

## New Species of *Apostolepis* (Serpentes, Dipsadinae, Elapomorhini) from Bolivia, from the *Apostolepis borellii* Group

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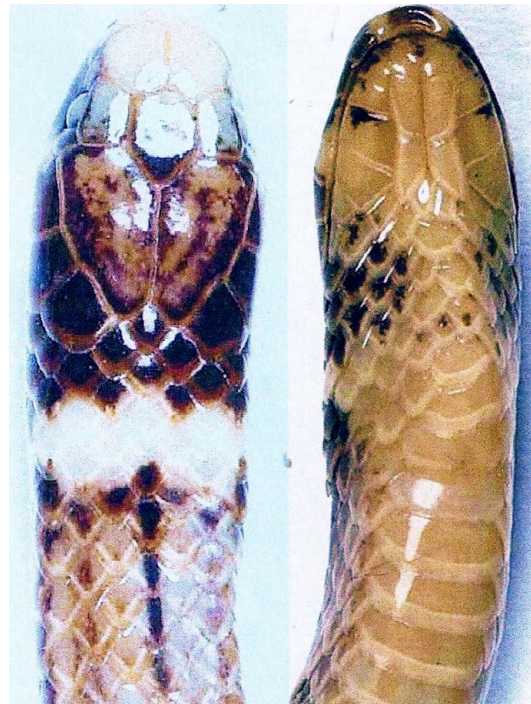
**Abbreviations:** AC: Anterior chin-shield; CC: Chin-shields; CL: Cloacal; DO: Dorsal scale; FR: Frontal; GR: Gular region; GU: Gular; IL: Infralabial; SL: Supralabial; ME: Mental; MR: Mental region; NA: Nasal; OC: Occipital (after the last SL does not contact PA); PA: Parietal; PC: Posterior chin-shield; PF: Prefrontal; PR: Preocular; PS: Postocular; PT: Posterior temporal; PV: Preventral; RO: Rostral; SC: Subcaudal; SL: Supralabial; SO: Supraocular; TE: Terminal; VE: Ventral scale. Bilateral data are indicated as right/left when necessary to indicate differences between them. The measurements given in millimeters were taken with a flexible ruler and digital caliper, and we used the following abbreviations: HEL: Head length; PVA: Portion of RO visible from above; SPF: Suture inter-PF; SVL: Snout-vent length; TAL: Tail length; TO: Total length; TRL: Trunk length. The sex was determined following a base-caudal incision.

#### ABSTRACT

Description of a new species of *Apostolepis* based on three specimens labelled *A. borellii* from Bolivia in The Museum of Natural History of London. The new species belongs to the *borellii* Group which is at present only represented by the species *A. borellii*. This new species differs from *A. borellii* by the following characters: (a) snout with median stripe (vs. immaculate); (b) supralabial blotch long (vs. short); (c) stripes evident on brown background (vs. having a blackish brown background with almost indistinct stripes) (d) ratio subcaudal by ventral scales low (vs. high) (e) lower sides cream (vs. darkish and dotted). The species area is Mato Grosso Plateau neighbouring the highlands of Bolivia in Cerrado Domain. The species is similar to *A. striata* and *A. serrana* from which it differs mainly by having nucho-cervical collars which is absent in the latter species. These species are placed in a specialized group (*borellii* group) while the *phillipsae* group is represented by *A. phillipsae*.

## INTRODUCTION

Three specimens housed in The Natural History Museum of London (BMNH) are determined as *Apostolepis borellii* Peracca<sup>[1]</sup>. The redetermined specimen belongs to a new species. *A. borellii* was synonymized with *Apostolepis nigroterminata* Boulenger<sup>[2]</sup> and following examination of the holotypes was revalidated<sup>[3]</sup> which is *in litteris* (submitted). The latter was allocated to the *nigrolineata* group and *A. borellii* to an isolated group. The new species is more similar to another two species from the same area, *A. serrana* Lema Renner and *A. striata* Lema. *A. borellii* is easily differentiated by having dark sides (**Figures 1 and 2**) and in the other species the sides are an immaculate cream colour. Importantly *A. phillipsae* belongs to specific a group represented by a single species, of which the major difference is the peculiar shape of the head. In a recent paper<sup>[3]</sup> reported on a visit to the Universidade Federal de Mato Grosso collection the discovery of several unknown species, this proves that there still exists a rich sample of unknown species from Serra do Amolar near Cuiabá Mato Grosso.



**Figure 1.** Holotype of *Apostolepis borellii* (MZUT.962), from Urucum Hill, Mato Grosso do Sul, Brazil.

## MATERIALS AND METHODS

The Cerrado of western Brazil encompasses a variety of habitats with much altitudinal variation including plateaus (“chapadas”) and mountain chains (“cordilleras”) on which there are savannahs, and/or growing forests. The area is on the Mato Grosso Plateau covering central to western Brazil and continuing to neighboring Bolivia It is between two major rivers the Araguaia at eastern end and the Paraguay at the western end. The Paraguay River bordering Brazil and Bolivia does not pose a significant barrier to reptile dispersal we expect the occurrence of similar herpetofauna on both sides as a result. The plateau of Chapada dos Guimarães has vertical slopes. At the tops of each highland are fields and forests arborous savannas forested savannas, as well as agriculture, and livestock. In the rainy seas ons October to November plus April to May floods are frequent. Rains are also usually frequent from December to March. The dry season is from May to September with the driest period from June to August<sup>[4]</sup>. Santa Cruz de la Sierra, the capital of Santa Cruz department in eastern Bolivia, has a tropical savanna climate (Köppen: Aw) with an average annual temperature of around 23 °C (73 F). Although the weather is generally warm all year round cold winds called “surazos” can blow in occasionally (particularly in the winter) from the Argentine pampas leading to a considerably and sudden temperature drop. The months of greatest rainfall are January and February; the average annual rainfall is 912 mm (36 in).

Collection acronyms follow<sup>[5]</sup>, except: UFMS Universidade Federal de Mato Grosso do Sul Campo Grande Mato Grosso do Sul Brazil; MHNSM Museo de Historia Natural Universidad Mayor San Marcos Peru; UFMT Universidade Federal de Mato Grosso Cuiabá Mato Grosso Brazil; UFRGS Universidade Federal do Rio Grande do Sul Porto Alegre Rio Grande do Sul Brazil.

## RESULTS

*Apostolepis underwoodi* sp. n.

(**Figures 2-11; Table 1**)

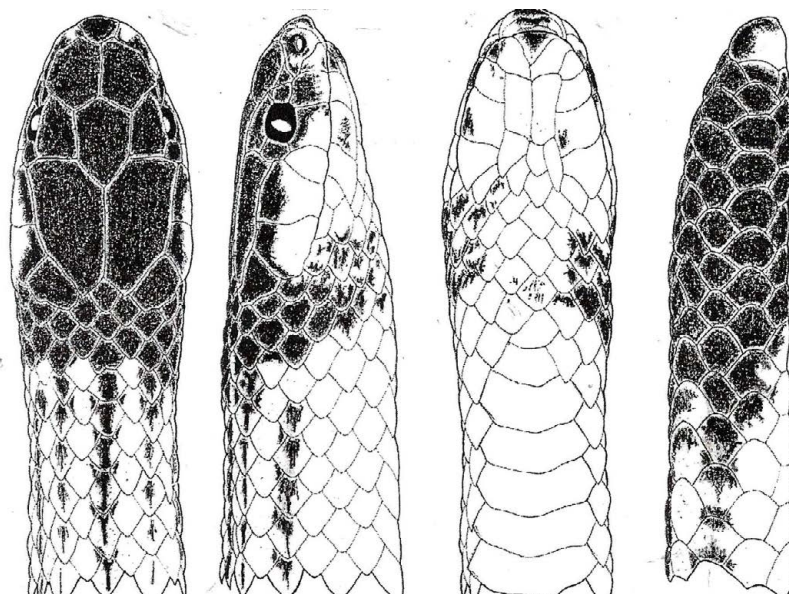
*Apostolepis borellii*<sup>[1]</sup> *Apostolepis nigroterminata*<sup>[2]</sup>.



**Figure 2.** Holotype of *Apostolepis borellii* (MZUT.962), from Urucum Hill, Mato Grosso do Sul, Brazil.



**Figure 3.** Holotype of *Apostolepis serrana* (BMNH.1972.430), from Serra do Roncador, Mato Grosso, Brazil.



**Figure 4.** Holotype of *Apostolepis striata* (CHUNB.12794), from Vilhena, Rondônia, Brazil





**Figure 5.** Holotype of *Apostolepis underwoodi* sp. b. (BMNH.1927.8.1.181) from Santa Cruz, Bolivia.



**Figure 6.** Holotype of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.181) from Santa Cruz, Bolivia.



**Figure 7.** Holotype of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.181) from Santa Cruz, Bolivia.





**Figure 8.** Paratype 1 of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.180) from Santa Cruz, Bolivia.



**Figure 9.** Paratype 1 of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.180) from Santa Cruz, Bolivia.



**Figure 10.** Paratype 1 of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.180) from Santa Cruz, Bolivia.



Figure 11. Paratype 2 of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.182) from Santa Cruz, Bolivia.

	<i>A. borellii</i>	<i>A. serrana</i>	<i>A. striata</i>	<i>A. underwoodi</i>	<i>A. underwoodi</i>	<i>A. underwoodi</i>
Specimens	MZUT.962	BMNH.1972.430	CHUNB.12794	BMNH.1927.8180	BMNH.1927.8181	BMNH.1927.8182
Sex	♂	♂	♂	♀	♂	♂
TOL	197	337	261	381.8	316.8	234.8
TAL	32	31	26	31.8	31.8	24
R	6.2	10.9	10	12	10	9.8
SVL	165	306	287	350	285	210.8
R'	0.194	0.101	0.091	0.091	0.112	0.114
VE	208	234	202	205	212	211
SC	32	33	26	27	28	31
R''	0.154	0.141	0.129	0.132	0.132	0.147
SL	3-4	3-6	3-6	3-6	3-6	3-6
WC	1.5-1	0	0	2	2-3	0.5
BC	0.5-1	0	0	1	1	0.5
LS	dark	immaculate	immaculate	immaculate	immaculate	spaced dots
TB	8/4	11/8	9/8	5/4	5/4	9/7
TE	white	white	black/white	black<white	black<white	black>>white
Snout	white, blotch on RO	black sutures	black	white, blotch on RO	white, blotch on RO	white, blotch on RO

Table 1. Data comparison of the *Apostolepis underwoodi* sp. n. with species belonging to the Group *borellii*. Abbreviations: BC, number of dorsal scales in black cervical collar; LS, lateral sides coloration; R, quotient TOL/TAL; R', quotient TAL/SVL; R'', quotient SC/VE; SC, subcaudal scales; SL, supralabial white scales forming blotch; SVL, snout-vent length; TAL, tail length; TB, number of dorsal and subcaudal scales in the tail blotch; TE, terminal shield coloration (dorsal and subcaudal number); TOL, total length; VE, ventral scales; WC, number of DO in white collar.



Figure 12. Paratype 2 of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.182) from Santa Cruz Bolivia.





**Figure 13.** Paratype 2 of *Apostolepis underwoodi* sp. n. (BMNH.1927.8.1.182) from Santa Cruz Bolivia.

**Type-specimens:** BMNH.1927.8.1.180, female, holotype; paratypes: BMNH.1927.8.1.181, holotype, male, and BMNH.1927.8.1.182, male; from Buena Vista, Santa Cruz Department, Bolivia (17°27'32"S, 63°39'33"W), 398 m OLS (**Figure 14**).

**Localization of Bolivian specimens:** These were captured in the department of Santa Cruz, highlands of western Cerrado at 416 m OLS. Climate: it is warm and tropical most of the year. Winters are short in the last two or three months of the year but can suddenly get very cold. "Surazos" (southerly winds that blow in from Argentina) can reduce the temperature by as much as 30 degrees overnight. This extreme cold lasts only a few days at a time however the beautiful sub-tropical Santa Cruz climate is evident throughout most of the year. Here the climate varies by geographical zone: temperate to cold in the western sierras and warm to hot and humid as one descends down to the extensive plains.

**Diagnosis:** The species which are most similar are *A. serrana* Lema and Renner (**Figure 3**) and *A. striata* Lema (**Figure 4**) differing from both, mainly by nuchal-cervical collars absent in these species. *Apostolepis aff. borellii* is another species showing similarities following analysis at the Universidade Federal de Mato Grosso do Sul campus Corumbá by Nelson R Albuquerque. The major difference is the shape of the supralabial blotch triangular in the latter and trapezoidal in the new species.

## DESCRIPTION OF HOLOTYPE

BMNH 1927.8.1.180, female Morphology: Head slightly elongate and slightly wider than neck; snout rounded not projected. Tail stocky with TE conic not spinous.

**Measurements:** HEL 8.91; TRL 310; TAL 31.8; SVL 350; TOL 381.8; quotient (TAL/TOL), 0.091; quotient (TAL/SVL), 0.094. Eye diameter, 0.91; distance eye to oral margin, 0.91; ratio eye/distance, 1, therefore the eyes are large. Head height: 3.12 (on PA level), 1.35 (on NA level); head width 4.22 (on PA), 2.27 (on NA). Neck height, 3.16. Body width: 4.13 (neck), half trunk, 4.97; CL region, 3.03; tail 3.03 (basis), 2.81 (half), and 1.36 (on last SC). Head shields: PA 3.63 (length), 1.57 (width); FR: 2.242 (length), 1.42 (width); PF: 1.43 (length), 1.41 (width); PA suture: 2.04; PF suture, 1.23; RO visible from above, 0.57; ratio PF suture/RO above, 2.2.

**Pholidosis:** PT only at right; SL, 6/6, second and third entering the orbit; IL, 7/7, the first four contacting AC; GU 6 on each side and median. PV, 2; VE, 205; SC, 27; quotient SC/VE, 0.132. DO contacting TE, 6.

**Colouration** (in conservation, in 80% Industrial methylated spirit): Pileon darkish brown, densely marbled, with light brown on inner parts of PA, extending to oral margin, crossing the eyes, and reaching the OC in nape black collar. PF is irregularly darkish in posterior margins. FR is dark in the apex and in middle line. SO light, fading brown blotched; the NA outside the head cap. Snout, mainly light cream in colour, with dark margins; the dark line between PF reaches the RO apex. Supralabial blotch is trapeze like, from third to sixth SL. Pileon nuchal margin narrow (two DO, not one), forming sideburns, which reach the GR, where it is patchy. White collar one DO long (narrow). Cervical collar patchy on lower sides, isolated from the vertebral stripe, where it is patchy (containing a few black blotches, some of which situated between them). Mental region light, with black blotches on ME, and second to fourth IL margins. GR disrupted by black nuchal collar. Vertebral stripe lineal, black running on the medial line of each DO. Paravertebral stripe fading, as wide as half of fifth DO row, more than half of the sixth DO row, with a dark margin. Lateral stripe is darker than the paravertebral stripe, as wide as half of the fourth DO row, more than half of a third, of DO row, margined up by black coloration. Light stripe situated between the paravertebral and pleural stripes, on half of fourth DO row; contrasting with





**Figure 14.** Map of South America showing the localization of the specimens examined several species of *Apostolepis*. Key: A. *borellii* (white circle), A. *underwoodi* sp. n. (black circle), A. *aff. borellii* (double circle); A. *nigroterminata* (white triangle), A. *serrana* (black square), and A. *striata* (white square).

blackish margins. Paraventral zone under pleural stripe is immaculate cream as well as along the ventral side from head to tail.

Variation (**Table 1**) The female has a much shorter tail than the males, approximately twelve to ten times. The RO is high, with the portion visible from above, being greater than half of suture length of PF. Each PF is large, with long sides, meeting nasal shield. The SO are short and wide, trapeze-rectangular like. The FR is pentagonal elongate, with anterior apex larger than the posterior, length larger than the distance to snout tip, and a little wide anterior. Each PA is wide and both joined in V-shape. The



NA is short and high like an equilateral triangle, and contacting the PR which is lozenge like. PS is angled and circles the orbit. The fifth SL is the largest and looks like an inverted trapeze. The VE varies from 205 to 212 and is reduced in number in females compared to males (205 to 211 and 212), and SC almost equal to males (27 to 28 and 31), this differs from the majority of species, the trunk of females is longer than it is in males.

**Colouration:** Pileon uniformly black. Snout usually a light brown, only one specimen is white (**Figures 5-13**); usually with black stripe on suture of PF and median line of rostral but can be partial. Pileon nuchal margin very narrow (one dorsal scale), extending down, usually forming sideburns, rarely reaching gular region, never forming a complete collar; with salience on last SL level, narrowing white collar. White collar as long as two DO. The black oblique band from the pileon running across the eye, reaching the oral margin (first to third SL). Cervical collar present, being narrow; one specimen with vestigial with anterior at extremity of pleural stripes enlarged. Supralabial blotch long, trapeze like, triangular, from posterior margin of third SL to anterior-lower margin of the sixty SL, with up parts of SL black. Background colour light brown, with five dorsal dark brown stripes, the vertebral scales and the pleurals are blackish brown; a light lineal stripe between paravertebral and pleural, usually present, contrasting against the darkish superior margin of the pleural. Vertebral stripe is lineal, on the median line of vertebral DO row, occurring in almost all striped species. The paravertebrals fades on half sixty, and half fifty DO rows, presenting darker lineal margins, fading to tail, where they disappear. The pleural is, usually, the widest stripe; they are dark brown, with the upper margin blackish on half of fourth DO row. The general formula for the stripes is (considering dorsal area from the sixty to first DO rows):  $\frac{1}{2}VI+1/2 V$  (paravertebral),  $1/2V$  (vertebral),  $\frac{1}{2} IV+1/2 III$  (pleural), II or II+I (dotted). The underside of the pleural stripes is cream, immaculate, or with serial dark dots on the second DO row. Tail blotch is as long as seven to five DO. TE mostly or fully white. The colouration in life is a dominant brown colour, with dark brown stripes; the areas under the pleural stripes snout labials and ventral are white. A narrow light stripe occurs between the pleural and paravertebral stripes creating a contrast with these stripes; this occurs frequently in almost all of the five-striped species of this genus.

**Etymology:** The name is a homage paid in memory to Garth Underwood, eminent herpetologist and a good friend of senior author with whom many memorable discussions on tropical African snake were enjoyed.

## DISCUSSION AND CONCLUSIONS

Harvey<sup>[2]</sup> determined the specimens from Bolivia and the holotype of *A. borellii*, as *A. nigroterminata*. The specimens housed in the BMNH are hereby revealed as new species (*A. underwoodi*). The others (USNM.280371, MNKP.472, MNKP.942; CM.2909\*, MNKM.2909, UMMZ.44687, UTA.44687, UMMZ.60773, ZFMK.66375, UMMZ.67962), have not been examined by the authors. However, according to the difference in biome (Amazonas x Cerrado) and the little data provided so far, these may not be considered *A. nigroterminata*. The UTA.44687, from which two figures was presented, one a drawing and the other a photograph, clearly shows a difference between the specimens; the supralabial blotch is long in the photo (as opposed to short), as it is in *A. underwoodi*. This specimen is from Santa Cruz, just like the specimens we examined (BMNH.1927.8.1.180-182). Harvey put the differences down to polymorphism, without giving a full explanation. The specimens examined from Cerrado differs from the holotype of *A. nigroterminata*, mainly by general morphology they are much slender in body form as opposed to the latter which has a much stockier form head to tail. This aspect of the morphology is peculiar to Amazonian species belonging to the *nigrolineata* Group. Furthermore strong differences between the two biomes Cerrado and Amazonia are another reason to separate these species. The *A. nigroterminata* (holotype, and FMNH.39646), specimens are from the Ayacucho Riverbank in the deep valleys of the Peruvian plateau at eastern and southern slopes respectively covered with Amazonian Forest. A photo of a neonate *A. nigroterminata* was taken in Madre de Dios bordering Brazil in the Amazonas and Acre states of the Amazonian Forest. A specimen found dead on the road (DOR) in the slopes of Cuzco, southern Peru which is also an area of importance home to tropical rainy forests, almost bordering Bolivia<sup>[6]</sup>.

We also examined several other specimens from the UHE Manso currently still under study with the senior author. An initial determination is inconclusive and it could be that they belong to an unknown species maybe two. All these specimens plus *A. underwoodi* are similar in morphology and colouration and we believe that they all belong to the *borellii* Group<sup>[7]</sup>.

There are two species from the Brazilian Cerrado, *Apostolepis serrana* Lema and Renner and *Apostolepis striata* Lema<sup>[8]</sup> which are very similar to *A. underwoodi*. The comparison of these species allow for a reallocation of these two species from the *phillipsae* Group to the *borellii* Group which is presented in a separate paper (*in litteris*) showing the phylogeny of the Group in plesiomorphy stage but apomorphy in relation to the *quinquelineata* and *nigrolineata* Groups easily differentiated by the absence of a tail blotch in the former. The determination of the species located in the Group *borellii* can be accomplished by use of the following short key:

Key to species known of *borellii* Group:

- 1a. Lower sides of body dark .....*A. borellii*
- b. Lower sides of body light, sometimes with some dots .....2
- 2a. Nucho-cervical collars present .....3

- b. Nucho-cervical collars absent .....4
- 3a. Supralabial blotch trapeze like .....*A. underwoodi*
- b. Supralabial blotch triangular .....*A. aff. borellii*
- 4a. Snout black; supralabial blotch extending to rostral; ventrals in 202; terminal black above .....*A. striata*
- b. Snout light, with median black stripe; ventrals in 234; terminal white .....*A. serrana*

### **VOUCHER SPECIMENS**

1. The specimens examined are indicated by an asterisk.
2. *Apostolepis borellii*—Brazil: Mato Grosso do Sul; Urucum Mountain (MZUT.962\*).
3. *Apostolepis aff. borellii*—Brazil: Mato Grosso: Chapada dos Guimarães, UHE Manso River (MCP.11372, 14524, 14525).
4. *Apostolepis nigroterminata*—Peru: Ayacucho, La Mar, in Sivia, Apurimac River valley, 760 OSL (FMNH.39646\*). Loreto, D.O.R. (MHNSM.005). Ucayali Valley: Callaria, ville and tributary of Ucayali River, between Poznan and Cabalococha (BMNH.1946.1.9.77\*).
5. *Apostolepis serrana*—Brazil: Mato Grosso; Serra do Roncador, Rio das Mortes (BMNH.1972.430\*).
6. *Apostolepis striata*—Brazil: Rondônia: Vilhena (CHUNB.12794\*).
7. *Apostolepis underwoodi n. sp.*—Bolivia: Santa Cruz: Buena Vista (BMNH.1927.8.1.180\*, 1927.8.1.181, 1927.8.1.182\*).

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