

Revalidation of *Apostolepis barrioi* (Serpentes: Dipsadidae)

Hugo Cabral,^{1,2} Thales de Lema,³ and Márcia Ferret Renner³

¹ Asociación Guyra Paraguay, Avenida Coronel Carlos Bóveda, Parque Asunción Verde, Viñas Cué, Paraguay.
E-mail: hugitocabral@gmail.com.

² Instituto de Investigación Biológica del Paraguay, Del Escudo 1607, Asunción, Paraguay.

³ Pontifícia Universidade Católica do Rio Grande do Sul, Museu de Ciências e Tecnologia, Laboratório de Sistemática de Vertebrados, Avenida Ipiranga 6681, bld. 40, Caixa Postal 1429, 90619-900, Porto Alegre, RS, Brazil.

Abstract

Revalidation of *Apostolepis barrioi* (Serpentes: Dipsadidae). With 32 species, *Apostolepis* is the most diverse genus in the tribe Elapomorhini. The description of *Apostolepis barrioi* is based on one specimen and the taxon later was synonymized with *A. dimidiata*. Based on an examination of new specimens, the taxon is resurrected to full species rank. *Apostolepis barrioi* differs from all congeners by having an immaculate white venter, narrow dorsolateral stripes not in contact with the ventrals, and a terminal black shield. With the addition of *A. barrioi*, the number of species of the genus increases to 33; however, more systematic research on the status of the species in the group is required, especially for those species that were described on the basis of only a few specimens.

Keywords: Atlantic Forest, Cerrado, Brazil, Paraguay, South America.

Resumo

Revalidação de *Apostolepis barrioi* (Serpentes: Dipsadidae). *Apostolepis* é o gênero mais diversificado da tribo Elapomorhini, com 32 espécies reconhecidas. *Apostolepis barrioi* foi descrita com base em um único exemplar e então sinonimizada a *A. dimidiata*. Depois de uma reavaliação de novos dados, reconhecemos *Apostolepis barrioi* como um táxon válido que se distingue das demais espécies do gênero por apresentar o ventre e as escamas gulares de cor branca imaculada, faixas dorsais mais finas que podem ou não apresentar contato com as escamas ventrais e placa terminal negra. Com a revalidação de *Apostolepis barrioi* o número de espécies do gênero aumenta para 33. No entanto, mais estudos taxonômicos relacionados aos grupos do gênero são necessários, especialmente com aquelas espécies cujas descrições estão baseadas em poucos exemplares.

Palavras-chave: América do Sul, Brasil, Cerrado, Mata Atlântica, Paraguai.

Received 23 January 2017
Accepted 11 August 2017
Distributed December 2017

Introduction

Apostolepis Cope, 1862 is a genus of fossorial snakes that is widely distributed in South America east of the Andes, from Guyana to northern Argentina (Giraud and Scrocchi 1998, Lema 2001, Nogueira *et al.* 2012). The genus was placed in the tribe Elapomorhini along with *Phalotris* Cope, 1862, *Elapomorphus* Wiegmann, 1843, and *Coronelaps* Lema and Hofstadler-Deiques, 2010 (Zaher 1999, Zaher *et al.* 2009, Lema and Hofstadler-Deiques 2010, Grazziotin *et al.* 2012, Pyron *et al.* 2013). Currently, 32 species of *Apostolepis* are known (Uetz *et al.* 2017); thus, it is the most diverse genus of the tribe.

The description of *Apostolepis barrioi* Lema, 1978 was based on a single specimen from Paraguay (Lema 1978) (Figure 1), which was differentiated from *A. dimidiata* (Jan, 1862) mainly by the absence of ventral blotches in *A. barrioi*, in contrast to the ventral dark blotches in *A. dimidiata*. Based on an analysis of color variation in *A. dimidiata*, Lema (1993) reported that the species is polymorphic and described the following morphs: (1) melanistic, with black dorsolateral stripes and belly; (2) two rows of black ventral blotches, forming a narrow white midventral area; and (3) albinistic, with black dorsolateral stripes not reaching the ventrals, and an immaculate belly. Based primarily on meristic data and their sympatry, Lema (1993) placed *A. barrioi* and *A. villaricae* (Lema, 1978) in the synonymy of *A. dimidiata*.

Recently, the “Para la Tierra” NGO from Paraguay published photographs of a living snake (Figure 1) from Laguna Blanca (23°47'56"S, 56°17'32" W) located in the Departamento of San Pedro, in the center of the Oriental Region of Paraguay, and deposited in the Museo Nacional de Historia Natural del Paraguay (MNHNP). Herein, we report the results of meristic and morphological analyses of this individual snake from Paraguay and numerous additional specimens, thereby providing support for the revalidation *A. barrioi*.

Materials and Methods

Data were gathered for *Apostolepis dimidiata* from specimens and databases in many collections. Photographs of living individuals were provided by colleagues (Acknowledgments). Collections in the following institutions [indicated by codes used by Sabaj-Pérez (2016)] were used: USA: AMNH, MCZ, USNM; United Kingdom: BMNH; Brazil: MZUSP, IBSP, MCN, MHNCL, MNRJ, UFU; Paraguay: MNHNP; Argentina: MACN, MLP, UNNEC, CHUNAM; Austria: NMW; Russia: ZISP; Germany: ZMB, ZSM. See Appendix I for specimens examined and localities.

Dowling's (1951) conventions for ventral scale counts were followed. Snout–vent and tail lengths were measured with a tape measure to the nearest millimeter. Other measurements were taken with a dial caliper (0.01 mm). Head pholidosis includes rostral, nasal, frontal and prefrontal, parietals, supralabials and infralabials, preoculars, postoculars. For supralabials and infralabials, the parenthetical range represents scales in contact with the orbit and chinshields, respectively. The nuchal collar is posterior to the head coloration; in some cases, the nuchal collar coloration is continuous with that of the head. Description of coloration is based on preserved specimens. Distribution maps were created with ArcGis (v10.1, ESRI). Ecoregions are those of Dinerstein *et al.* (1995), and we followed the group definitions of Nogueira *et al.* (2012). When present, the coloration of nuchal, cervical, and post-cervical collars were compared the information in the original descriptions of the species. Any stripe in the vertebral region is referred to as a “vertebral stripe.” Dorsolateral stripes usually are black and several scales in width; they differ from the much narrower stripes present in some species of *Apostolepis*.

Results

On reviewing Lema (1978, 1993), we noticed that the albinistic morph was found mainly in



Figure 1. *Apostolepis barrioi* from Laguna Blanca, Paraguay. (A) Dorsal view; (B) ventral view, showing the absence of black coloration on ventral scales; (C) dorsal view showing the black dorsolateral stripes not reaching the ventral scales; (D) details of the head.

Paraguay, and when we compared data from a large sample ($N = 142$) of *A. dimidiata*, we noted some differences between the albinistic and the other morphs. The analysis included three morphs: melanistic, belly with a narrow white midventral area, and albinistic. The albinistic form occurs in Paraguay and Brazil (Figure 2) and is characterized by the immaculate white venter, and dorsolateral black stripes that do not reach the ventral scales (Figure 3). The other two morphs occur in Argentina, Brazil, and Paraguay and have completely dark venters or dark coloration on the edges of the ventral scales, lateral dark stripes that always reach the ventral scales, and an incomplete vertebral stripe (Giraudó 2002). In *A. barrioi*, ventrals range from 222–256 and subcaudals from 23–35; in *A. dimidiata*, ventrals range from 214–264 and subcaudals from 22–39. The Table 1 summarizes

the measurements and range of the pholidosis of the specimens examined. The numbers of ventrals and subcaudals in the two species are the same. Based on the presence or absence of dark pigments on the belly, we distinguished only two morphs among the three described: (1) individuals with completely white bellies; and (2) snakes with either entirely black bellies, or black on the edges of the ventrals and lowest dorsal scales. These two morphs seem to be different species because these characters seem to be conserved. The holotype of *Apostolepis barrioi* matches the characteristics of the albinistic morph. Below, the holotype of *A. barrioi* is redescribed and the species revalidated. Data describing morphological variation of *A. barrioi* are presented. *Apostolepis barrioi* belongs to the *A. dimidiata* Group, which is characterized by the presence of a pointed rostral, elongate

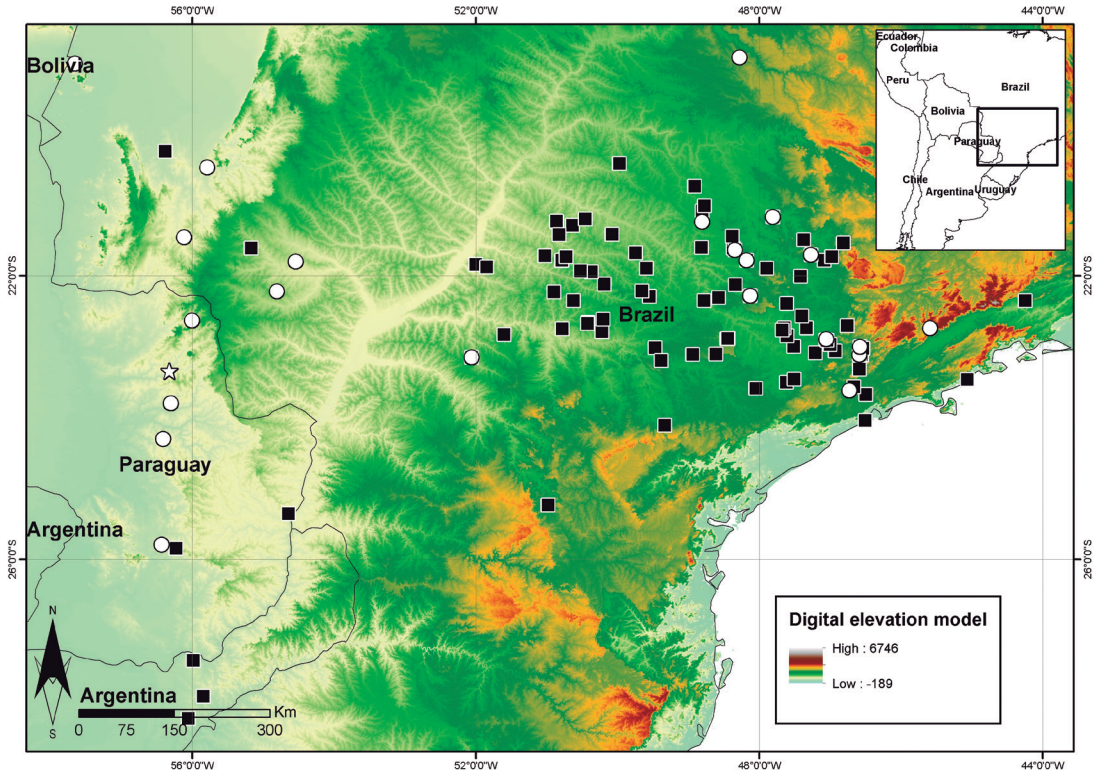


Figure 2. Distribution of *Apostolepis barrioi* and *A. dimidiata*. Black squares represent the records of *A. dimidiata*, white circles the records of *A. barrioi*, and white star represents the type locality of *A. barrioi*.

white supralabial blotch, rounded terminal shield, and a body with black dorsolateral stripes (Nogueira *et al.* 2012).

Apostolepis barrioi Lema, 1978
Apostolepis dimidiata Lema, 1993

Holotype.—MACN 49402 (CHINM 3309 in the original description, young male); col: G. J. Williner, 1965 February; from Avelino Barrio Collection, Buenos Aires, Argentina (Figure 4).

Type locality.—Cororó, Río Ypané, Departamento Concepción, Paraguay (Figure 2). The type locality is an area of transition from the Atlantic Forest to the Cerrado and Chaco Ecorregión (Dinerstein *et al.* 1995).

Table 1. Scale counts of ventrals (Vent), subcaudals (SC), and measurements of snout-vent length (SVL), tail length (TL) and ratio between TL and SVL of *Apostolepis barrioi* and *A. dimidiata*. The number of specimens examined (N) is given in parentheses.

	<i>A. barrioi</i>	<i>A. dimidiata</i>
Vent	222–256 (34)	214–264 (113)
SC	23–55 (34)	22–39 (111)
SVL	188–542 (17)	180–676 (112)
TL	16–45 (18)	16–60 (112)
Ratio	0.06–0.11 (17)	0.05–0.12 (112)



Figure 3. Dorsal and ventral view of *Apostolepis barrioi* (MNHNP 11548) showing the immaculate white ventral coloration.

Distribution.—From Minas Gerais and São Paulo to Mato Grosso do Sul states, Brazil, to northern and central Paraguay (Figure 2).

Diagnosis.—*Apostolepis barrioi* differs from its congeners by the following characteristics: absence of white nuchal collar; presence of a complete black nuchal collar; venter immaculate white; prefrontal uniformly black; gular region white; narrow dorsolateral stripes



Figure 4. Holotype of *Apostolepis barrioi* (MACN 49402).

not reaching the ventrals; terminal shield black. In a complete diagnosis, *A. barrioi* is compared with all congeners; characters in parentheses are those of *A. barrioi*. Table 2 summarizes these differences.

Apostolepis barrioi is distinguished from *A. albicollaris*, *A. ammodites*, *A. arenaria*, *A. assimilis*, *A. borelli*, *A. cearensis*, *A. cerradoensis*, *A. dorbgnyi*, *A. flavotorquata*, *A. gaboi*, *A. multicincta*, *A. nelsonjorgei*, *A. nigroterminata*, *A. phillipsi*, *A. quirogai*, *A. tenuis*, and *A. tertulianoebui* by the white or yellow nuchal collars in these species (black nuchal collar in *A. barrioi*). *Apostolepis christinae*, *A. goiasensis*, *A. longicaudata*, *A. niceforoi*, *A. nigrolineata*, *A. pyimi*, and *A. serrana* lack nuchal collars (present in *A. barrioi*). *Apostolepis albicollaris*, *A. ammodites*, *A. arenaria*, *A. assimilis*, *A. borelli*, *A. cearensis*, *A. cerradoensis*, *A. dorbgnyi*, *A. flavotorquata*, *A. gaboi*, *A. multicincta*, *A. nigroterminata*, *A. phillipsi*, *A. quirogai*, and *A. tertulianoebui* have black cervical collars (cervical collar absent in *A. barrioi*). *Apostolepis ammodites* has a white postcervical collar (postcervical absent in *A. barrioi*). *Apostolepis arenaria*, *A. borelli*, *A. breviceps*, *A. cerradoensis*, *A. christinae*, *A. dimidiata*, *A. gaboi*, *A. goiasensis*, *A. intermedia*, *A. lineata*, *A. longicaudata*, *A. nelsonjorgei*, *A. niceforoi*, *A. nigrolineata*, *A. nigroterminata*, *A. phillipsi*, *A.*

Table 2. Selected external characters for *Apostolepis* species. Data extracted from original descriptions and taxonomic comparisons (Duméril *et al.* 1854, Cope 1887, Peracca 1904, Amaral 1921, 1935, Ruthven 1927, Peters and Orejas-Miranda 1972, Lema 1978, 1998, 2002, 2003, 2004a,b, 2016, Rodrigues 1993, Giraudo and Scrocchi 1998, Harvey 1999, Harvey *et al.* 2001, Lema and Renner 2004, 2005, 2012, Ferrarezi *et al.* 2005, Lema and Albuquerque 2010, Curcio *et al.* 2011, Albuquerque and Lema 2012, Loebmann and Lema 2012, Nogueira *et al.* 2012, Entiauspe-Neto and Lema 2015).

Species	Characters							
	Nuchal collar	Cervical collar	Postcervical collar	Vertebral stripe	Body stripes	Body lines	Tip of the tail	Ventral coloration
<i>Apostolepis albicollaris</i> Lema, 2002	White	Black	Absent	Absent	Dorsolateral	Absent	Black dorso-ventrally	Ventral surface with a pair of large ventrolateral black spots on each ventral shield
<i>Apostolepis ambiniger</i> (Peters, 1869)	Black	Absent	Absent	Absent	Absent	Absent	White ventrally	Uniform white
<i>Apostolepis ammodites</i> Ferrarezi, Erritto Barbo and Albuquerque, 2005	White	Black	White	Absent	Absent	Absent	Black	Uniform white
<i>Apostolepis arenaria</i> Rodrigues, 1993	White	Black	Absent	Present	Present	Five	Black	Uniform white
<i>Apostolepis assimilis</i> (Reinhart, 1861)	White	Black	Absent	Absent	Absent	Absent	Black	Uniform white
<i>Apostolepis barrioi</i> Lema, 1978	Black	Absent	Absent	Absent	Present	Absent	White	Uniform white
<i>Apostolepis borellii</i> Peracca, 1904	White	Black	Absent	Present	Present	Four	White	Uniform white
<i>Apostolepis breviceps</i> Harvey, Gonzalez and Scrocchi, 2001	Black	Absent	Absent	Faint vertebral stripe, only on anterior half of body	Absent	Absent	Creamy	Uniform white
<i>Apostolepis cearensis</i> Gomes, 1915	White	Black	Absent	Absent	Absent	Absent	Black	Uniform white
<i>Apostolepis cerradoensis</i> Lema, 2003	White	Black	Absent	Vestigial	Dorsolateral	Absent	White	Uniform white

Table 2. Continued.

Species	Characters							
	Nuchal collar	Cervical collar	Postcervical collar	Vertebral stripe	Body stripes	Body lines	Tip of the tail	Ventral coloration
<i>Apostolepis christineae</i> Lema, 2002	Absent	Absent	Absent	Present	Absent	Five	White	Uniform white
<i>Apostolepis dimidiata</i> (Jan, 1862)	Black	Absent	Absent	Vestigial or absent	Dorsolateral	Absent	White	Heavily pigmented with black, only the edge of ventrals white
<i>Apostolepis dorbignyi</i> (Schlegel, 1837)	White	Black	Absent	Absent	Absent	Absent	Cream	Uniform white
<i>Apostolepis flavotorquata</i> (Duméril, Bibron and Duméril, 1854)	Yellow	Black	Absent	Absent	Absent	Absent	Cream	Uniform white
<i>Apostolepis gaboi</i> Rodrigues, 1993	Yellow	Black	Absent	Present	Present	Seven	Black	Uniform white
<i>Apostolepis goiasensis</i> Prado, 1942	Absent	Absent	Absent	Present	Absent	Three	White	Uniform white
<i>Apostolepis intermedia</i> Koslowsky, 1898	Black	Absent	Absent	Present	Absent	Five	White	Uniform white
<i>Apostolepis lineata</i> Cope, 1887	Black	Absent	Absent	Present	Present	Five	White	Uniform white
<i>Apostolepis longicaudata</i> Gomes, 1921	Absent	Absent	Absent	Present	Absent	Five	White	Uniform white
<i>Apostolepis multicincta</i> Harvey, 1999	White	Black	Absent	Absent	Absent	Absent	Mostly gray	Uniform white
<i>Apostolepis nelsonjorgei</i> Lema and Renner, 2004	White	Absent	Absent	Present	Present	Five	Black	Uniform white
<i>Apostolepis niceforoi</i> Amaral, 1935	Absent	Absent	Absent	Present	Present	Seven	Black	Uniform white
<i>Apostolepis nigrolineata</i> (Peters, 1869)	Absent	Absent	Absent	Present	Present	5 in juveniles, 3 in adults	White	Uniform white

Table 2. Continued.

Species	Characters							
	Nuchal collar	Cervical collar	Postcervical collar	Vertebral stripe	Body stripes	Body lines	Tip of the tail	Ventral coloration
<i>Apostolepis nigroterminata</i> Boulenger, 1896	Cream	Irregular brown collar	Absent	Present	Present	Five	Cream	Uniform white
<i>Apostolepis phillipsi</i> Harvey, 1999	White	Irregular black collar	Absent	Present	Present	Five	White	Uniform white
<i>Apostolepis polylepis</i> Amaral, 1921	Black	Absent	Absent	Present	Present	Absent	Black	Uniform white
<i>Apostolepis pyimi</i> Boulenger, 1903	Absent	Absent	Absent	Present	Present	Three	Black	Uniform white
<i>Apostolepis quirogai</i> Giraudo and Scrocchi, 1998	White	Black	Absent	Reduced to small dots	Dorsolateral	Absent	Center lighter	Pigmented with black
<i>Apostolepis serrana</i> Lema and Renner, 2006	Absent	Absent	Absent	-	-	-	White	-
<i>Apostolepis striata</i> Lema, 2004	Black	Absent	Absent	Present	Present	Five	White	Uniform white
<i>Apostolepis tenuis</i> Ruthven, 1927	White	Absent	Absent	Present	Present	Absent	White	Uniform white
<i>Apostolepis tertulianoabei</i> Lema, 2004	White	Black	Absent	Absent	Absent	Absent	White	Uniform white
<i>Apostolepis vittata</i> (Cope, 1887)	Black	Absent	Absent	Present	Present	Five	White	Uniform white

polylepis, *A. pyimi*, *A. quirogai*, *A. striata*, *A. tenuis*, and *A. vittata* have a vertebral stripe, which sometimes is reduced to small dots (absence of vertebral stripe or dots in *A. barrioi*). *Apostolepis arenaria*, *A. borelli*, *A. christinae*, *A. gaboi*, *A. goiasensis*, *A. intermedia*, *A. lineata*, *A. longicaudata*, *A. nelsonjorgei*, *A. niceforoi*, *A. nigrolineata*, *A. nigroterminata*, *A. phillipsi*, *A. pyimi*, *A. striata*, and *A. vittata* have five or seven

narrow black dorsal stripes (presence of two broad black dorsolateral stripes in *A. barrioi*). In *A. albicollaris*, *A. ammodites*, *A. arenaria*, *A. assimilis*, *A. cearensis*, *A. gaboi*, *A. nelsonjorgei*, *A. niceforoi*, *A. polylepis*, and *A. pyimi* the tips of the tail are black (tip of the tail white in *A. barrioi*), and in *A. albicollaris*, *A. dimidiata*, and *A. quirogai*, the ventral scales are black (immaculate white ventral scales in *A. barrioi*).

Description of the holotype.—Head elongate; snout slender, rounded, and strongly projecting, 1.5 mm beyond jaws; tongue groove deep; nostril, on anterior part of the nasal, posteriorly oblique. Measurements: head length 11 mm; tail length 37 mm; total length 390 mm; snout–vent length 353 mm; tail length/snout–vent length relation 0.105, tail long, 10% of the total length. Dorsal aspect of rostral one-half length of suture between prefrontal; prefrontal shorter than frontal; parietals elongate (5.5 × 4.5 mm); nasal large (2.5 × 2.0 mm, in contact with prefrontal, and 1st and 2nd supralabials; prefrontal larger than postocular; posterior temporal absent; 5th and 6th supralabials in contact with parietals; ventrals 220; paired subcaudals 27; supralabials 6 (2–3), infralabials 7 (1–4). Mental long and pointed; seven dorsal scale rows on tail. Tail tip rounded, short.

Coloration in preservative.—Head black from the snout posterior to first five dorsal vertebral scales, forming nuchal collar; rostral white or cream, with black blotches medially; supralabials white with black on the suture between postocular and temporals; infralabials white. Two dorsolateral black stripes extending from collar; tail with dark blotches on 11 dorsal scales.

Coloration in life.—Head entirely black in dorsal view with white on only some supralabials and rostrum. Ventral aspect of infralabials and chinshields completely white. Black coloration extends onto the first three dorsal scales; two dorsolateral stripes, two dorsal scales wide, extending from black collar posteriorly along flanks and onto the tail. Flanks below dorsolateral black stripes grayish white. Dorsum red, only head and tail tip black. Venter immaculate white.


Discussion

Apostolepis barrioi belongs to the *A. dimidiata* Group as defined by Ferrarezi *et al.* (2005) and Nogueira *et al.* (2012). The absence of dark coloration on the ventrals and subcaudals and the presence of two black dorsolateral stripes

differentiate *Apostolepis barrioi* from other members of the group (Table 1). In *A. albicollaris* Lema, 2002, the belly is heavily pigmented, at least laterally (Nogueira *et al.* 2012), and in *A. quirogai* Giraud and Scrocchi, 1998, the ventral pattern consists of dark ventrolateral stripes over the anterior third of the belly; the black coloration increases posteriorly (Giraud and Scrocchi 1998). In these two species, the black coloration is restricted to some parts of the ventrals.

The resurrection of *Apostolepis barrioi* brings the number of species *Apostolepis* to 33 (Harvey 1999, Ferrarezi *et al.* 2005, Nogueira *et al.* 2012, Uetz *et al.* 2017), making it the most diverse genus of the tribe Elapomorhini. Further systematic study of the genus is recommended, especially for those species described the basis of only a few specimens.

Acknowledgments

We thank Elizabeth Paggini and Francisco Franco for permission to examine specimens of *Apostolepis* in their care, and Jean Paul Brouard and Fundación Para La Tierra and Nicolas Martinez (MNHN) for photographs. Julian Faivovich and Santiago Nenda (MACN) provided data and photographs of the holotype of *A. barrioi*. We thank Pier Caccial and Ross MacCulloch, who reviewed earlier drafts of the manuscript, as well as Lía Romero and Jeffrey Thompson who reviewed our English usage. Jessica Fratani provided the Portuguese abstract. HC would like to thank Consejo Nacional de Ciencias y Tecnologías (CONACYT) for financial support through the Programa Nacional de Incentivo a Investigadores (PRONII). 

References

- Albuquerque, N. R. and T. Lema. 2012. Description of the second known specimen of *Apostolepis intermedia* (Serpentes, Colubridae, Xenodontinae). *Zootaxa* 3325: 53–58.
- Amaral, A. 1921. Contribuição para o conhecimento dos ofídios do Brasil. Parte I. Quatro novas espécies de serpentes brasileiras. *Memórias do Instituto Butantan* 4: 1–68.

- Amaral, A. 1935. Estudos sobre ofídios nos neotrópicos XXXIII. Novas espécies de ofídios da Colômbia. *Memórias do Instituto Butantan* 9: 219–223.
- Cope, E. D. 1887. Synopsis of the Batrachia and Reptilia obtained by H. H. Smith in the Province of Mato Grosso, Brazil. *Proceedings of the American Philosophical Society* 24: 44–60.
- Curcio, F. F., P. M. S. Nunes, M. B. Harvey, and M. T. Rodrigues. 2011. Redescription of *Apostolepis longicaudata* (Serpentes: Xenodontinae) with comments on its hemipenial morphology and natural history. *Herpetologica* 67: 318–331.
- Dinerstein, E., D. M. Olson, D. J. Graham, A. L. Webster, S. A. Primm, M. P. Bookbinder, and G. Ledec. 1995. *Una Evaluación del Estado de Conservación de las Ecorregiones Terrestres de América Latina y el Caribe*. Washington. Island Press. 174 pp.
- Dowling, H. 1951. A proposed standard system of counting ventrals in snakes. *British Journal of Herpetology* 1: 97–99.
- Duméril, A. M. C., G. Bibron, and A. H. A. Duméril. 1854. *Erpétologie générale ou Histoire Naturelle complète des reptiles. Tome septième. Deuxième partie, comprenant l'histoire des serpents venimeux*. Paris. Librairie Encyclopédique de Roret: i-xii + 781–1536.
- Entiauspe-Neto, O. M. and T. Lema. 2015. *Apostolepis christineae* Lema, 2002 (Serpentes: Xenodontinae: Elapomorhini): first record for Bolivia. *Check List* 11: 1–4.
- Ferrarezi, H., F. E. Barbo, and C. E. Albuquerque. 2005. Phylogenetic relationship of a new species of *Apostolepis* from Brazilian Cerrado with notes on the *assimilis* group (Serpentes: Colubridae: Xenodontinae: Elapomorhini). *Papéis Avulsos de Zoologia* 45: 215–229.
- Girardo, A. R. 2002. *Serpientes de la Selva Paranaense y del Chaco Húmedo*. Buenos Aires. Literature of Latin America. 328 pp.
- Girardo, A. R. and G. J. Scrocchi. 1998. A new species of *Apostolepis* (Serpentes: Colubridae) and comments on the genus in Argentina. *Herpetologica* 54: 470–476.
- Grazziotin, F. G., H. Zaher, R. W. Murphy, G. J. Scrocchi, M. A. Benavides, Y.-P. Zhang, and S. L. Bonatto. 2012. Molecular phylogeny of the New World Dipsadidae (Serpentes: Colubroidea): a reappraisal. *Cladistics* 88: 437–459.
- Harvey, M. 1999. Revision of Bolivian *Apostolepis* (Squamata: Colubridae). *Copeia* 1999: 388–409.
- Harvey, M. B., L. A. Gonzales, and G. J. Scrocchi. 2001. New species of *Apostolepis* (Squamata: Colubridae) from the Gran Chaco in Southern Bolivia. *Copeia* 2001: 501–207.
- Lema, T. 1978. Novas espécies de opistoglifodontes do gênero *Apostolepis* Cope, 1861 do Paraguai (Ophidia: Colubridae: Colubrinae). *Comunicações do Museu de Ciências PUCRGS* 18/19: 27–49.
- Lema, T. 1993. Polimorfismo em *Apostolepis dimidiata* (Jan, 1862), com a invalidação de *Apostolepis villaricae* Lema, 1978 e *Apostolepis barrioi* Lema, 1978 (Serpentes: Colubridae: Xenodontinae: Elapomorhini). *Acta Biologica Leopoldensia* 15: 35–52.
- Lema, T. 1998. A redescription of the tropical Brazilian serpent *Apostolepis nigrolineata* (Peters 1869), (Colubridae: Elapomorhinae), synonymous with *A. pyi* Boulenger, 1903. *Studies Neotropical Fauna and Environment* 32: 193–199.
- Lema, T. 2001. Fossorial snake genus *Apostolepis* from South America (Serpentes: Colubridae: Elapomorhinae). *Cuadernos de Herpetología* 15: 29–43.
- Lema, T. 2002. Redescription of *Apostolepis sanctaeritae* Werner, 1924 (Serpentes, Colubridae) and a comparison with related species. *Copeia* 2002: 1147–1151.
- Lema, T. 2003. Descrição de nova espécie de *Apostolepis* Cope, 1861 do Cerrado do Brasil, pertencente ao grupo *dimidiata* (Serpentes, Elapomorhinae). *Acta Biologica Leopoldensia* 25: 123–131.
- Lema, T. 2004a. Nova espécie de *Apostolepis* Cope do Estado de Rondônia, Brasil (Serpentes: Elapomorhinae). *Comunicações do Museu de Ciências e Tecnologia PUCRGS, Série Zoologia* 17: 81–89.
- Lema, T. 2004b. New species of *Apostolepis* Cope, 1861 from Caatinga belonging to *assimilis* group (Serpentes, Elapomorhinae). *Comunicações do Museu de Ciências PUCRGS, Série Zoologia* 17: 3–7.
- Lema, T. 2016. Description of new species of *Apostolepis* (Serpentes: Dipsadidae: Xenodontinae: Elapomorhini) from Serra do Roncador, Central Brazil. *Cuadernos de Pesquisa, Série Biologia* 28: 1–12.
- Lema, T. and M. Renner. 2004. New species of *Apostolepis* from Alto Tocantins, Brazil, with comments on the striped pattern species (Serpentes, Elapomorhinae). *Biociências* 12: 139–145.
- Lema, T. and M. F. Renner. 2005. Contribution to the knowledge of *Apostolepis cearensis* Gomes, 1925 (Serpentes: Colubridae: Elapomorhinae), with comments on similar species from northeastern Brazil. *Comunicações do Museu de Ciências e Tecnologia PUCRGS, Série Zoologia* 18: 129–140.

- Lema, T. and M. F. Renner. 2012. A new species of *Apostolepis* (Serpentes, Colubridae, Elapomorhini), belonging to *assimilis* group, found in Brazilian Cerrado. *Ciência em Movimento* 27: 71–76.
- Lema, T. and N. R. Albuquerque. 2010. The identity of *Apostolepis pyimi* and placement of *A. quinquelineata* in the synonymy of *A. nigrolineata* (Serpentes, Xenodontinae). *Biota Neotropica* 10: 343–346.
- Lema, T. and C. Hofstadler-Deiques. 2010. Description of a new genus for allocation of *Elapomorphus lepidus* and the status of *Elapomorphus wuchereri* (Serpentes: Dipsadidae: Xenodontinae: Elapomorhini). *Neotropical Biology and Conservation* 5: 113–119.
- Loebmann, D. and T. Lema. 2012. New data on the distribution of the rare and poorly known *Apostolepis goiasensis* Prad, 1943 (Serpentes, Xenodontinae, Elapomorhini) with remarks on morphology and colouration. *Herpetology Notes* 5: 523–525.
- Nogueira, C., F. E. Barbo, and H. Ferrarezzi. 2012. Redescription of *Apostolepis albicollaris* Lema, 2002, with a key for the species groups of the genus *Apostolepis* (Serpentes: Dipsadidae: Elapomorhini). *South American Journal of Herpetology* 7: 213–225.
- Peters, J. and B. Orejas-Miranda. 1972. The taxonomic validity of *Apostolepis tenuis* Ruthven and *Apostolepis vittata* (Cope) (Serpentes: Colubridae). *Copeia* 1972: 588–590.
- Peracca, M. 1904. Viaggio del Dr. A. Borelli nel Matto Grosso brasiliano e nel Paraguay, 1899. IX. *Rettili ed anfibiai*, *Bolletino del Musei di Zoologia ed Anatomia Comparada* 19: 1–15.
- Pyron, R. A., F. T. Burbrink, and J. J. Wiens. 2013. A phylogeny and revised classification of Squamata, including 4161 species of lizards and snakes. *BMC Evolutionary Biology* 13: 1–53.
- Rodrigues, M. T. 1993. Herpetofauna das dunas interiores do Rio São Francisco: Bahia: Brasil. V. Duas novas espécies de *Apostolepis* (Ophidia, Colubridae). *Memórias do Instituto Butantan* 54: 53–59.
- Ruthven, A. G. 1927. Description of an apparently new species of *Apostolepis* from Bolivia. *Occasional Papers of the Museum of Zoology, University of Michigan* 188: 1–2.
- Sabaj-Pérez, M. H. 2016. Standard symbolic codes for institutions resource collections in herpetology and ichthyology: an online reference. Version 6.5. Electronic Database accessible at <http://www.asih.org>, American Society of Ichthyologists and Herpetologists, Washington, USA.
- Uetz, P., P. Freed, and J. Hosêk (eds.). 2017. The Reptile Database. Electronic Database accessible at <http://www.reptile-database.org>. Captured on 18 July of 2017.
- Zaher, H. 1999. Hemipenial morphology of the South American Xenodontinae snakes, with a proposal for a monophyletic Xenodontinae and a reappraisal of colubroid hemipenis. *Bulletin of the American Museum of Natural History* 240: 1–168.
- Zaher, H., F. G. Grazziotin, J. E. Cadle, R. W. Murphy, J. C. Moura-Leite, and S. L. Bonatto. 2009. Molecular phylogeny of advanced snakes (Serpentes, Caenophidia) with an emphasis on South American Xenodontines: a revised classification and descriptions of new taxa. *Papéis Avulsos de Zoologia* 49: 115–153.

Editor: Ross D. MacCulloch

Appendix I. *Specimens examined.*

Apostolepis barrioi: without locality: IBSP 204, IBSP 214, IBSP 231, IBSP 280, IBSP 328, IBSP 414, IBSP 422, IBSP 434, IBSP 443, IBSP 445, IBSP 448, IBSP 474, IBSP 483, IBSP 529, IBSP 583. BRAZIL: IBSP 3760. MATO GROSS DO SUL: Aquidauana, LPH 130, earlier CHAFB 902; Dourados, IBSP 40425; Rio Brilhante, IBSP 42721. MINAS GERAIS: Guia Lopes da Laguna LPH 129 earlier CHAFB.902; Uberlândia UFU 757. SÃO PAULO: Araraquara: IBSP 23363, Severino Farm IBSP 46535; Atalaia IBSP 8521; Brotas IBSP 32759, Elba Farm IBSP 42264; Caetetuba IBSP 4509; Jardim dos Lagos IBSP 12347; Faveiro: Rio das Pedras IBSP 355, IBSP 539, IBSP 540; Paraisópolis IBSP 20359; Ribeirão Preto IBSP 117, Tambaú IBSP 4817; Santa Adélia: Terra Roxa IBSP 5809; Toriba IBSP 10274. PARAGUAY: AMAMBAY: Cerro Cora National Park, one km N from Park Administration Building MHNP 5162, formerly USNM 97053. CONCEPCIÓN: Cororo, Ypane River MACN 49402 formerly CHINM.3309, holotype of *A. barrioi*. SAN PEDRO: Private Reserve Laguna Blanca MNHNP 11548, Colonia Primavera BMNH.1955.1.6.1, BMNH.1960.1.3.3.

Apostolepis dimidiata: BRAZIL: without locality: NMW 21992. MATO GROSSO DO SUL: Maracaju AMNH.62192; Miranda MLP 577, holotype *A. ventrimaculatus* IBSP 5626; Salobra, km 122 railroad NW MNRJ 763. RIO DE JANEIRO: Joaquin Leite IBSP 8515. SÃO PAULO: Água Vermelha IBSP 7747; Americana IBSP 42589, IBSP 47513; Anísio de Moraes IBSP 1187; Araçatuba IBSP 7524; Araçoiaba da Serra IBSP 29232; Araraquara IBSP 19970; Distrito Américo, Boa Esperança Farm IBSP 46535, IBSP 48992; Assis IP 1901, IBSP 1905, IBSP 23226, IBSP 30861, IBSP 44471, IBSP 49205, IBSP 49688; Atalaia IBSP 9108; Atibaia IBSP 6084, IBSP 40402; Avaré IBSP 22895; Batoví IBSP 19131; Bernardino de Campos IBSP 27371; Botucatu IBSP 5669, AMNH.72425; Brotas IBSP 32759, IBSP 40520; Elba Farm IBS 42264; Caetetuba IBSP 5905; Caiuá IBSP 7029; Campinas IBSP 44477; Capivari IBSP 9353; Casa Branca IBSP 1393; Cerqueira César IBSP 7880; Conchas IBSP 118; Corumbataí IBSP 425; Cruzália IBSP 27671; Echaporã (= Cocaramurú) IBSP 31237; Faveiro, Rio das Pedras IBSP 119, IBSP 2547; Ferdinando Laboriau IBSP 5803; Fernão Dias IBSP 8024; Gália IBSP 40733; Garça IBSP 27568; Guaianás IBSP 8121; Guarani IBSP 1786; Guarantã IBSP 10357; Guararapes IBSP 5593; Herculândia IBSP 34117; Ibarra IBSP 8021; Indaiatuba IBSP 45198; Ipanema IBSP 4566, ZIB 5822 holotype of *Elapomorphus erythronotus*, lost; Itaguá IBSP 4546, IBSP 5066, IBSP 5873; Itapetininga IBSP 9507, IBSP 29640, IBSP 41354; Itápolis IBSP 6041; Itararé IBSP 9349, IBSP 49007; Itatinga IBSP 3294; Itobí IBSP 7335, IBSP 7603; Jaú IBSP 42727; Lauro Müller IBSP 5537; Lençóis IBSP 1362; Limeira IBSP 812, IBSP 47371; Lins IBSP 43894; Lucélia IBSP 31631; Mairiporã IBSP 42527; Maracanã IBSP 10066; Matão IBSP 4747, IBSP 5773; Miguel Calmon MCZ 27660, USNM 76369; Motuca IBSP 16665; Nova Odessa IBSP 3319; Novo Horizonte IBSP 1631; Olímpia IBSP 9340, IBSP 40413; Palmas IBSP 7736; Palmital IBSP 27688; Paraiso IBSP 15657; Paranapuã IBSP 16733, IBSP 32483; Paula Souza IBSP 3063; Pederneiras IBSP 9825, IBSP 9829; PeixotoGomide IBSP 12745; Penápolis IBSP 8819, IBSP 31049; Piracicaba IBSP 42123, IBSP 42128; Pirassununga: Emas MP 100, MP 102, MP 103, MP 104, MP 1891; IBSP 8986, IBSP 9479; Pirajú IBSP 7415, IBSP 9957, IBSP 16734; Platina IBSP 27842; Pompéia IBSP 46141; Presidente Wenceslau IBSP 34279; Prudentópolis IBSP 5733; Rancharia IBSP 32396, AMNH 102242; Ribeirão Preto IBSP 25604; Rinópolis IBSP 16644; Rubião Júnior IBSP 7271; Santa Ernestina IBSP 923, IBSP 1176; Santa Lúcia: Sta. Izabel Farm IBSP 44543; Santa Rosa do Viterbo IBSP 19059; São Paulo ZSM 197-10a, syntype *A. nigriceps*, lost; NMW 21990; Sapezal IBSP 7690; Tambaú IBSP 32112; Toriba IBSP 10297, IBSP 10298; Torrinhã IBSP 32447; Tupã: Universo IBSP 17175; Valinhos IBSP 4494; Valparaíso IBSP 14524, IBSP 31901; Varnhagen, near Ipanema Farm FMNH 1645; Vila Costner IBSP 3095; Votuporanga IBSP 41048. PARANÁ: IBSP 5325, NMW 13807; Campo Mourão IBSP 49624; Centenário do Sul MHNCI 3086. PARAGUAY: GUAIRA: Ybytyruzú National Park CZ 741.

Apostolepis aff. *dimidiata*: ARGENTINA: bordering Uruguay River IBSP 7781. CORRIENTES: UNNEC 147, 189, 249. MISIONES: CUNAM 002, 003, 004; UNNEC 183; CUNAM 237, 850.

Apostolepis spp.: Without locality: ZSM 197-10b, syntype of *A. nigriceps*; IBSP 727, IBSP 3066, IBSP3333, IBSP 3760, IBSP 3801, IBSP 7836, IBSP 9738, IBSP 9739, IBSP 9759, IBSP 20539, IBSP 48102, IBSP 53547, IBSP 53110.