



BIOLOGICAL SCIENCES

A new species of *Oxyrhopus* Wagler, 1830 (Serpentes: Dipsadidae) from the Bolivian Andes

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Abstract: We describe a new dipsadine snake species, of the genus *Oxyrhopus* Wagler, 1830, from the highlands of Bolivia. *Oxyrhopus emberti* sp. n. is diagnosed from its congeners based on external and hemipenial morphology. The new species inhabits the humid forests of Yungas and Tucumano-Bolivian Forest highlands, between 1.200 – 1.800 meters above sea level, and is likely to be a Bolivian endemic. We also discuss the relationships of the new species with Andean congeners and provide a key to the identification of the *Oxyrhopus* species from the Central Andes of Bolivia and Peru.

Key words: Pseudoboini, systematics, taxonomy, Xenodontinae.

INTRODUCTION

Within neotropical caenophid snakes, one of the most diverse and enigmatic groups is the Pseudoboini tribe, that encompasses the genera *Boiruna* Zaher, 1999, *Clelia* Fitzinger, 1826, *Drepanoides* Dunn, 1926, *Mussurana* Zaher, Grazziotin, Cadle, Murphy, de Moura-Leite & Bonatto, 2009, *Oxyrhopus* Wagler, 1830, *Paraphimophis* Zaher, Grazziotin, Cadle, Murphy, de Moura-Leite & Bonatto, 2009, *Phimophis* Cope, 1860, *Pseudoboa* Schneider, 1801, *Rodriguesophis* Zaher, Grazziotin, Murphy, Scrocchi, Benavides, Zhang, & Bonatto, 2012, *Rhachidelus* Boulenger, 1908, and *Siphlophis* Fitzinger, 1843, and is supported by several morphological and molecular synapomorphies (Bailey 1970, Zaher 1999, Lynch 2009, Grazziotin et al. 2012, Alencar et al. 2013, Gaiarsa et al. 2013). Despite many works on taxonomy and systematics of these genera, there remain many poorly resolved or supported relationships, taxonomically unstable species, or even paraphyletic problems, issues that are largely related to the currently incomplete evaluation

of species boundaries, morphological and molecular variation (Zaher 1994, Sheehy et al. 2012, Figueroa et al. 2016).

The genus *Oxyrhopus* Wagler, 1830 represents a polyphyletic conglomerate of 14 nocturnal, small to moderate sized species, and widely distributed across the Neotropical region, occurring in pluvial forests, open formations, desertic areas, and oceanic islands, from southern Mexico, to northern Argentina (Alencar et al. 2013, Uetz 2019, Zaher et al. 2009, 2019). The species of *Oxyrhopus* share an undivided cloacal scale, paired subcaudals, a temporal formulae of 1+2 or 2+3, 7-10 infralabials and 7-8 supralabials, as well as a deeply bilobed, bicalyculate and bicapitated hemipenis, also presenting enlarged and well-developed lateral spines, in three or four rows, usually with a nude area in the lateral region of each lobe (Peters & Orejas-Miranda 1970, Zaher 1999); these characteristics, however, are not exclusive to *Oxyrhopus*, and the genus remains without a diagnosis. Five species (*Oxyrhopus formosus* (Wied), *Oxyrhopus guibeii* Hoge & Romano, *Oxyrhopus petolaris* (Linnaeus), *Oxyrhopus*

rhombofer Duméril, Bibron & Duméril, and *Oxyrhopus melanogenys* (Tschudi)) have confirmed records to Bolivia (Fugler et al. 1995, Embert 2007). Another congener, *Oxyrhopus trigeminus* Duméril, Bibron & Duméril, presents unconfirmed and unvouchered records to Bolivia (Nogueira et al. 2019); its occurrence in Bolivia is treated herein as probable.

While examining snake specimens from the Yungas and Tucumano-Bolivian Forests, we encountered a large series of a distinctive *Oxyrhopus* species, with unique coloration and morphology, that could not be assigned to any described species. After a detailed comparison with all its congeners, we concluded it represents a new species, easily diagnosed by morphology. We describe the species and provide brief comments on the taxonomy of Andean *Oxyrhopus*, suggesting that a comprehensive taxonomic and systematic review should be realized to clarify the status of some poorly known congeners.

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MATERIALS AND METHODS

We examined 56 preserved specimens (Appendix I) from the following collections: Coleção Herpetológica Universidade de Brasília (CHUNB), Brazil; Instituto Butantan (IBSP), Brazil; Coleção Herpetológica Museu de Ciências e Tecnologias PUCRS (MCP), Brazil; Museo Noel Kempff Mercado (MNKR), Bolivia; Colección Boliviana de Fauna en La Paz, (CBF) Bolivia; Coleção Herpetológica Universidade Federal do Rio Grande (CHFURG), Brazil; Field Museum of Natural History (FMNH), United States; The Louis Agassiz Museum of Comparative Zoology (MCZ), United States; Museu de Zoologia Universidade Federal de São Paulo

(MZUSP), Brazil; Zoologisches Forschungsinstitut und Museum Alexander Koenig en Bonn (ZFMK), Germany; Centro de Biodiversidad y Genética Reptiles en Cochabamba (CBGR), Bolivia. Of these, 28 specimens (11 adult females, 5 adult males, 2 juvenile females, 4 juvenile males, 6 unsexed juveniles) were identified as an undescribed taxon.

Comparative morphological data was also obtained from Peters & Orejas-Miranda (1970), Zaher (1999), Freitas (2003), and Lynch (2009). We follow standard terminology for describing scalation and coloration (Peters 1964, Peters & Orejas-Miranda 1970, Savage & Slowinski 1992). Dentition was examined in eight specimens, and described by exposing and counting teeth over both maxillae; these specimens are indicated with an asterisk mark (*). Hemipenial preparation and terminology follows Zaher (1994, 1999). Measurements of snout-vent length (SVL) and tail length were taken with a flexible ruler (to the nearest 1 mm), while head, eye and scale were taken with a dial caliper (to the nearest 0,05 mm). Standards for adult (mature) or juvenile (immature) individuals follows Pizzatto & Marques (2002), as defined for *O. guibei* [juvenile females present a total body length (SVL + TL) smaller than 632 mm, and juvenile males 388 mm]. Sex was determined either by subcaudal incision or through visual inspection of everted hemipenes. A ratio of ventral per subcaudal scales was calculated by dividing each ventral scale count by its subcaudal scale count. Measurements and meristic counts were unavailable for damaged or incomplete specimens. Other used abbreviations are: SD= standard deviation, n= number of specimens.

RESULTS

Oxyrhopus emberti Gonzales, Reichle & Entiauspe-Neto, sp. n.

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Holotype

MNKR 2551* (Figs. 1, 2, and 6). Adult female, collected 15/01/98, at Santa Rosa de Lima (17,87° W,64,25° S), Provincia Florida, Departamento Santa Cruz, Bolivia, by Francisco Sagot.

Paratypes (25 specimens)

Bolivia: Departamento Cochabamba: provincia Ayopaya: Cotacajes-Altamachi (16,48° W, 66,78° S): CBGR 0061: adult female, unknown collection date. Provincia Carrasco: Road between Antena Entel y Limbo (no coordinates): MNKR 3727: juvenile female, collected on 07/03/05. Provincia Tiraque: Chaquisaca (17,41° W,65,24° S): CBGR 701: adult male, collected on 1/11/09.

Departamento Chuquisaca: provincia Luis Calvo: Río Ticucha (19,60° W,63,88° S): MNKR 3616: unsexed juvenile, collected on 11/04/04.



Figure 1. Dorsal view of *Oxyrhopus emberti* (MNKR 2551, holotype).

Departamento Santa Cruz: provincia Florida: La Hoyada (17,92° W,64,12° S): MNKR 2625: unsexed juvenile, collected on 18/11/03; MNKR 3506: juvenile female, collected on 20/12/02; MNKR 3493: adult female, collected on 29/03/03; MNKR 3537: adult female, collected on 25/12/02. Los Monos (no coordinates): MNKR 4344: juvenile male, collected on 21/04/07. Palmasola (17,89° W,64,21° S): MNKR 1488*: adult female, collected on 25/02/98; MNKR 1531*: adult female, collected on 22/11/97; MNKR 2237*: adult female, collected on 15/07/99; MNKR 1506*: adult male, collected on 20/01/98. Palmasola, Paraje Yunga de las Doncellas (no coordinates): MNKR 4336: unsexed juvenile, collected on 03/06/04. Pampagrande (18,1 W,64,1 S): MNKR 3522: unsexed juvenile, collected on 16/05/02; MNKR 3544: unsexed juvenile, collected on March 2003. Samaipata (18,18° W,63,86° S): MNKR 2971: adult female, collected on 24/11/02. San José (Pampagrande) (18,1° W,64,1° S): MNKR 2684*: adult female, collected on 14/06/01. Santa Rosa de Lima (17,87° W,64,25° S): MNKR 2421*: adult female, collected on 19/07/2001; MNKR 3415: unsexed juvenile, collected on 17/10/02. Sivingalito (no coordinates): MNKR 2058*: adult female, collected on 5/12/99. Verdugo: MNKR 1223: adult male, collected on 12/12/96. Aguaclarita (17,99° W,64,09° S): MNKR 4714: unsexed juvenile, no collection data. Provincia Vallegrande: Pampas (Postrervalle) (no coordinates): MNKR 4825: juvenile male, collected on 12/11/09. Provincia Cordillera: Yupa (19,8° W,63,7° S): MNKR 4369: juvenile male, collected on 26/11/07.

Referred specimens (2 specimens)

Departamento La Paz: Provincia Caranavi: Serranía Bellavista: Road between Caranavi and Yucumo (15,7° W,67,47° S): ZFMK 80614 (AJ03/6): unsexed adult, collected on March 2003; ZFMK 80615 (AJ03/44): juvenile male, collected on March 2003.

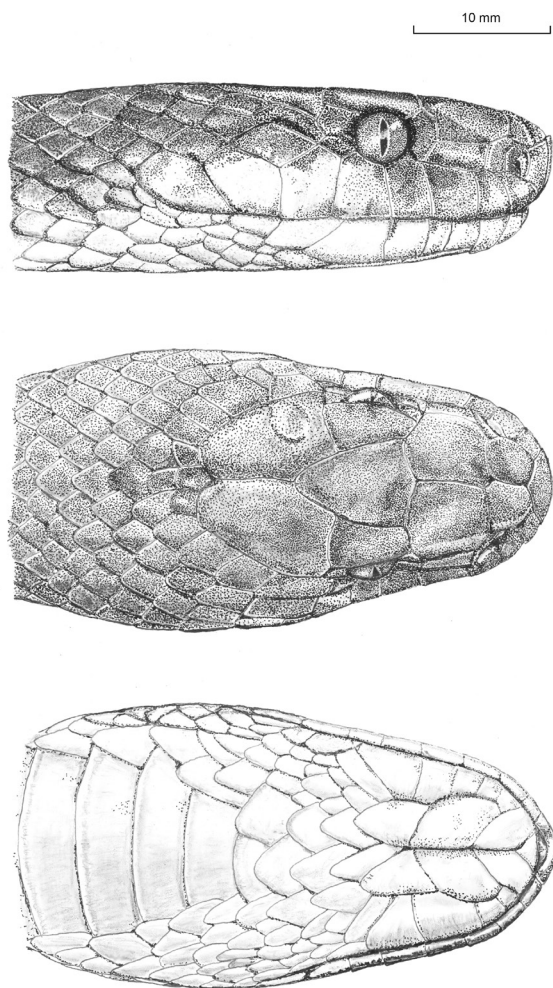


Figure 2. Head views of *Oxyrhopus emberti* (MNKR 2551, holotype). Illustration by Arthur Tiutenko.

Diagnosis

Oxyrhopus emberti sp. nov can be distinguished from all its congeners based on: (1) smooth dorsal scales with two apical pits, 19/19/17 rows; (2) postoculars two; (3) loreal rectangular, wider than higher; (4) temporal formula 2+3, 1+3 (or rarely 1+2); (5) supralabials usually eight, with 4th and 5th (rarely 4th, 5th, and 6th) in contact with orbit; (6) infralabials nine or ten (rarely eight), with 4–5 in contact with first pair of genials; (7) ventrals 197–209 in females, 189–195

in males; (8) subcaudals 66–74 in females, 75–87 in males; (9) in life, dorsum uniform black in adults, juveniles present alternating large black bands, with cream bands on tail and anterior third of body, including nuchal region, bands changing to orange on posterior body (body black bands 4–17 scales wide; body white bands 1–4 scales wide; tail black bands 3–8 scales wide; tail white bands 1–3 scales wide); (10) in life, venter uniform black with yellow gular region in adults, dorsal bands continue onto venter in juveniles; (11) juveniles with black body bands 17–29 and white body bands 16–21, black tail bands 6–11 and white tail bands 7–10; (12) maximum TTL in females 1277 mm and males 916 mm; (13) maxillary teeth 15:13 smooth and two grooved teeth; (14) supraocular and prefrontal in contact, separating preocular from frontal; (15) hemipenis strongly bilobed, bicalyculate, bicapitate, with lateral spines developed and enlarged, in five rows.

Comparisons

Characteristics from other species are presented in parentheses in this section. *Oxyrhopus emberti* sp. n. can be readily distinguished from *O. melanogenys*, *O. guibei*, *O. trigeminus*, *Oxyrhopus melanogenys orientalis* Cunha and Nascimento, 1983, and *Oxyrhopus vanidicus* Lynch, 2009 by preocular scale separated from frontal by a supraocular and prefrontal contact (preocular in contact with frontal); in adults of *O. emberti* uniform black dorsum dorsum and venter, juveniles with narrow orange or white body bands (diads or triads of black body bands) (Cunha & Nascimento 1983, Zaher & Caramaschi 1992, Freitas 2003, Lynch 2009).

Oxyrhopus emberti differs from *O. petolarius* by preocular separated from frontal by supraocular and prefrontal contact (preocular in contact with frontal); subcaudals in males 75–87, in

females 66–74 (100–126 in males, 86–110 in females of *O. petolaris*); uniform black adult dorsum and venter (alternating black and red body bands with white venter; although it might have a uniform black dorsum in some individuals, it retains a white venter) (Cunha & Nascimento 1983, Freitas 2003, Lynch 2009); only papillate calyces present on asulcate and sulcate medial surfaces (enlarged spines widely present on asulcate and sulcate medial surfaces) (Zaher 1999); maxillary teeth 13+2 (8+2) (MacCulloch et al. 2009).

Oxyrhopus emberti may be distinguished from *O. occipitalis* by uniform black adult coloration (red with faint black bands, yellow snout and gular region, top of head brown); maxillary teeth 13+2 (7–8+2) (Hoge et al. 1977, Cunha & Nascimento 1989, MacCulloch et al. 2009).

Oxyrhopus emberti may be distinguished from *O. formosus* by maximum range of ventrals reaching up to 209 (191); dorsal scale rows 19/19/17 (19/19/19); snout black (yellow, orange, or red), adults uniform black (black and reticulated red or white crossbands, venter white); juvenile body bands reaching up to 29 in body, 11 in tail (19 and 8) (Hoge et al. 1977, Cunha & Nascimento 1989, Silva Jr 1993, Freitas 2003).

Oxyrhopus emberti may be distinguished from *O. rhombifer* by preocular separated from frontal by supraocular and prefrontal contact (preocular in contact with frontal); white nuchal collar in juveniles (red in juveniles and adults); adults uniform black (black crossbands or triangles over incomplete red and white bands); hemipenis strongly bilobed with conspicuous pair of nude pockets in the lobular crotch (moderately bilobed, with moderately developed nude pockets) (Cei 1993, Zaher 1999, Freitas 2003).

Oxyrhopus emberti may be distinguished from *O. clathratus* by presenting a nude area in lateral region of the tip of hemipenial lobes, five rows of enlarged spines, and organ Y-shaped

(ornamented with papillate calyces, four rows of enlarged spines, either T or Y-shaped); adults uniform black (alternating red, white, and black crossbands, adults sometimes with black dorsum, with a white venter); (Zaher 1999, Bernardo et al. 2012).

Oxyrhopus emberti may be distinguished from *O. doliatus* in having dorsal scale rows 19/19/17 (19/19/19); adult uniformly black (red with broad black rings anteriorly, diminishing in width posteriorly) (Zaher & Caramaschi 2000).

Oxyrhopus emberti may be distinguished from *O. fitzingeri* by dorsal scale rows 19/19/17 (vs. 19/19/19); adults uniform black, crossbands in juveniles (light brown with irregular and scattered dark brown blotches, head pale orange) (Peters & Orejas-Miranda 1970).

Oxyrhopus emberti may be distinguished from *O. leucomelas* by dorsal scale rows 19/19/17 (17/17/15); higher range of infralabials 8–10 (7–8); uniform black dorsum in adults and crossbands in juveniles (alternating black and white crossbands, with a vertebral orange stripe) (Peters & Orejas-Miranda 1970).

Oxyrhopus emberti may be distinguished from *O. marcapatae* by supralabials 8–9 (7); dorsal scale rows 19/19/17 (15/15/15); adults uniform black (alternating black and cream bands) (Ruthven in Barbour 1913, Peters & Orejas-Miranda 1970, Gaiarsa et al. 2013).

Oxyrhopus emberti may be distinguished from *O. erdisii* by dorsal scales in 19/19/17 rows, with two apical pits (19/19/15 rows without apical pits); broad white nuchal collar in juveniles, absent in adults (incomplete narrow cream nuchal collar, in juveniles and adults); adults uniform black, juveniles with black and white or orange crossbands (juveniles and adults with alternating black, white or red crossbands); larger first black band in juveniles, 9–17 scales wide (5–8 scales wide) (Zaher & Caramaschi 2000) (Figs. 3 and 6).

Description of holotype

Adult female, SVL 1044 mm, tail length 233 mm (22.3% SVL); head slightly distinct from body; head length 34.8 mm (3.33% SVL); head width 18.8 mm (54% head length); rostral scale wider (6.0 mm) than higher (4.9 mm); distance between internasals 3.3 mm, less than distance between edge of prefrontals (5.6 mm). Prefrontals paired, pentagonal, contacting internasals, loreals, preoculars, supraoculars, and frontal. Interparietal suture slightly shorter than frontal scale, and much shorter than distance from anterior frontal margin to rostral tip. Frontal scale triangular, with slightly curved edges, width 8.2 mm, length 6.0 mm. Supraoculars length 5.7 mm, width 3.2 mm. Nasal divided, higher than wide. Loreal rectangular, width 3.7 mm, height 1.8 mm. Preocular single, height 2.9 mm, than

width 2.0 mm; postoculars two, similar in size and shape; temporals 2 + 3; supralabials 8/8, 2nd and 3rd in contact with loreal, 3rd and 4th in contact with preocular, 4th and 5th in contact with orbit; infralabials 10/10, first pair in contact with distal border of mental, 1-4 in contact with anterior genial, 5th and 6th larger and in contact with posterior genial. Posterior genials length 6.2 mm / 5.8 mm, than anterior 7.9 mm / 7.3 mm; dorsal scales smooth, with two apical pits, in 19/19/17 rows; ventrals 209; cloacal scale single; subcaudals in 69 pairs; eye diameter 3.1 mm, snout-orbit distance 10.7 mm; pupil vertical; maxillary teeth 13/13, followed by a distema, and then two grooved teeth.

Etymology

The specific epithet “*emberti*” is a noun in genitive case, and honours German herpetologist

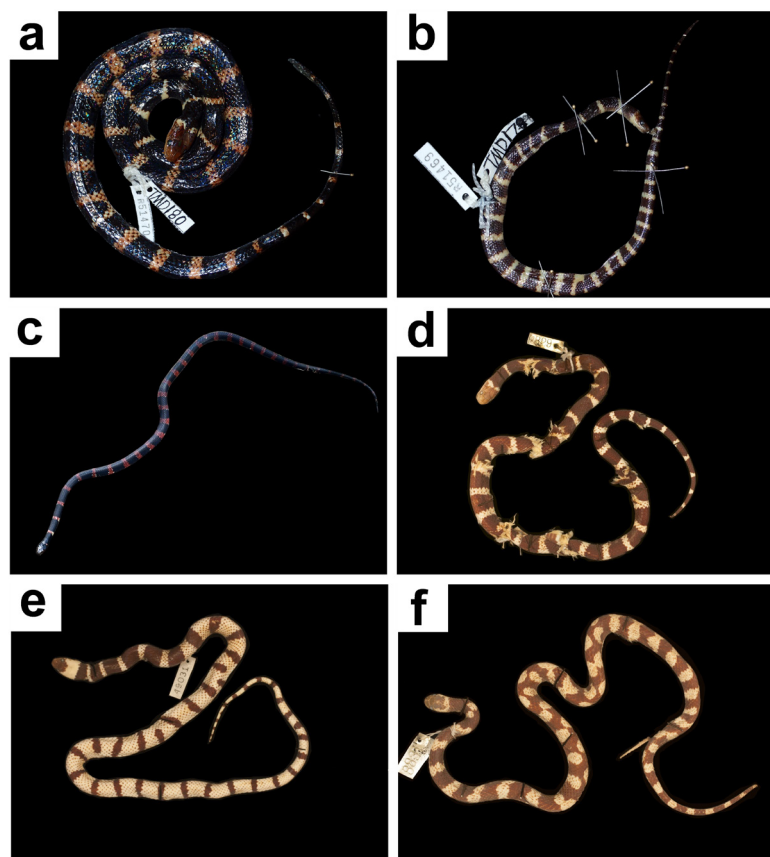


Figure 3. Comparison between similar *Oxyrhopus* species from Central and Northern Andes. a: Juvenile individual of *Oxyrhopus erdisii* from Chachabamba-Winaywayna, Bolivia (UTA R-51470); b: Juvenile individual of *Oxyrhopus erdisii* in preservative from Chachabamba (UTA-R 51469); c: Topotypical adult individual of *Oxyrhopus erdisii* in life from Macchu Picchu, Peru (Unvouchered); d: Holotype of *Oxyrhopus erdisii* in preservative from Macchu Picchu, Peru (MCZ 8829); e: *Oxyrhopus doliatus* in preservative from Pauji, Venezuela (MCZ 49031, Holotype of *O. venezuelanus*); f: *Oxyrhopus marcapatae* from Macchu Picchu, Peru (MCZ 8831, Holotype of *Drepanodon eatonii*). Photo credits: Carl J. Franklin (a, b), Harvey Rogoff (c), Joseph Martinez (d, f).

Dirk Embert, who has provided extensive contributions to the Bolivian Herpetology.

Variation

Largest male SVL 916 mm; largest female SVL 1277 mm (holotype). Ventral scales 189–209 (mean = 199; SD = 6.72; n = 25); in males, 189–195 (mean = 191; SD = 3.46; n = 3), in females, 197–209 (mean = 204; SD = 3.32; n = 13). Subcaudals 62–87 (mean = 73; n = 16); in males, 75–87 (mean = 82; SD = 6.11; n = 3), in females 66–74 (mean = 70; SD = 3.25; n = 13). Most individuals have eight supralabials (n = 22), rarely nine (n = 2; MNKR 3506, 3537), with 4th and 5th (n = 22) or rarely 4th, 5th, and 6th (MNKR 3506, 3537) in contact with orbit. Infralabials eight (n = 1), nine (n = 16), or 10 (n = 7), with 1st–4th (n = 12) or 1st–5th (n = 12) in contact with first pair of genials. Examined specimens presented temporal formulae 1 + 2 (n = 1), 1 + 3 (n = 9), or 2 + 3 (n = 15). Ventral/subcaudal relation ranges from 30–46% (males, 40–46%, mean = 43; females, 32–36%, mean = 34). Relation between tail length and total length ranges from 16–23% (males, 23–23%, mean = 22.81; females, 17–20%, mean = 18.27). All examined specimens had 13 maxillary teeth, a single premaxillary teeth, and two grooved postmaxillary teeth.

Hemipenial morphology

Strongly bilobed, bicalyculate, bicapitate, elongated, with lobes half as long as hemipenial body (Fig. 4). Lateral spines enlarged, in five rows, converging to distal ends of an enlarged crest, present on medial surface of both lobes. A pair of moderately developed naked pockets in the lobular crotch, under the enlarged crest. *Sulcus spermaticus* proximally bifurcated, dividing on proximal part of hemipenial body, becoming centrifugal, and conducted directly to upper portion of organ. Lobes are ornamented with papillate calyces, spinulate over border of

capitulum. As in most of *Oxyrhopus* species, *O. emberti* sp. nov. presents a nude area on lateral region of each lobe; in the new species, it is poorly developed.

Coloration

The 10 examined juvenile specimens (MNKR 2625, 3415, 3522, 3544, 3616, 4336, 4369, 4714, 4825, ZFMK 80615) of undetermined sex, and two juvenile females (MNKR 3506, 3727), exhibited banded pattern, consisting of black body bands 17–29 and white body bands 16–21, black tail bands 6–11 and white tail bands 7–10; in one specimen, MNKR 3544, black color does not extend onto venter anteriorly; white bands 1–4 scales wide dorsally, wider on venter; separated by black bands of 4–17 scales; head black dorsally, with a broad and complete red or yellow nuchal collar in juveniles; one juvenile female (MNKR 3506, 537 mm total body length) is almost fully black, with a yellow gular region, and white body bands visible on the last body third and tail, dorsally and ventrally; the other juvenile female (MNKR 3727, 565 mm TTL) is completely black, with a yellow gular region.

Some small adult individuals (e.g. CBGR 0061, 1032 mm total body length) conserve red incomplete bands, although indistinct or vestigial, turning white on alcohol; an adult male (MNKR 1506, 450 mm) has a uniform black dorsum, and a dark yellow venter; all other adult individuals present uniform black dorsum and venter, with a pale yellow gular region; supralabials are black, and infralabials are pale yellow, as in the gular area; iris coloration red. In preservative, yellow turns white.

Geographic distribution and natural history

The new species is known only from humid rainforests, from 1.200–1.800 m above sea level. It is known from 11 localities, all in humid rainforests

of Yungas and Tucumano-Bolivian ecoregions, and is currently endemic to Bolivia (Fig. 5).

Most specimens were collected during rainy season (June to February, 14 specimens), in March (2 specimens) and May (1 specimen). Three juvenile males were collected in May, November, and December. An adult female (MNKR 2058) collected in December contained nine eggs in its oviduct, while another (CBGR 0061) collected in November contained six eggs. A rodent (Muridae) was in the stomach content of a specimen (MNKR 2551, adult female). One juvenile specimen (MNKR 4336) has a second head, slightly malformed on the right side of the neck, slightly smaller than the normal head and seemingly non-functional.

DISCUSSION

The description of *Oxyrhopus emberti* sp. n. raises the number of valid *Oxyrhopus* species to 15. The genus *Oxyrhopus* presents an intricate taxonomic history and systematic relationships, being considered as polyphyletic (Zaher 1994, Sheehy et al. 2012, Figueroa et al. 2016). Although fitting the morphological diagnosis of *Oxyrhopus*

(Peters & Orejas-Miranda 1970, Zaher 1999), an integrated taxonomic revision of *Oxyrhopus* is needed; noteworthy examples are *O. marcapatae*, that presents a strikingly different morphological characterization, differing from other *Oxyrhopus* species by presenting 15 dorsal rows, 7 supralabials, and 8 infralabials (vs. more than 15 dorsal rows with or without reduction, except for *O. leucomelas*, 8 or more supralabials except for *O. leucomelas*, 9 or more supralabials except for *O. leucomelas*), and *O. leucomelas*, which presents unique morphological characters (7 or 8 supralabials and infralabials, 17/17/15 dorsal rows) and shares hemipenial similarities and a similar coloration pattern with *Siphlophis* species (Zaher 1999, Lynch 2009, Sheehy et al. 2012).

The new species appears to be most morphologically similar to *O. erdisii*, which is currently known to its type locality, in the lowland Amazon Rainforests of the Macchu Picchu mountain range, Cusco department, southern Peru (Zaher & Caramaschi 2000). Both species share several similarities in hemipenial morphology (hemipenis elongated, strongly bilobed, bicalyculate, bicapitate, lobes ornamented with papillate calyces and spinules

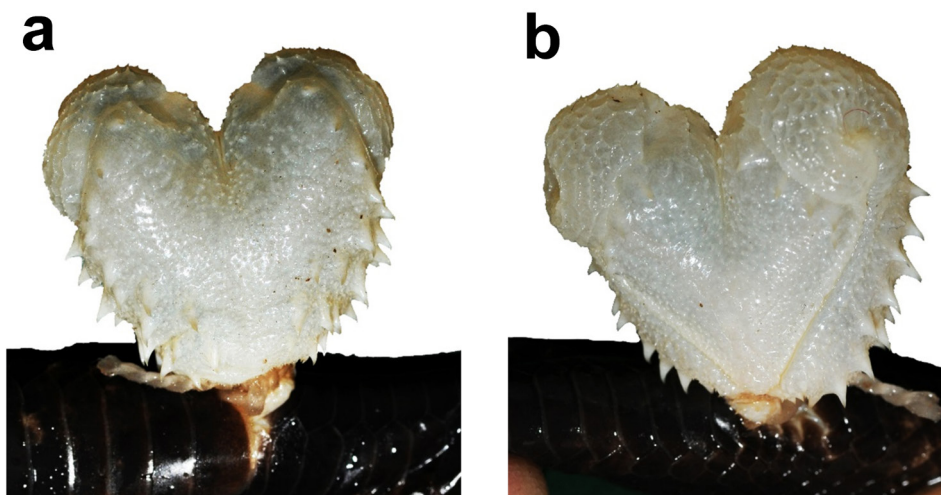


Figure 4. Hemipenial morphology of *Oxyrhopus emberti* sp. n (MNKR 1223). Asulcate side (Left) and sulcate side (Right).

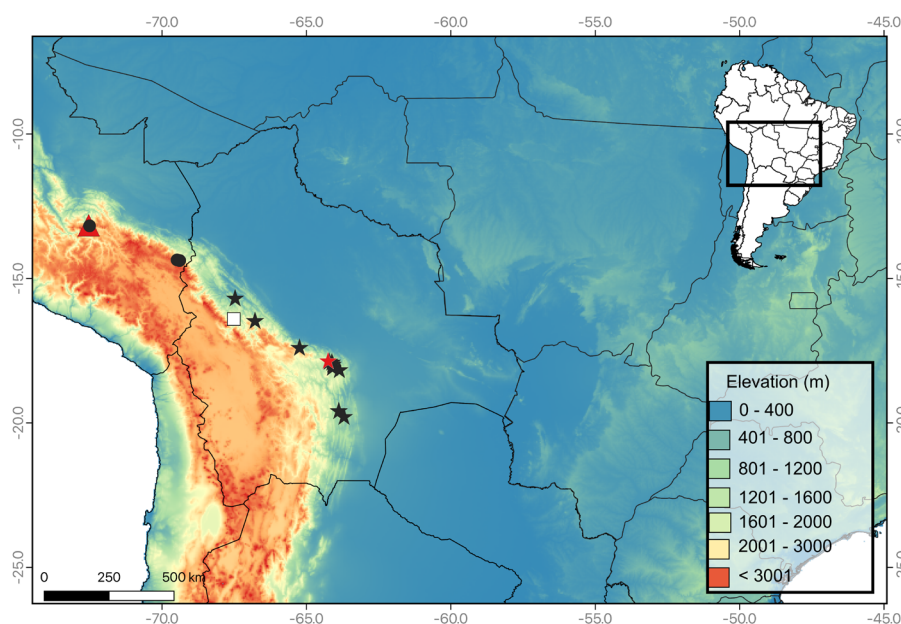


Figure 5. Geographic distribution of some Central Andes *Oxyrhopus*: *Oxyrhopus emberti* sp. n. (Star), *Oxyrhopus* cf. *erdisii* (Square), *Oxyrhopus erdisii* (Circles). Type locality of *O. emberti* (Red star), type locality of *O. erdisii* (Red triangle).

over the border of the *capitulum*, with poorly developed nude areas at the tip of lobes) and juvenile coloration pattern (both present monadal pattern and nuchal collars); we have also examined specimens of *O. erdisii* (Appendix 1) from the lowland Amazon Rainforests of Sandia, Puno department, southeastern Peru close to the Bolivia border, and unvouchered live specimen, tentatively assigned as *Oxyrhopus* cf. *erdisii* from the Yungas of Chulumani, La Paz department, in Bolivia, approximately 360 km S from the southernmost record (Fig. 7b, d). Likewise, *O. formosus* also shares with *O. emberti* and *O. erdisii* elongated and strongly bilobed hemipenis, with poorly developed nude areas at the tip of lobes. Other two species that present similarities with *O. emberti* are *O. clathratus* (occurs in Montane Atlantic Rainforest of Argentina and Brazil, share similar scale counts in dorsal scale rows, supralabials and infralabials, and a monadal band pattern, with melanistic adult individuals), and *O. petolarius* (widely distributed in South America, share similar adult and juvenile coloration). However, *O. clathratus* and *O. petolarius* present white

ventral coloration, even in melanistic specimens. Melanistic individuals have been widely reported for *O. clathratus* and *O. petolarius* (Bernardo et al. 2012); as both *O. emberti* and *O. clathratus* occur in montane areas, the melanistic coloration may reflect an adaptation to increase thermoregulatory capacity, as there is a debate whether darker colors and its reflectance difference may influence a rate in which solar radiation is converted into body heat (see Forsman 1995, Bernardo et al. 2012).

The new species inhabits humid rainforests of Yungas and Tucumano-Bolivian ecorregions, and is currently endemic to Bolivia. Considering its restricted range, we suggest that *O. emberti* should be considered as a candidate for a threatened species status, and further assessments on its conservation and populational trends are warranted. In agreement with other authors (e.g. Zaher 1999, Zaher et al. 2009, 2019), we also highlight the need for a genus-wide systematic and taxonomic revision based on integrative data sets, to elucidate the phylogenetic relationships of this new species, and other exquisite congeners.

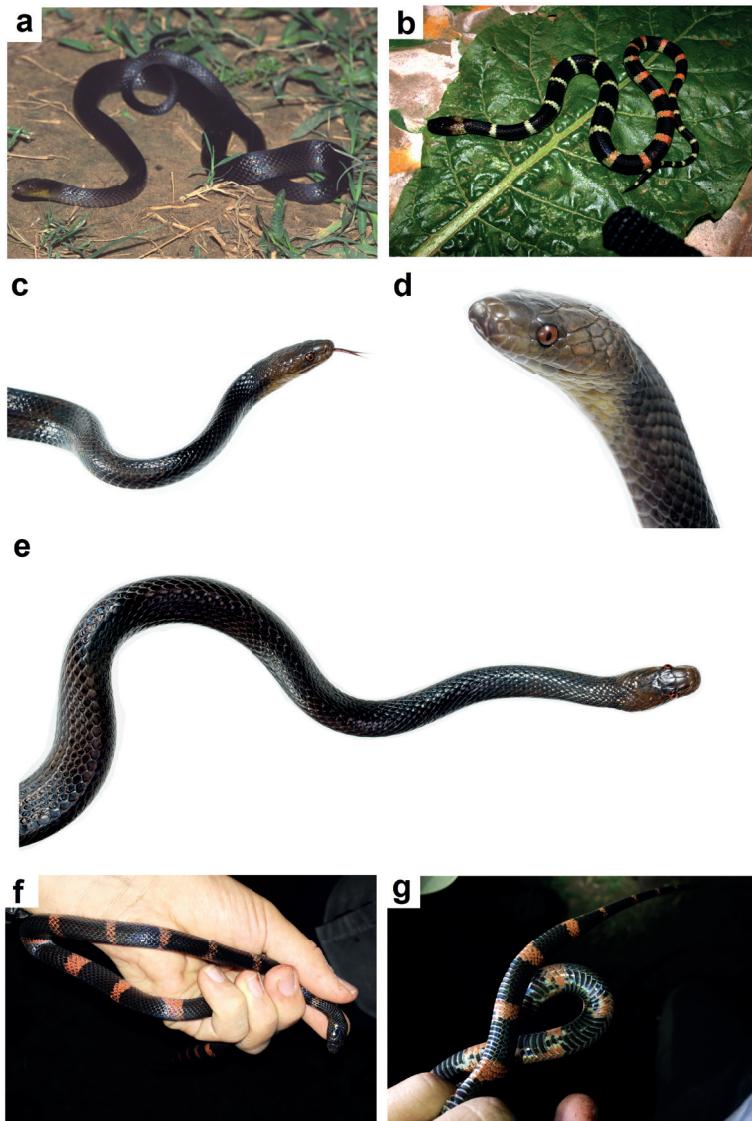


Figure 6. Coloration of *Oxyrhopus emberti* in life. a: Adult specimen (MNKR 2551, holotype) from Santa Rosa de Lima, Provincia Florida, Departamento Santa Cruz, Bolivia; b: Juvenile specimen (MNKR 4825); c: Unvouchered adult from Departamento Santa Cruz, Bolivia; d: Head close of same individual; e: Dorsal view of same individual; f: Unvouchered juvenile from Muyupampa-Ipati, Departamento Santa Cruz, Bolivia; g: Same previous individual, ventral view. Photo credits: Daniel Alarcón (c, e), Oscar Johnson (f, g).

Dichotomous key for *Oxyrhopus* on the central Andes Mountains

- 1a. Dorsal rows 15, supralabials 7, with 3rd and 4th in contact with orbit.....*O. marcapatae*
- 1b. Not as above2
- 2a. Dorsal pattern with alternating, diads, or triads of black bands.....3
- 2b. Not as above.....6
- 3a. Background body coloration red with black reticules, red nuchal collar, disperse black triads *O. melanogenys*
- 3b. Not as above.....4
- 4a. Body with complete black bands in diads or triads, black head, yellow nuchal collar, orange or yellow body bands.*O. vanidicus*
- 4b. Not as above5
- 5a. Body with groups of complete black bands in diads or triads, separated by red rings, usually visible on the venter.*O. guibei*

- 5b. Body with vestigial or conspicuous alternating black bands.....10
- 6a. Adults light brown with irregular and scattered light blotches, head pale orange, 19 dorsal rows.....*O. fitzingeri*
- 6b. Not as above7
- 7a. Head mostly black dorsally in adults....8
- 7b. Head light brown, usually incomplete white nuchal collar.....*O. erdisii*
- 8. Fully black adult individuals, 19/19/17 dorsal scales with two apical pits, juveniles with monadal pattern, preocular not in contact with frontal..... *O. emberti* sp. n.
- 8b. Not as above.....9
- 9a. Dorsum with triangular or semicircular black blotches, with red and yellow background coloration.....*O. rhombifer*
- 9b. Black and red monadal bands on dorsum, white venter.....*O. petolarius*
- 10a. Head coloration white, yellow or red, cream snout coloration, vestigial or conspicuous transverse black body bands.....*O. formosus*
- 10b. Head coloration black, orange nuchal collar, alternating black and white crossbands with a orange vertebral stripe.....*O. leucomelas*

a



b



c



d



Figure 7. Comparison of *Oxyrhopus* cf. *erdisii* and *Oxyrhopus emberti*. a: Juvenile specimen of *O. emberti* (MNKR 4369) from Departamento Santa Cruz, Bolivia; b: Unvouchered juvenile *O. cf. erdisii* from La Paz, Bolivia (note its narrower black bands); c: Unvouchered adult *O. cf. erdisii* from La Paz, Bolivia; d: Adult female *O. cf. erdisii* from La Paz, Bolivia (MNKR, voucher unavailable). Photo credits: Mauricio Pacheco (d).

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APPENDIX I

Additional material examined:

Oxyrhopus clathratus (n = 1): **BRAZIL:** RIO GRANDE DO SUL: *Bento Gonçalves* (MCP 5117).

Oxyrhopus erdisii (n = 7): **PERU:** Unknown locality (FMNH 40068), CUSCO: *Macchu Picchu* (MCZ

8829, holotype), *Macchu Picchu Archeological Site* (Unvouchered), URUBAMBA: *Chachabamba* (UTA R-51469), *Chachabamba-Winaywayna* (UTA R-51470), PUNO: *Sandia: Sandia* (UTA R-59045), *Santo Domingo* (FMNH 39370).

Oxyrhopus cf. erdisii (n = 1): **BOLIVIA:** LA PAZ: *Chulumani* (MNKR, without voucher).

Oxyrhopus doliatus (n = 1): **VENEZUELA:** FALCON: Distrito Acosta: *Pauji* (MCZ 49031, Holotype of *O. venezuelanus*).

Oxyrhopus guibei (n = 1): **BRAZIL:** BAHIA: *Correntina* (CHUNB 03655).

Oxyrhopus marcapatae (n = 2): **PERU:** CUSCO: *Macchu Picchu* (MCZ 8831, holotype of *Drepanodon eatonii*, BMNH 1946.1.8.72, holotype of *Oxyrhopus marcapatae*).

Oxyrhopus melanogenys (n = 1): **BRAZIL:** AMAZONAS: *Estação Ecológica Juami-Japurá* (MCP 19495).

Oxyrhopus vanidicus (n = 5): **BRAZIL:** AMAPÁ: *Macapá* (CHFURG 5699). **PERU:** HUANUCO: *Cayumba Valley* (FMNH 5589), LORETO: *Upper Amazon* (FMNH 11194, 11195, 11196).

Oxyrhopus melanogenys orientalis (n = 1): **BRAZIL:** CEARÁ: *Ubajara* (IBSP 77061).

Oxyrhopus petolarius (n = 6): **BRAZIL:** BAHIA: *Elísio Medrado* (MZUSP w/n), *Santa Maria da Vitória* (Photographic voucher), MATO GROSSO: U.H.E. Guaporé, *São Domingos* (MCP 14021, 14022), RIO DE JANEIRO: Sítio 13, Taquara, *Duque de Caxias* (CHFURG 4873, 4874).

Oxyrhopus rhombifer (n = 1): **BRAZIL:** RIO GRANDE DO SUL: *Rio Grande* (CHFURG 5966).

Oxyrhopus trigeminus (n = 1): **BRAZIL:** BAHIA: *Cocos* (CHFURG 51118).

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LG and SR collected specimens in field and wrote manuscript draft, OME-N wrote manuscript draft.

