

A remarkable new species of coralsnake of the *Micrurus hemprichii* species group from the Brazilian Amazon

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Abstract. A new species of elapid snake of the genus *Micrurus* is described herein, from the states of Rondônia and Mato Grosso, in the western Brazilian Amazon. The new species has a single anal plate, a unique characteristic shared with members of the *M. hemprichii* species group. It can be distinguished from the other members of this group by having a parietal reddish band in juveniles (absent in adults) and the absence of brownish or orange-yellow dorsal body bands. In addition, this species is distinguished from *M. hemprichii* by its lower number of body triads, and from *M. ortonii* by its lower numbers of ventrals and subcaudals scales.

Key words. Squamata, Serpentes, Elapidae, Amazon rainforest, colour pattern, external morphology, Neotropical region.

Resumo. Uma nova espécie de serpente elapídea do gênero *Micrurus* é descrita aqui, proveniente dos estados de Rondônia e Mato Grosso, no oeste da Amazônia Brasileira. A nova espécie possui placa anal simples, uma característica unicamente compartilhada entre os membros do grupo de espécies *M. hemprichii*. Ela é diagnosticável dos outros membros desse grupo por possuir banda parietal avermelhada em juvenis (ausente em adultos) e ausência de bandas dorsais corporais amareladas ou laranjas. Além disso, essa espécie distingue-se de *M. hemprichii* pelo menor número de tríades corporais, e de *M. ortonii* pelo menor número de escamas ventrais e subcaudais.

Palavras-chave. Squamata, Serpentes, Elapidae, Floresta Amazônica, padrão de coloração, morfologia externa, Região Neotropical.

Introduction

The genus *Micrurus* WAGLER, 1824 currently comprises 78 species distributed from southeastern United States to Argentina (ROZE 1983, CAMPBELL & LAMAR 2004, SILVA-JR et al. 2016). The members of the *Micrurus hemprichii* species group are distinguished from all other congeners by having a single cloacal plate, which is divided in all other species of *Micrurus*. This species complex also displays a distinct colour pattern, with five to ten triads separated by brownish or orange-yellow bands (ROZE 1996, CAMPBELL & LAMAR 2004).

Traditionally, three subspecies of *Micrurus hemprichii* have been recognized: *M. h. hemprichii* (JAN, 1858) occurring in eastern Colombia, southern Venezuela, the Guianas (Guyana, Suriname, French Guiana), and central and

eastern Amazonian Brazil; *M. h. ortonii* SCHMIDT, 1953 occurring in central Amazonian Colombia, eastern Ecuador, eastern Peru, western Amazonian Brazil, and northern Bolivia; and *M. h. rondonianus* ROZE & SILVA JR, 1990 in the municipality of Porto Velho, in the state of Rondônia, Brazil (ROZE 1996, CAMPBELL & LAMAR 2004). However, SILVA JR (1993) and SILVA JR et al. (2016) recognized only two subspecies (*M. h. hemprichii* and *M. h. ortonii*), considering *M. h. rondonianus* a junior synonym of *M. h. ortonii*. Recently, VALENCIA et al. (2016) elevated *M. hemprichii* and *M. ortonii* to species rank.

We discovered a population of coralsnakes of the genus *Micrurus* along southern Rondônia and northern Mato Grosso, in the Brazilian Amazon, sharing a single cloacal plate but differing from *M. hemprichii* and *M. ortonii* in colour pattern and meristic data. Therefore, the aim of

the present study was to describe this population as a new species.

Historical summary

Elaps hemprichii JAN, 1858 was described from two syntypes, one from Colombia, housed in the Museo Civico di Storia Naturale di Milano, and one from an unknown locality housed in the Naturhistorisches Museum Wien. Subsequently, BOULENGER (1896) used the combination *Elaps hemprichii* and stated its distribution in Suriname, Peru, and Colombia, realizing that specimens studied by GÜNTHER (1858) as *Elaps lemniscatus* belonged to this species. AMARAL (1924) transferred South American *Elaps* species to the genus *Micrurus* WAGLER 1824. The following year, AMARAL (1925) created the new combination *M. hemprichii*. SCHMIDT (1936), following AMARAL's arrangement, expanded the species distribution for the Guianas, Ecuador, and Brazil (in the state of Pará), and highlighted the presence of a whole anal plate. SCHMIDT (1953) provided new data for *M. hemprichii*, redefining its type locality to "Vicinity of Bartica, British Guiana", under argument that 100 years after the JAN's original description no other specimen from Colombia was found, and therefore it would be plausible to regard the statement of Colombian origin as in error. SCHMIDT (1953) also described a new subspecies: *M. hemprichii ortonii*, based on a male specimen (MCZ 12423) collected from Pebas, Peru housed in the Museum of Comparative Zoology, Harvard University, and 10 paratypes (three males and six females from Peru and Ecuador, and one single female from Pará, Brazil). This author also reported one specimen studied by BOULENGER (1896) from Serrania de Mosetenes, extending the species distribution to Bolivia. The new subspecies was distinguished from its typical form by a higher number of ventrals and lower number of triads. Thus, the nominal species changed to *M. h. hemprichii*, restricted to the Guianas. ROZE (1954) expanded the *M. h. hemprichii* distribution to Venezuela and, in the following year, stated that the type locality of this species (Colombia, cf. JAN, 1858) may be correct (ROZE, 1955). ROZE (1967) maintains his position regarding the *M. h. hemprichii* type locality, citing it as "Colombia". PETERS & OREJAS-MIRANDA (1970) recognized the validity of the two subspecies, citing the occurrence of the nominal subspecies for eastern Colombia, Venezuela, and the Guianas, and *M. h. ortonii* for Amazonian slopes of Colombia, Ecuador, Peru, and Pará in, Brazil. HOGE & ROMANO (1971, 1979) expanded the distribution of *M. h. hemprichii* to Brazil, from two specimens collected in the states of Pará and Amazonas, they invalidated the record from SCHMIDT (1953) for *M. h. ortonii* in Pará, and reported on a specimen of the same taxon, *M. h. ortonii*, from Tefé, Amazonas, Brazil. CUNHA & NASCIMENTO (1973) cited three additional specimens of *M. h. hemprichii* collected in eastern Pará. ROZE (1982) provided a taxonomic and biological summary of New World Elapidae, but ignored the reports by HOGE & ROMANO (1971, 1979) and CUNHA &

NASCIMENTO (1973). VANZOLINI (1986) reported *M. hemprichii* (without a subspecific designation) from the state of Rondônia, Brazilian southwestern Amazon, but without mentioning vouchered specimens. ROZE & SILVA JR (1990) described a new species, *Micrurus rondonianus*, from a large series of specimens collected from the Hydroelectric Power Plant of Samuel, in the state of Rondônia. This new species is considered closely related to *M. hemprichii*, differing solely by the absence of white rings on the dorsal portion of the body (ROZE & SILVA JR 1990). Subsequently, SILVA-JR (1993), considered *M. rondonianus* as a junior synonym for *M. h. ortonii*, a decision apparently ignored by ROZE (1994, 1996), who allocates this taxon to a subspecific level (*M. h. rondonianus*). HARVEY et al. (2003) questioned the occurrence of *M. hemprichii* (without subspecific allocation) in Bolivia, since the recording by SCHMIDT (1953) for that country was performed without examining BOULENGER's (1896) specimen and, in more than 50 years after SCHMIDT's publication, no additional *M. hemprichii* specimens were found in Bolivia. CAMPBELL & LAMAR (2004) follow ROZE (1994), recognizing *M. h. hemprichii*, *M. h. ortonii* and *M. h. rondonianus* as valid taxa, and continue to report the occurrence of *M. hemprichii* (as *M. h. ortonii*) in Bolivia. However, WALLACH et al. (2014) consider *M. h. ortonii* as a junior synonym for *M. hemprichii*, without further comments. Conversely, SILVA-JR et al. (2016) and SILVA-JR (1993) recognized two subspecies (*M. h. hemprichii* and *M. h. ortonii*) after synonymizing *M. h. rondonianus* with *M. h. ortonii*. VALENCIA et al. (2016) elevated *Micrurus ortonii* to full species status based on preliminary phylogenetic analyses by FEITOSA et al. (2010). Here we follow the proposal by VALENCIA et al. (2016) and recognize *M. hemprichii* and *M. ortonii* (including *M. h. rondonianus*) as full species.

Materials and methods

All specimens evaluated herein are listed in the Appendix. Institutional abbreviations follow SABA-J-PÉREZ (2016): Herpetological Collection Alphonse Richard Hoge at the Instituto Butantan (IBSP), São Paulo, São Paulo; Herpetological Collection of Universidade de Brasília (CHUNB), Brasília, Distrito Federal; Herpetological Collection of Universidade Federal do Mato Grosso (UFMT), Cuiabá, Mato Grosso; except the Herpetological Collection of Universidade Federal do Acre (UFAC), Rio Branco, Acre; the Herpetological Collection of the Federal University of Mato Grosso (ABAM), Sinop, state of Mato Grosso; and the Herpetological Collection of Universidade Federal do Acre (UFACF), Cruzeiro do Sul, Acre.

Specimen measurements were taken with dial callipers to the nearest 0.1 mm, except for snout-vent length (SVL), caudal length (CL), and total length (TL), which were measured to the nearest 1.0 mm with a flexible ruler. Head scale terminology follows ROZE (1996) and SILVA JR & SITES (1999). Morphological descriptions and scale counts follow DOWLING (1951) and SILVA JR & SITES (1999). Considering

the absence of data available for the sexual maturation of *Micrurus* sp. n., the same values as for *M. hemprichii* (sensu lato) were assumed, considering its morphological similarities and putative close phylogenetic relationship. Thus, males and females were considered sexually mature when the SVL was greater than 328 mm and 439 mm, respectively (COETI et al. 2016). Colour patterns were described from live specimens and photographs of live specimens. Sex was determined by a longitudinal incision at the base of the tail to check for the presence/absence of hemipenis.

Statistical analyses

An ANOVA (analysis of variance) was performed to test mean differences in meristic variables (ventrals, subcaudals and triads) among *M. hemprichii*, *M. ortoni* and *M. sp. n.* Assumptions concerning homogeneity of variance and residue normality were tested by LEVENE's and SHAPIRO-WILK's tests, respectively. In cases where characters showed insufficient variation to justify these assumptions, the non-parametric KRUSKAL-WALLIS test was carried out. Alpha was set as < 0.05 and all statistical tests were performed using the R software (R Core Team, 2015).

Nomenclatural Acts

The electronic edition of this article conforms to the requirements of the amended International Code of Zoological Nomenclature, and hence the new names contained herein are available under that Code from the electronic edition of this article. This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The LSID (Life Science Identifier) for this publication is: urn:lsid:zoobank.org:pub:22EE275E-1A6A-4350-BC6F-11840352A2CB. The electronic edition of this work was published in a journal with an ISSN, has been archived, and is available from the following digital repositories: www.salamandra-journal.com.

Results

Statistically significant morphological differences were observed between *Micrurus* sp. n. and both *M. hemprichii* and *M. ortoni* in all meristic variables: ventrals ($F=23.41$; $p<0.001$), subcaudals ($F=30.32$; $p<0.001$) and triads ($H=31.182$; $p<0.001$) (Fig. 1).

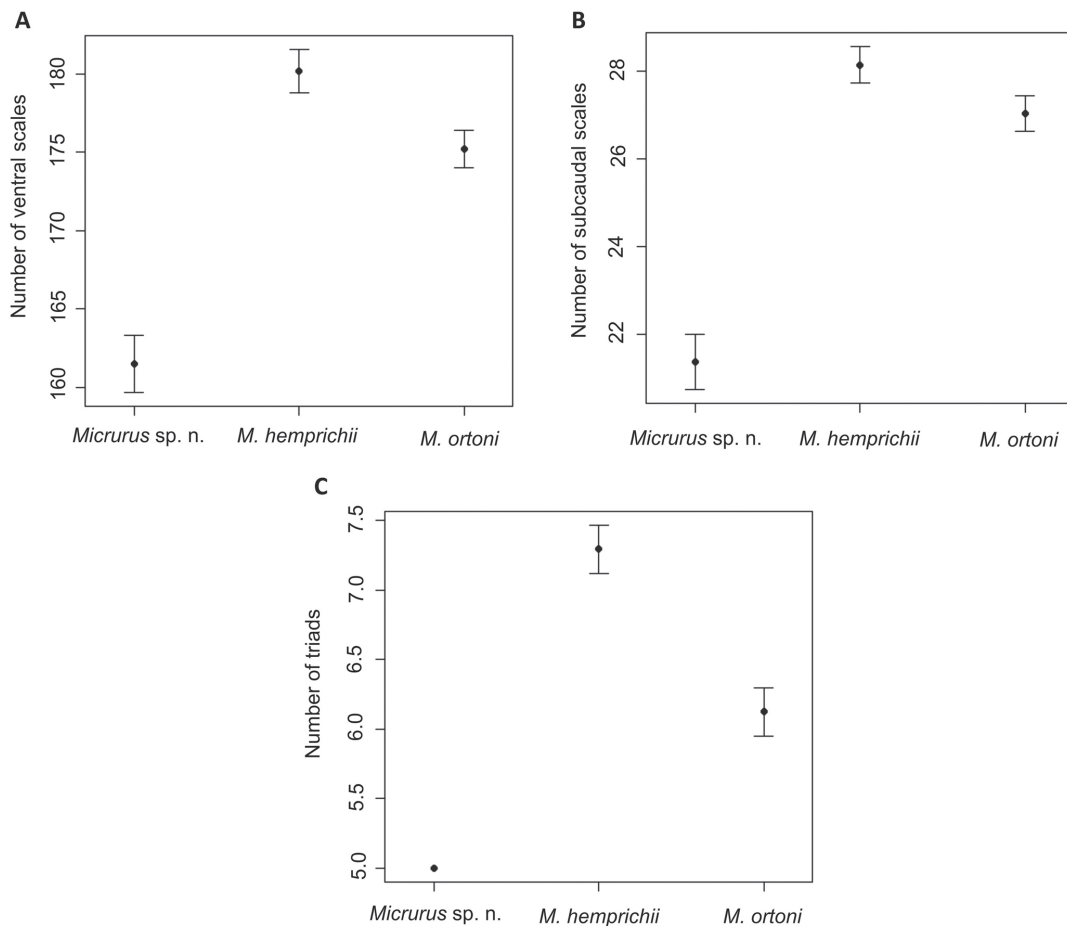


Figure 1. Meristic comparisons between members of the *Micrurus hemprichii* group: ventrals (A), subcaudals (B), and triads (C).

***Micrurus boicora* sp. n.**
(Figs 2–5, Table 1)

ZooBank: LSID: urn:lsid:zoobank.org:pub:22EE275E-1A6A-4350-BC6F-11840352A2CB

Micrurus hemprichii nec (Jan, 1858) – BERNARDE & ABE, 2006

Micrurus hemprichii nec (Jan, 1858) – TURCI & BERNARDE, 2008

Micrurus sp. nov. – BERNARDE et al. 2012

Holotype: IBSP 77.773, a subadult male from Rondon II Hydroelectric Power Plant, Municipality of Pimenta Bueno, State of Rondônia, Brazil (11°57'S, 60°41'W; 325 m above sea level), collected by MIQUÉIAS FERRÃO DA SILVA JR and ANGELE MARTINS DA SILVA on 23 December 2007 (Figs 2 and 3).

Paratypes (N=7): All from Brazil: one adult male (IBSP 89.474), two subadult females (IBSP 89.475, 77.774), and one juvenile female (IBSP 89.473), with the same data as the holotype; one subadult male (IBSP 76.565), collected on 07 November 2001 by PAULO SÉRGIO BERNARDE at Jaburi Farm, Municipality of Espigão do Oeste, State of Rondônia, (11°38'S; 60°43'W; 315 m above sea level; severely damaged at both ends due to the fire at the Butantan Institute); one adult male (IBSP 77.772; also severely damaged at both ends), collected on 03 February 2006 by LUIZ CAR-

LOS BATISTA TURCI at the property of the School Família Agrícola Padre Ezequiel Ramim, Municipality of Cacoal, State of Rondônia (11°28'S, 61°19'W; 200 m above sea level); one adult male (ABAM 1549) collected on 13 October 2012 by DOMINGOS DE JESUS RODRIGUES at São Nicolau Farm, Municipality of Cotriguaçu, State of Mato Grosso (9°49'S, 58°15'W; 273 m above sea level).

Diagnosis and comparisons: *Micrurus boicora* can be distinguished from all congeners by the following combination of characters: cloacal plate single; narrow parietal reddish band in juveniles present (absent in adults); body triads 5; brownish or orange-yellow dorsal body bands absent; white body rings equidistantly arranged, more than 11 ventral scales apart; red gular region; with red spots on belly triads; ventrals 155–166; subcaudals 19–23.

Micrurus boicora is distinguished from all congeners, except those from the *Micrurus hemprichii* group, by presenting a single cloacal plate. It is distinguished from *M. hemprichii* by its lower number of body triads (5 vs. 6–10). *Micrurus boicora* differs from *M. ortonii* by its lower number of subcaudals (19–23 vs. 24–34) and ventrals (155–168 vs. 172–193), and triads (5 vs. 5–7). In addition, *M. boicora* presents more ventrals between the white rings (> 11 vs. < 8, in *M. hemprichii* and *M. ortonii*). Unlike *M. hemprichii* and *M. ortonii*, *M. boicora* displays red colour ven-



Figure 2. *Micrurus boicora* sp. n., preserved holotype (IBSP 77.773); body dorsum (A) and venter (B).

Table 1. Ventrals, subcaudals and triads in *Micrurus boicora*, *M. hemprichii* and *M. ortonii*. Data from ROZE (1996) and this study (*); males (M), females (F), specimens examined (N), means (X), standard deviation (SD) and mode (MO); the SD and MO are presented only for our data. Ranges in number of triads include grouped males and females.

Species	N		Ventrals		Subcaudals		N. Triads
	M	F	M	F	M	F	
<i>M. boicora</i> sp. n. *	5	3	154–164	165–168	20–24	19–20	5
N=8			X=158.6	X=166.3	X=21.8	X=19.5	MO=5
			SD=4.1	SD=1.52	SD=1.6	SD=2	
<i>M. hemprichii</i>	16	6	157–181	160–182	26–29	22–28	6–10
N=22			X=173.6	X=178	X=27.7	X=24.3	
<i>M. hemprichii</i> *	26	9	161–191	166–184	26–32	24–32	6–9
N=35			X=181	X=178.3	X=28.7	X=26.8	MO=7
			SD=8.2	SD=7.2	SD=1.7	SD=3.4	
<i>M. ortonii</i>	33	20	173–193	174–185	24–32	21–28	5–7
N=53			X=180	X=180.7	X=28.5	X=25.1	
<i>M. ortonii</i> *	15	15	167–180	166–188	25–30	24–32	5–7
N=30			X=174.2	X=175.9	X=27.2	X=26.5	MO=6
			SD=4	SD=7	SD=1.5	SD=2.3	

trally among the triads (vs. brownish or orange-yellow as in these species), on mental and labial areas (vs. brownish or orange-yellow in *M. hemprichii* and *M. ortonii*), and has single red band on the tail, but no red on its neck or body dorsum. The body dorsum is black and with slender white

rings (black with slender white rings and brownish or orange-yellow body bands in *M. hemprichii* and *M. ortonii*).

Description of the holotype: A subadult male; SVL 279 mm; CL 27 mm (9.6% SVL); head length 8.9 mm (3.15% SVL);

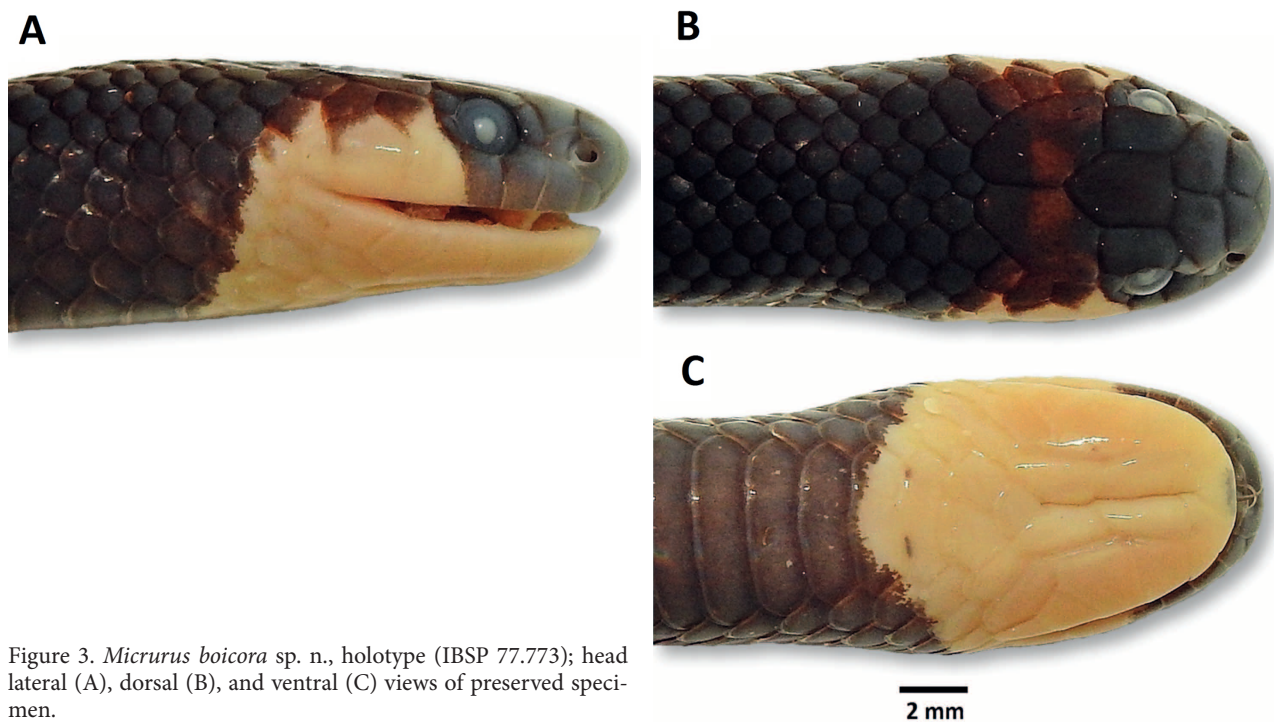


Figure 3. *Micrurus boicora* sp. n., holotype (IBSP 77.773); head lateral (A), dorsal (B), and ventral (C) views of preserved specimen.

head width 6.89 mm; head without cervical constriction; head height, at labial commissure, 4.7 mm; eye round, medium-sized, with a semicircular pupil; eye to mouth distance (1.2 mm) slightly smaller than horizontal diameter of eye (1.7 mm); distance from eye to snout (2.8 mm) about 1.6 ×

eye diameter (1.7 mm); distance between eyes 4 mm; rostral shield wider than high (2.5×1.5 mm), visible from above; internasals smaller than prefrontals, wider than long (1.6×1 mm); prefrontals slightly wider than long (2.2×1.6 mm); frontal pentagonal, longer than wide (2.1×3.1 mm); frontal

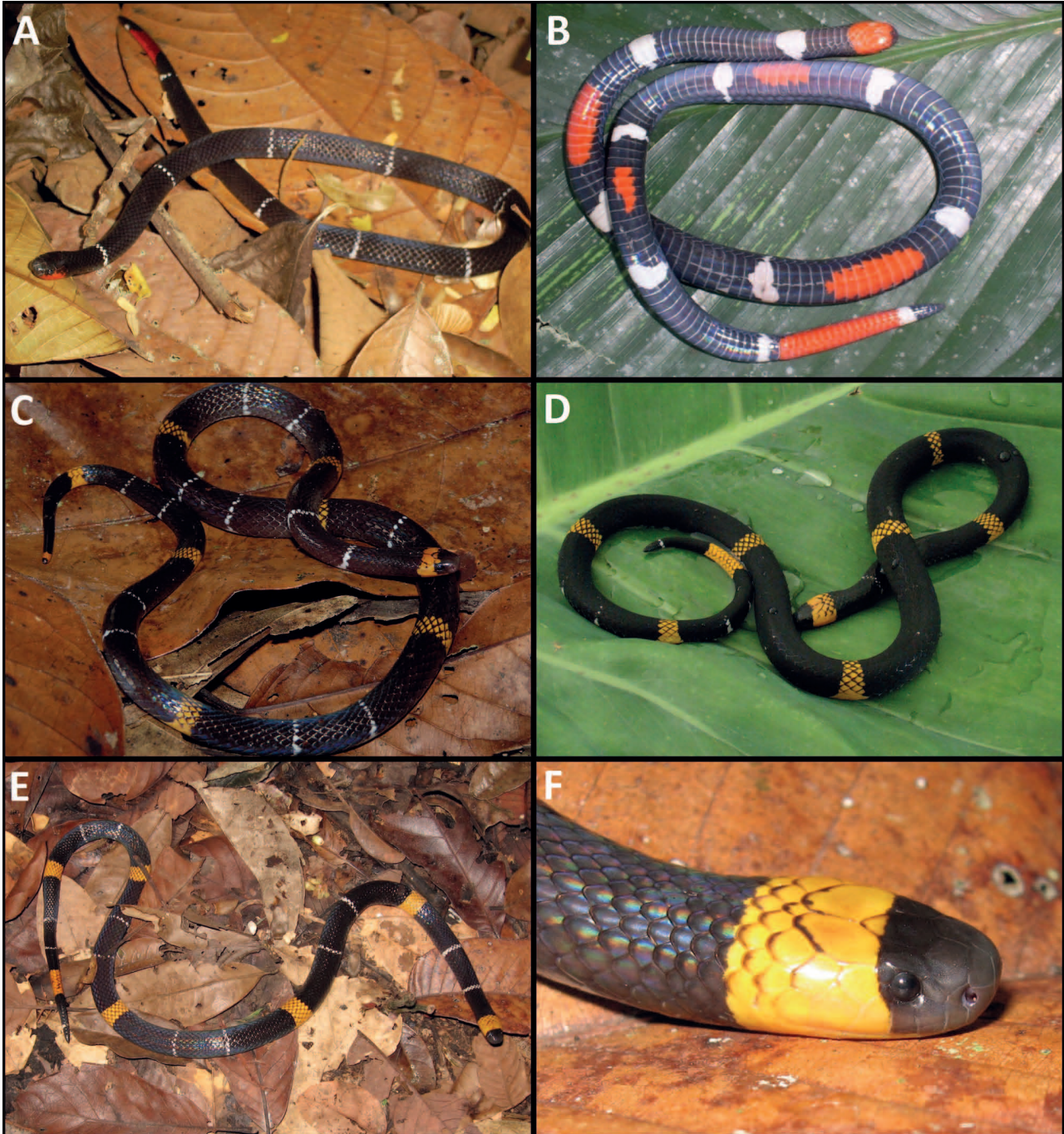


Figure 4. Photographs of live individuals in the *Micrurus hemprichii* group. Body dorsum (A) and venter (B) of *Micrurus boicora* sp. n. (IBSP 77.772, paratype) from the municipality of Cacoal, Rondônia, Brazil; body dorsum (C) of *Micrurus hemprichii* (unvouchered, photographed by M. A. Passos) from the municipality of Itaituba, Pará, Brazil; body dorsum (D) of *Micrurus ortonii* (the “rondonianus” form, unvouchered) from the municipality of Cacoal, Rondônia, Brazil; and body dorsum (E) and head dorsolateral view (F) of *Micrurus ortonii* (UFACF 727) from Resex Riozinho da Liberdade, municipality of Tarauacá, Acre, Brazil.

to snout distance (2.8 mm) $1.1 \times$ frontal length; supraoculars almost rectangular (1.2×2.5 mm); parietals longer than wide (2.55×3.6 mm), smaller than their distance to snout tip (4.9 mm); prenasals larger than postnasals; nasal divided, in contact with first two supralabials; postnasal touching preocular, no loreal shield; distance between nostrils 3.1 mm. Preocular single higher than long, (1.2×0.7); postoculars 2, upper slightly longer than high; temporal shields $1 + 1$, 2nd larger than 1st; supralabials 7, 3rd and 4th contacting eye, 6th largest; infralabials 7, 1st pair contacting each other on posterior border of symphyseal, 1st to 4th contacting primary mental shields, 4th infralabial largest and contacting both pairs of mentals; primary pair of mental shields slightly shorter secondary pair; two prementals between secondary mental shields and first ventral; three rows of gulars between first ventral and last supralabial; dorsals rows 15/15/15, smooth, with no apical pits; ventrals 162; anal plate single; subcaudals 21/21; terminal spine large and pyramidal.

Dorsum of head black, with soft remnants of cream parietal band; 1st to 4th supralabials black, 5th to 7th with cream coloration extending to temporals; dorsum black, with 10 white rings on body and half a dorsal scale in length; tail red band 12 scales in length dorsally, with oval black blotch 7 scales long; immaculate cream infralabials and gular region, except for symphyseal area, presenting small black dots; ventrals black, with cream blotches among the five black and white triads, 10 cream blotches 1.5 to 4 ventrals in length and four big cream blotches 4 to 9 ventrals in length; tail venter with one reddish cream band 16 subcaudals in length, between black cloacal plate and black end of tail.

Coloration in life (from paratype IBSP 77.772). Head dorsum black; supralabials predominantly red, with or without parietal band extension; no nuchal coloured band (orange, yellow, red or brownish); head venter vivid red, including labials, mental and gulars, only excluding black symphyseal plate; dorsum black, with 10 thin white rings, each a half-dorsal scale in length; body venter predominantly black, with white blotches continued from dorsal white rings, and four big red blotches four to nine ventral scales in length, between triads; tail with one big red band between black cloacal plate and posterior white border, before black tail end (Fig. 4).

Variation: In general, all paratypes agree with holotype regarding pholidosis and general colour pattern. The parietal band is conspicuous in the juvenile specimen (IBSP 89.473), poorly visible in half-grown specimens (IBSP 89.475, 77.774, 77.773), and completely absent in the adults (IBSP 77.772, ABAM 1549) (Fig. 5). Ventrals 154–164 (mean=158.6, SD=4.15, n=5) in males, 165–168 (mean=166.3, SD=1.52, n=3) in females; subcaudals 20–24 (mean=21.8, SD=1.64, n=5) in males, 19–23 (mean=20.6, SD=2.08, n=3) in females; SVL 279–360 mm (mean=328, SD=43.09, n=3) in males, 166–341 mm in females (mean=279, SD=98.01, n=3); CL 27–41 (mean=34.3, SD=7.02, n=3) mm in males, 19–35 mm in females (mean=27.6, SD=8.08, n=3); head length 8.8–11.6 mm (mean=10.1, SD=1.4, n=3) in males, 7.49–9.05 mm in females (mean=8.8, SD=1.2, n=3).

Distribution and natural history: *Micrurus boicora* is known from the municipalities of Alto Alegre dos Parecis, Cacoal, Espigão do Oeste, Ji-Paraná and Pimenta Bueno in the state of Rondônia, and Cotriguaçu in the state of

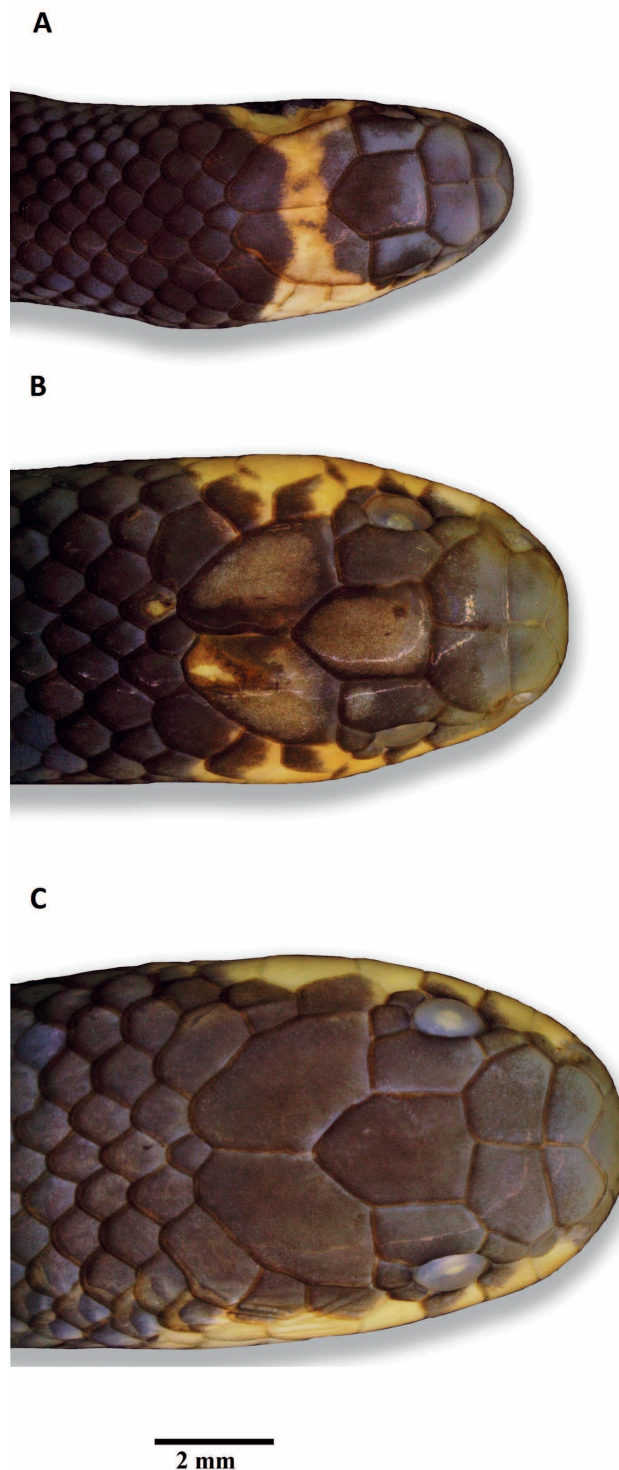


Figure 5. Dorsal view of head of some *Micrurus boicora* sp. n. preserved paratypes, showing variation of the parietal band through ontogeny. (A) IBSP 89.473; (B) IBSP 89.475; (C) ABAM 1549.

Mato Grosso, Brazil (Fig. 6). The paratype (IBSP 77.772) was found foraging on the ground at night, inside a forest fragment. The paratype (IBSP 76.565) (Fig. 4), was caught by a pitfall-trap, also in forest. When placed on the ground, it hid its head under its body and ground leaves, raised and rolled its tail (displaying the large and bright-red ventral blotch), everted its hemipenes, brandished advertisement strikes, tried escape and bit when handled.

Etymology: The specific epithet *boicora* is a Tupi-Guarani name (mbói = snake; corá = coral), employed herein as a noun in apposition alluding to the coral coloration of the new species. Many Amerindians and peasants in Brazil collectively name true coralsnakes and their mimics as “Boicorá”.

Discussion

SILVA-JR (1993) indicated that *M. hemprichii* was poorly understood, as the definition of the species (or subspe-

cies) was based on widely overlapping counts of ventral scales and body triads (confirmed herein), and its geographic range was not well established (a cause for taxonomic confusion, see historical summary). HOGE & ROMANO (1971), for example, were wrong to identify an unnumbered specimen from Tefé, Amazonas, Brazil (recognized by us as IBSP 15.603) as *M. ortonii*, herein re-identified as *M. hemprichii*. SILVA-JR (1993) and ROZE (1994), believed that their own described species, *Micrurus rondonianus*, was a synonym for *M. ortonii*, with no taxonomic recognition or gave it a subspecific status (*M. h. rondonianus*), respectively. The two authors considered this form only a melanic form of *M. h. ortonii*. In fact, other species belonging to the genus *Micrurus* have been described and later synonymized when based on melanic or other extreme polychromatic patterns (SOINI 1974, FEITOSA et al. 2015), making imperative to use and support qualitatively or quantitatively well-established characters for taxa recognition.

CAMPBELL & LAMAR (2004) followed ROZE (1994, 1996) and considered *M. hemprichii*, *M. ortonii* and *M. rondonia-*

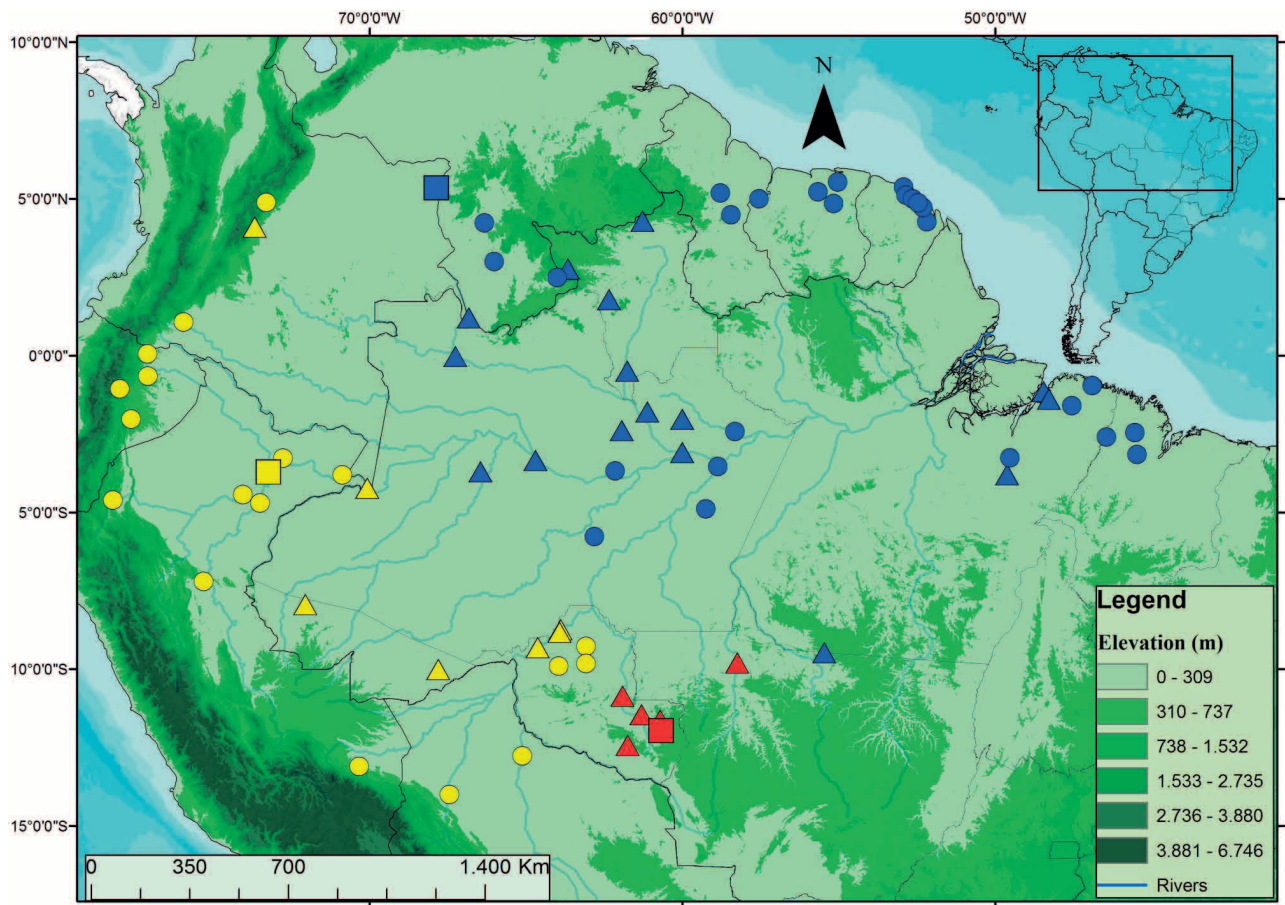


Figure 6. Geographic distribution of the *Micrurus hemprichii* group in South America (inset). The colour legends are as follow: blue (*M. hemprichii*), yellow (*M. ortonii*) and red (*M. boicora* sp. n.). Triangles represent examined specimens, circles represent literature records, and the type localities are marked with squares. The literature records were obtained from ROZE (1996) and CAMPBELL & LAMAR (2004).

nus as valid taxa, but did not offer a sufficient diagnosis. ROZE (1996) presented a key for the subspecies and descriptions, summarizing the available knowledge at the time. The main diagnostics characters used by ROZE (1996) are listed in abridged form in Table 1, compared to the data from the present study. SCHMIDT (1953) expanded the variation in ventrals for female *M. ortonii* (172–186), and mentioned a male *M. hemprichii* with 184 ventrals. HOGE & ROMANO (1971) cited 23 subcaudals for a female *M. ortonii*, identified herein as *M. hemprichii* and with 24 subcaudals. This study agrees with SILVA-JR (1993), in that a great overlap in this traditional diagnostic characters exists, making it difficult to identify this forms.

On the other hand, it is very easy to distinguish *M. boicora* sp. n. from the other species in the *M. hemprichii* group, it is the only species without complete brightly coloured bands on the body dorsum or nuchal/parietal region (except in juveniles), and only a complete red band is present on the tail. Ventrally, *M. boicora* presents red colour blotches, while *M. hemprichii* and *M. ortonii* presents complete orange-yellow or brownish rings on the body. The red rings formerly mentioned by CUNHA & NASCIMENTO (1982) and ROZE (1996) for *M. hemprichii* may have been quoted for the reason that some preserved specimens changed their dark orange-yellow bands into pinkish red ones (MARTINS & OLIVEIRA 1998). In addition, *M. boicora* sp. n. presents significantly different meristic character counts, compared to *M. hemprichii* and *M. ortonii*. Thus, *M. boicora* sp. n. is also promptly distinguished from other species in the *M. hemprichii* group by having fewer ventrals, subcaudals and triads.

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References

- AMARAL, A. (1924): Contribuição à biologia dos ophidios brasileiros (habitat, hábitos e alimentação). – 1a Nota prévia. Coleções de Trabalhos do Instituto Butantan, 2: 177–181.
- AMARAL, A. (1925): Ophidios de Matto Grosso (Contribuição II para o conhecimento dos ophidios do Brasil). Comm. Linhas Telegraph. Estrat. Matto Grosso ao Amazonas. – História Natural Zoológica, 84: 1–29.
- BERNARDE, P. S. & A. S. ABE (2006): A snake community at Espigão do Oeste, Rondônia, Southwestern Amazon, Brazil. – South American Journal of Herpetology, 1: 102–113.
- BERNARDE, P. S., S. ALBUQUERQUE, T. O. BARROS & L. C. B. TURCI (2012): Serpentes do Estado de Rondônia, Brasil. – Biota Neotropica, 12: 1–29.
- BOULENGER, G. A. (1896): Catalogue of the Snakes in the British Museum: (Natural History.): Colubridæ (Opisthoglyphæ and Proteroglyphæ), Amblycephalidæ, and Viperidæ. – Printed by order of the Trustees, London.
- CAMPBELL, J. A. & W. W. LAMAR (2004): The Venomous Reptiles of the Western Hemisphere. – Comstock Publishing Associates, Cornell University Press, Ithaca and London, 870 pp.
- COETI, R. Z., K. M. P. SILVA & S. M. ALMEIDA-SANTOS (2016): Sexual maturity in Amazonian snakes of the genus *Micrurus*: wearing the snake's shoes. – pp. 72–72 in: Internacional Symposium on Coral snakes, 1.
- COSTA, H. C. & R. S. BERNILS (2015): Répteis brasileiros: lista de espécies 2015. – Herpetologia Brasileira, 4: 75–93.
- CUNHA, O. R. & F. P. NASCIMENTO (1973): Ofídios da Amazônia. IV. As cobras corais (gênero *Micrurus*) da região leste do Pará (Ophidia: Elapidae). Nota preliminar. – Publicações Avulsas Museu Paraense Emílio Goeldi, 20: 273–286.
- CUNHA, O. R. & F. P. NASCIMENTO (1982): Ofídios da Amazônia XIV. As espécies de *Micrurus*, *Bothrops*, *Lachesis* e *Crotalus* do sul do Pará oeste do Maranhão, incluindo as de cerrado deste estado. (Ophidia: Elapidae e Viperidae). – Boletim do Museu paraense Emílio Goeldi, 112: 1–58.
- CUNHA, O. R. & F. P. NASCIMENTO (1993): Ofídios da Amazônia. As cobras da região leste do Pará. – Boletim do Museu Paraense Emílio Goeldi, Série Zoologia, 9: 1–191.
- DI-BERNARDO, M., M. BORGES-MARTINS & N. J. SILVA, JR (2007): A new species of coralsnake (*Micrurus*: Elapidae) from southern Brazil. – Zootaxa, 1447: 1–26.
- DOWLING, H. G. (1951): A proposed standard system of counting ventral in snakes. – British Journal of Herpetology, 1: 97–99.
- FEITOSA, D. T., A. L. C. PRUDENTE, N. J. SILVA JR & M. G. PIRES, L. R. S. NASCIMENTO (2011): Análise taxonômica do complexo *Micrurus hemprichii* (Jan, 1858) (Serpentes, Elapidae). – In: IX Congresso Latinoamericano de herpetologia, 2011, Curitiba. IX Congresso Latinoamericano de Herpetologia, 2011.
- FEITOSA, D. T., N. J. SILVA, M. G. PIRES, H. ZAHER, & A. L. C. PRUDENTE (2015): A new species of monadal coral snake of the genus *Micrurus* (Serpentes, Elapidae) from western Amazon. – Zootaxa, 3974: 538–554.
- GÜNTHER, A. (1858): Catalogue of the Colubrine Snakes in the Collection of the British Museum. – Printed by order of the Trustees, London.

- HARVEY, M. B., J. APARICIO & L. GONZALEZ (2003). Revision of the venomous snakes of Bolivia: part 1. The coral snakes (Elapidae: *Micrurus*). – *Annals of Carnegie Museum*, **72**: 1–52.
- HOGUE, A. R. & S. A. ROMANO (1971): *Micrurus hemprichii hemprichii* recorded for Brazil (Serpentes, Elapidae). – *Memórias do Instituto Butantan*, **35**: 107–109.
- HOGUE, A. R. & S. A. R. W. D. L. ROMANO (1979): Sinopse das serpentes peçonhentas do Brasil. – *Memórias do Instituto Butantan*, **42/43**: 373–493.
- HOGUE, A. R. & S. A. R. W. L. ROMANO-HOGUE, “1978/79” (1981): Sinopse das serpentes peçonhentas do Brasil. – *Memórias do Instituto Butantan*, **40/41**: 373–496.
- JAN, G. (1858): Plan d’une iconographie descriptive des ophiidiens et description sommaire de nouvelles espèces des serpents. – *Revue et Magasin de Zoologie*, **10**: 438–449.
- MARTINS, M. & M. E. OLIVEIRA (1998): Natural history of snakes in forests of the Manaus region, central Amazonia, Brazil. – *Herpetological Natural History*, **6**: 78–150.
- PETERS, J. A. & B. OREJAS-MIRANDA (1970): Catalogue of the neotropical squamata: part I snakes. – *United States National Museum Bulletin*, **297**: 1–347.
- ROZE, J. (1954): Nota preliminary sobre los ofidios de la expedición FrancoVenezolana al alto Orinoco. – *Archivos Venezolanos De Medicina Tropical Y Parasitologia Medica*, **2**: 227–237.
- ROZE, J. (1955): Ofidios coleccionados por la expedición Franco-Venezolana al alto Orinoco, 1951 a 1952. – *Boletim Museu Ciências Naturais Caracas*, **1**: 179–195.
- ROZE, J. A. (1983): New World coral snakes (Elapidae): a taxonomic and biological summary. – *Memórias do Instituto Butantan*, **46**: 305–338.
- ROZE, J. A. & N. J. SILVA JR (1990): Coral snakes (Serpentes, Elapidae) from Hydroelectric Power Plant of Samuel, Rondônia, Brazil, with description of a new species. – *Bulletin of the Maryland Herpetological Society*, **26**: 169–176.
- ROZE, J. A. (1994): Notes on taxonomy of venomous coral snakes (Elapidae) of South America. – *Bulletin of the Maryland Herpetological Society*, **30**: 177–185.
- ROZE, J. A. (1996): Coral Snakes of the Americas. Biology, identification, and Venoms. – Krieger Publishing Company, Malabar, 327 pp.
- SABAJ-PÉREZ, M. H. (2016): Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Washington (DC): American Society of Ichthyologists and Herpetologists. Version 6.5. – Available at http://www.asih.org/sites/default/files/documents/symbolic_codes_for_collections_v6.5_2016.pdf
- SCHMIDT, K. P. (1936): Preliminary account of coral snakes of South America. – *Zoological Series of Field Museum of Natural History*, **20**: 189–203.
- SCHMIDT, K. P. (1953): Hemprich’s coral snakes – *Micrurus hemprichi*. – *Fieldiana Zoology*, **34**: 165–170.
- SILVA JR, N. J. (1993): The snakes from Samuel Hydroelectric Power Plant and vicinity, Rondônia, Brazil. – *Herpetological Natural History*, **1**: 37–86.
- SILVA JR, N. J. & J. W. SITES JR (1999): Revision of the *Micrurus frontalis* complex (Serpentes: Elapidae). – *Herpetological Monographs*, **13**: 142–194.
- SILVA JR, N. J. & J. W. SITES JR (2001): Phylogeny of South American triad coral snakes (Elapidae: *Micrurus*) based on molecular characters. – *Herpetologica*, **37**: 1–22.
- SILVA JR, N. J., M. G. PIRES & D. T. FEITOSA (2016): Diversidade das cobras-corais do Brasil. – In: Silva Jr, N. S. (Org.): *As Cobras-Corais do Brasil: Biologia, Taxonomia e Envenenamentos*. 1. ed., PUC Goiás, Goiânia, 369 pp.
- SOINI, P. (1973): Notes on an Upper Amazonian coral snake, *Micrurus putumayensis* Lancini. – *Journal of Herpetology*, **7**: 306–307.
- SOINI, P. (1974): Polychromatism in a population of *Micrurus langsdorffi*. – *Journal of Herpetology*, **8**: 267–269.
- TURCI, L. C. B. & P. S. BERNARDE (2008): Levantamento herpetofaunístico em uma localidade no município de Cacoal, Rondônia, Brasil. – *Biokos*, **22**: 101–108.
- VALENCIA, J. H., K. GARZÓN-TELLO & M. E. BARRAGÁN-PALADINES (2016): Serpientes venenosas del Ecuador: sistemática, taxonomía, historia natural, conservación, envenenamiento y aspectos antropológicos. – Quito, Ecuador, Fundación Herpetológica Gustavo Orcés, Universidad de Texas, Fondo Ambiental Nacional.
- VANZOLINI, P. E. (1986): Levantamento herpetológico da área do Estado de Rondônia sob a influência da rodovia BR 364. – Programa Polonoroeste, Subprograma Ecologia Animal, Relatório de Pesquisa, 50 pp.
- WALLACH, V., K. L. WILLIAMS & J. BOUNDY (2014): Snakes of the world: a catalogue of living and extinct species. – CRC Press.

Appendix

Specimens examined

Micrurus hemprichii: Brazil: Amazonas: Cucui (IBSP 42.620), Juruá (MZUSP 9412), Manaus (IBSP 55205), Presidente Figueiredo (IBSP 43.438, 52.226, 52.857), Tefé: Rio Solimões (IBSP 15063), Mato Grosso: Baixo Rio Cristalino (CHUNB 47130), UFMT 9839, 10235, 10379; Pará: Ananindeua (MZUSP 17346, 17347, 17348), Mosqueiro (IBSP 54151), Rodovia Belém-Brasília km 86 (IBSP 20678), U.H.E. Tucuruí: Rio Tocantins (IBSP 46767, 47038); Roraima: Alto Alegre (Serra dos Surucucus) (MZUSP 8278, 10476), Apiaú (MZUSP 9256, 10914), Cachoeira do Cujubim (MZUSP 6394, 7456, 8069), Caracará (MZUSP 19643–47), Pacaraima (MZUSP 8823, 10370, 10906), Santa Maria do Boaçu (MZUSP 10116).

Micrurus ortonii: Brazil: Acre: Rio Branco (UFAC 090, 195, 361), Tarauacá: Reserva Extrativista Riozinho da Liberdade (UFACF 575, 727), Amazonas: São Gabriel da Cachoeira: Rio Tanaretê (IBSP 33377), Rondônia: Porto Velho (IBSP 52808, 52815, 53154, 53155, 53308, 53344, 53584, MZUSP 5902, 19058–61, 19463, 19703, 19721, 19988, 19990, 20554, 20836). Colômbia: Letícia (IBSP 42699), Villaciencio (MZUSP 6009).