of the fourth
supralabial and, in MZUSP 12694, it invades
more prominently the posterior and lower
portions of the third and the anterior portion
of the fifth supralabials. The dorsal ground color
of MZUSP 12692–12694 is considerably darker
than in the holotype; likewise, the lateral brown
stripes are cohesive, mostly restricted to the
fourth dorsal row, flanked in some regions of the
trunk by weakly defined interrupted lines
formed by brown pigment on the apexes of
scales of the third and fifth rows; paravertebral
and vertebral stripes are similar to the ones of
the holotype.
Live specimens have considerably darker
colors than preserved specimens (MZUSP
12692–12694). In life, the cephalic cap, terminal
caudal band, and stripes are dark brown to
almost black; the ground color of the trunk is
orange-tan; the venter is cream.

Hemipenial morphology.—Description on
the basis of the fully everted and expanded
right organ of MZUSP 12964 (Fig. 4). Hemi-
penis unilobed; distal end of retractor muscle
divided; body corresponding to two-thirds
of total length of organ; small spines uniformly
distributed on proximal one-third of organ’s
base, entire sulcate face, and lateral and apical
portions of capitulum; base ornamented with
two pairs of rows of enlarged spines, one
lateral and composed of about five moderately-
sized spines, second one parasagittal to
asulcate face and composed of four distinct-
vively larger spines on each row; latter pair of
spine rows delimit an almost nude median
area on asulcate face sparsely ornamented by
small spinules; lobe differentiated as unicaly-
culated capitulum, noncapitate, covered with
papilate calyces on sulcate and lateral faces;
asulcate face of lobe restricted to concave
area, surrounded by small spines, forming
inverted U-shaped and completely nude area;
sulcus spermaticus forked and divided ap-
proximately in middle of organ; branches of
sulcus centrolineal on body, acquiring slightly
centrifugal direction on capitulum. The aliz-
arin red stained the spines and spinules, but
no other calcified structures were detected.
Distribution and ecology.—Apostolepis longicaudata is reported from northeastern Brazil (type locality) and the Rio Tocantins Depression. The type locality is in an ecotonal area between the Cerrado and Caatinga biomes (Fig. 6). Nonetheless, despite the presence of sparse xeric elements, the type locality is generally dominated by cerrado vegetation. No data on habitat or field notes are available for the holotype.

Specimens MZUSP 12692–12694 were collected in the municipality of Guaraí, Tocantins, about 270 km NW of the type locality (Fig. 6). Quartzitic sandy soils predominate in the region (SEPLAN, 1999), and the landscape is basically composed of typical open cerrado vegetation interrupted by interfluvial and gallery forests. These specimens were collected in pitfall traps, always checked in the morning. The pitfall trap system at each of the collection sites included 40 buckets (height = 40 cm; diameter = 30 cm; volume = 18 L) assembled in 10 Y-shaped stations (Jones, 1981). Each station consisted of one central and three peripheral buckets, all connected to the first by plastic fences 4 m long and 50 cm high.

MZUSP 12693 and 12694 were collected in two small forest fragments, both on sandy soils and covered by thick layers of leaf litter. MZUSP 12694 was collected in a gallery forest at an elevation of about 260 m (“point 1” of Fazenda Marupiara; see Appendix for precise coordinates); the canopy was mostly closed, although sparse openings allowed sunlight to touch the ground in some small clearings. Other reptile species recorded in the area were Colobosauna modesta (Gymnophthalmidae), Kentropyx calcicarta (Teiidae), and Typhlops brongersmianus (Typhlopidae; collection effort 480 bucket-days; sample period 18–29 October 2001, 12 d). MZUSP 12693 was found in an interfluvial forest about 14 km southwest of the collection site of MZUSP...
12694 ("point 2" of Fazenda Marupiara; see Appendix for precise coordinates) at a slightly higher elevation. Large trees were still present in the area, though presence of lianas, small shrubs, and several clearings were obvious evidence of disturbance. *Bachia micromela*, *C. modesta* (Gymnophthalmidae), *Anolis chrysolepis* (Polychrotidae), *Ameiva ameiva* (Teiidae), and *T. bronzensmianus* (Typhlopidae) were other reptile species collected at this site (collection effort 440 bucket-days; sample period 18–29 October 2001, 11 d).

In contrast to both previous individuals, MZUSP 12692 was obtained in an open cerrado area on quartzitic sandy soils ("point 3" of Fazenda Marupiara; see Appendix I for precise coordinates). Short and twisted trees were sparsely distributed and small bushes of grass were frequent. Narrow tracks of bare sand remained directly exposed to sun (collection effort: 480 bucket-days; sample period 18–29 October 2001, 12 d). However, it is important to mention that, despite the striking differences in overall structure among the forest areas of MZUSP 12693 and 12694 and the open cerrado of MZUSP 12692, the latter specimen was collected in a pitfall station placed contiguous to a gallery forest, quite similar in structure to the area of collection of MZUSP 12694. Thus, it would not be unreasonable to consider the record of MZUSP 12692 in an open cerrado area as a possible effect of the contact with forest habitats to which the species might show some degree of preference.

**DISCUSSION**

Until additional specimens are collected, we can only speculate about the distribution of this rare elapomorphine. Colli et al. (2002) considered *A. longicaudata* endemic to the Cerrado biome. Since the species occurs in forested sandy soils of the Rio Tocantins Depression, it may be widespread in similar substrates throughout the Cerrado of northeastern Brazil. Several squamate taxa such as *Parapostolepis polylepis* (Amaral, 1921b, 1930; has not yet been formally synonymized with *Apostolepis*) and *Amphisbaena ibijara* (Rodrigues et al., 2003) appear to be largely restricted to the sandy formations of the Parnaíba sedimentary basin, and *A. longicaudata* may have a similar distribution.

The specimens from the Tocantins Depression have slightly acuminate snouts (Fig. 5A), contrasting with the rounded snout of the holotype (Fig 2A). This difference cannot be attributed to allometric variation, because all specimens are adults. Alternatively, the slightly acuminate snouts may be a local adaptation to the particular texture of quartzitic sandy soils present in Guarani.

Like other fossorial vertebrates, most *Apostolepis* species have short tails (subcaudal counts lower than 40 scales). A relatively long tail and high subcaudal counts for the genus are the most important diagnostic features of *A. longicaudata*. The only species that undisputedly has subcaudal counts overlapping with those of this species is *A. nelsonjorgei*. Nonetheless, this fact is contradicted by some recent publications where reports of high subcaudal counts in other species were based on misidentified specimens of *A. nelsonjorgei*.

On the basis of Lema and Renner (1998), Lema (2001:36) claimed that the high subcaudal counts of *A. longicaudata* would be “equal” to those of *A. quinquelineata* and *A. nigrolineata*. According to Boulenger (1896), the holotype of *A. quinquelineata* is a male specimen with 28 subcaudals (Ferrarezzi, 1993; Hoge, 1958). Lema and Renner (1998:103) report 22–30 subcaudals in females and 28–53 subcaudals in males of this species, suggesting existence of an enormous discrepancy between the ranges of both sexes. However, subcaudal counts higher than 40 scales occur in only three specimens examined by Lema and Renner (1998; MPEG 11487, 16954, and 17051). We re-examined MPEG 16954 and 17051, both with 52/53 subcaudals, and identified them as *A. nelsonjorgei*. The third specimen (MPEG 11487, with 48 subcaudals according to Lema and Renner, 1998) was not available for study. Excluding these three specimens, male *A. quinquelineata* in the sample of Lema and Renner (1998) have 28–37 subcaudals, which is in better agreement with the variation observed in females.

Regarding *A. nigrolineata*, nomenclatural confusion explains high subcaudal counts reported by Lema (1997, 2001) for this species. Lema (1997) considered *A. nigrolineata*
(Peters, 1869) to be a senior synonym of A. pymi Boulenger, 1903. Nonetheless, 1 yr later, Lema and Renner (1998) used the name A. pymi when referring to populations of the eastern Amazon. This inconsistent use of names is apparently due to timing of the publications involved, because Lema (1997: 194, 197, 199) explicitly cites Lema and Renner (1998). Presumably, Lema and Renner (1998) was submitted before Lema (1997), and the features of A. pymi provided by Lema and Renner (1998) must be interpreted as features of A. nigrolineata (see also Lema, 2001). In view of this information, since Lema and Renner (1998) claim that subcaudals of A. nigrolineata range from 21 to 40 in females and from 33 to 46 in males, we believe that the report of 52 subcaudals by Lema (1997) resulted from confusion with Lema and Renner’s (1998) data for A. quinquelineata (MPEG 16954 and 17051, herein identified as A. nelsonjorgei). Among specimens examined by us (Table 1), male A. nigrolineata have fewer ventrals ($t_{21,15} = 6.17, P < 0.000$), more subcaudals ($t_{20,15} = 6.01, P < 0.000$), and relatively longer tails ($F_{20,15} = 97.62, P < 0.000$, Fig. 7) than females. Moreover, the relatively shorter tails of male A. nigrolineata immediately distinguish this species from A. longicaudata ($F_{20,4} = 10.42, P = 0.004$, Fig. 7).

In summary, there are no reliable records of more than 46 subcaudals in A. nigrolineata and 37 subcaudals in A. quinquelineata. On the other hand, considering the data from the literature (Lema and Renner, 2004a), along with additional specimens examined herein (Table 1), males of A. nelsonjorgei may have up to 53 subcaudals (MPEG 16954), clearly overlapping the range of A. longicaudata.

During this study, we examined two striped-patterned specimens of doubtful identity (MZ-USP 2045 and MZUSP 17614) that deserve attention. Ferrarezzi (1993) considered these specimens related to A. longicaudata because they have 0+0 temporals, fifth and sixth supra-labials in contact with parietals, five dorsal stripes similar in width, a white terminal scale, and subcaudal counts high for the genus (54/54 and 40/41, respectively). Nevertheless, the same author pointed out that both specimens were distinct from each other and from A. longicaudata with respect to features of head scalation and color pattern.

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**Fig. 7.**—Relative tail lengths of two species of stripe-patterned Apostolepis from eastern Brazil.
Herein, we opted for a cautious posture with respect to these specimens, avoiding a final decision regarding their identification; instead, we refer to them as Apostolepis aff. A. nigrolineata. Both individuals differ from typical A. longicaudata in lacking preocular-nasal contact, as well as by presence of a large light snout spot (vs. preocular-nasal contact present and snout pattern mostly black with small and irregular light blotches). In addition, MZUSP 17614 has rudiments of a white nuchal collar, which is completely lacking in MZUSP 2045 and in all four specimens of A. longicaudata (compare head patterns on Fig. 5). A specimen illustrated by Freitas (2003:pl. 157), from Itapebi, state of Bahia (15°57′S, 39°32′W, 177 m; sensu www.glosk.com), which we were unable to locate, seems to fit the characterization of MZUSP 17614 at least with respect to color pattern.

Since the character states related to snout color and preocular-nasal contact are polymorphic in other striped-patterned Apostolepis (Harvey, 1999; Lema and Renner, 2004a), MZUSP 2045 and 17614 could be attributed to A. longicaudata and these features would be implicitly regarded as polymorphic also for this species. However, both specimens were collected far from the known range of A. longicaudata. MZUSP 17614 is a female collected in the vicinities of the municipality of Cabaceiras, state of Pará, northeastern Brazil, in the core area of the Caatinga biome (Fig. 6). The specimen was found in a mesic forest sheltered by a large block of crystalline rocks and the soil was composed of moderately compacted clay, densely covered with leaf litter. On the other hand, MZUSP 2045 is a male from Linhares, state of Espírito Santo, in the Atlantic Rainforest of southeastern Brazil (Fig. 6); this specimen has obvious anomalies in head scalation (Table 1).

Further study is required to determine whether these specimens from eastern Brazil are conspecific with A. longicaudata. The eastern localities appear ecologically quite different from the Cerrado, but resolution of this problem must await collection of additional specimens.

Finally, we mention that this paper has a sad peculiarity. On 15 May 2010, a tragic accident caused a fire that consumed most of the more than 80,000 snake specimens housed in the collection “Alphonse Richard Hoge” at the Instituto Butantan. This tragic loss of Neotropical snakes included the largest samples of Brazilian taxa, assembled through more than a century of work. Along with several type specimens, Gomes’ holotype of A. longicaudata has apparently disappeared and is probably lost forever. Our measurements and recent photographs of IBSP 1684 are the last information obtained through direct examination of this specimen.

Note added to proofs.—While our paper was submitted, Lema and Albuquerque (2010) resurrected A. pymi and synonymized A. quinquelineata with A. nigrolineata. The authors provided a list of characters that distinguish A. nigrolineata from A. pymi; however, interspecific variation in these characters is greater than their brief note indicates. For example, Lema and Albuquerque (2010) claimed that only juvenile A. quinquelineata have five dorsal stripes. In our sample, three adult specimens (MPEG 17453, 17982–83, each more than 300 mm SVL) retained five distinct and cohesive dorsal stripes, whereas Lema and Albuquerque (2010) claimed that at least the paravertebral stripes tend to fade throughout development and become indiscernible in fully grown individuals. Herein, we continue to recognize A. nigrolineata (A. pymi included) and A. quinquelineata as defined respectively by Lema (1997) and Lema and Renner (1998). Nonetheless, the status of these names needs clarification and must be assessed elsewhere.

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Appendix I
Specimens Examined
Specimens are listed according to their respective localities, organized as "COUNTRY: STATE: locality name"; geographic coordinates are based on the WGS84 datum. Coordinates of localities marked with an "***" were obtained primarily from gazetteers (Paynter and Traylor, 1991; www.gloko.com) and then refined with the aid of the software Google Earth 5.0.11733.9347; coordinates of localities marked with "**" were directly taken in the field using a hand-held global positioning system receiver.

Apostolepis longicaudata.—BRAZIL: PIAÚI: Santa Filomena*: (09°07’S, 45°35’W, 277 m); IBSP 1684 (holotype); TOCANTINS: Guarani* (08°50’S, 48°30’W, 259 m), “Fazenda Marupiara”*** (8°35’S, 48°27’W, point 1**, (8°36’S, 48°15’W, 255 m); MZUSP 12964; point 2** (8°39’S, 48°25’W, 286 m); MZUSP 12963; point 3*** (08°15’S, 48°19’W, 250 m); MZUSP 12962.

Apostolepis aff. longicaudata.—BRAZIL: ESPÍRITO SANTO: Linhares*: (19°23’S, 40°04’W, 33 m); MZUSP 2405; PARAÍBA: Cabaceiras**: (07°29’S, 36°17’W, 388 m); MZUSP 17614.

Apostolepis nelsonjorgei.—BRAZIL: GOIÁS: Serra da Mesa dam, Point 1** (14°01’S, 48°19’W, 460 m); MZUSP 10997; Conceição do Araguaia* (08°15’S, 49°15’W, 165 m) MPEG 16954; 17051; TOCANTINS: Estação Ecológica Serra Geral do Tocantins** (11°07’S, 46°46’W, 560 m); MZUSP 17615; Porto Nacional*, (10°42’S, 48°25’W, 212 m); CHUNB 16182.

Apostolepis nigrolimeata.—BRAZIL: PARÁ: Anamandra* (01°27’S, 48°22’W, 17 m); MPEG 2368, 6943, 9459; Benevides, Santa Bárbara* (01°22’S, 48°15’W, 26 m); MPEG 18513; Bragança* (01°03’S, 46°46’W, 19 m); MPEG 13009; Capitão Poço* (01°45’S, 47°04’W, 73 m); MPEG 10461, 12170; Castanhal, Macapá* (01°18’S, 47°56’W, 41 m); MPEG 11794, 12693; Colônia Nova, BR-316 road, near Rio Gurupi* (approximate coordinates: 01°29’S, 46°22’W, 50 m); MPEG 15063, 15863; Conceição do Araguaia, Rio Maria* (08°15’S, 49°16’W, 165 m); MPEG 17671; Gurupat** (not located): MPEG 10887, 13260; Igapó-Açu* (01°08’S, 47°37’W, 37 m); MPEG 925; Ilha de Mosqueiro* (01°07’S, 48°24’W, 10 m); MPEG 12771; Inhângapi* (01°26’S, 47°55’W, 35 m); MPEG 1571; Nova Vida, BR-316, 25 Km do Rio Gurupá (not located): MPEG 16227–28; Ourêmb* (01°33’S, 47°07’W, 12 m); MPEG 7016, 7019; Fariú, BR-316 road (not located): MPEG 10835, 14352; Acará road, Km 16 (not located): MPEG 12903-04; Santa Maria, rodovia BR-226 (not located): MPEG 16137, Maracanaí road, Km 23 (not located): MPEG 8187; Santa Rosa (not located): MPEG 11835–836, 12590; Santarém Nova, Trombetinha* (00°56’S, 47°24’W, 30 m); MPEG 7081; Santo António do Tumi* (01°09’S, 48°08’W, 51 m); MPEG 7557; Tomé-Açu** (02°25’S, 48°09’W, 20 m); MPEG 11723; Viseu* (01°12’S, 46°08’W, 6 m); MPEG 15126–27.

Apostolepis quinquelineata.—BRAZIL: AMAZONAS: Presidente Figueiredo, Balbina Hydroelectric Power Plant* (02°02’S, 60°01’W, 122 m); MZUSP 17453; RONDÔNIA: Porto Velho, Samuel Hydroelectric Power Plant* (08°46’S, 63°54’W, 145 m): MPEG 17453, 17982–83.