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## THE GENUS *OXYRHOPUS* (SERPENTES: DIPSADIDAE: XENODONTINAE) IN GUYANA: MORPHOLOGY, DISTRIBUTIONS AND COMMENTS ON TAXONOMY

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### ABSTRACT

*Considerable confusion exists regarding taxonomy and distributions of Oxyrhopus in northern South America. Specimens and records of Oxyrhopus from Guyana were examined. Oxyrhopus melanogenys, O. occipitalis and O. petola occur in Guyana. Data on morphology and colouration of these species are presented. Species distributions and characters to distinguish among the species are discussed.*

**KEYWORDS:** *Oxyrhopus formosus*; *Oxyrhopus occipitalis*; *Oxyrhopus melanogenys*; *Oxyrhopus petola*; *Oxyrhopus trigeminus*; Guyana.

### INTRODUCTION

The genus *Oxyrhopus* contains 13 described species in Central and South America, although some of these names may represent more than one species (Bailey, 1970; Hoge & Romano, 1977; Zaher & Caramaschi, 1992). Five described species of *Oxyrhopus* have been reported from the Guiana region of northeastern South America: *O. formosus* (Wied-Neuwied), *O. melanogenys* (Tschudi), *O. occipitalis* (Wagler), *O. petola* (Linnaeus) and *O. trigeminus* Duméril, Bibron and Duméril (Roze, 1966; Bailey,

1970; Moonen *et al.*, 1979; Gasc & Rodrigues, 1980; Abuys, 1985; Chippaux, 1986; Zaher & Caramaschi, 1992; Starace, 1998; Kornacker, 1999; Campbell & Lamar, 2004; Avila-Pires, 2005). Some species of *Oxyrhopus* resemble one another, and identification can be difficult. *Oxyrhopus formosus* and *O. occipitalis* have long been confused, as have *Oxyrhopus melanogenys* and *O. trigeminus*. Species identifications and relationships among species have traditionally been based on colour pattern, although some squamation characters have been used (Bailey, 1970). It has been reported that those species of *Oxyrhopus* with triad

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colour patterns are closely related (Cadle, 1984; Des-sauer *et al.*, 1987). Relationships based on hemipenial morphology were examined by Zaher & Caramaschi (1992). The phylogenetic relationships of *Oxyrhopus* within the Xenodontinae were established by Zaher *et al.* (2009).

The aim of this paper is to confirm which species of *Oxyrhopus* occur in Guyana, to establish characters that distinguish among the species, and to provide data on morphology, colour pattern and distributions.

## METHODS AND MATERIALS

Field-collected specimens and specimens from museum collections were examined. Specimens were measured using a metric ruler, scales were counted, and colour patterns were noted (Bailey, 1970; Hoge & Romano, 1977; Zaher & Caramaschi, 1992). Maxillary tooth formulae were determined from X-rays. Information on specimens from outside Guyana was obtained from published accounts (Roze, 1966; Moonen *et al.*, 1979; Gasc & Rodrigues, 1980; Abuys, 1985; Chippaux, 1986; Zaher & Caramaschi, 1992; Starace, 1998; Kornacker, 1999). Acronyms follow Leviton *et al.* (1985), with the addition of CSBD

– Centre for the Study of Biological Diversity, University of Guyana, Georgetown, Guyana and MAD – collection of M.A. Donnelly.

## RESULTS

Snakes of the genus *Oxyrhopus* in the Guiana Shield region exhibit the following suite of characters: scale rows 19-19-17; dorsal scales smooth with two apical pits; anal single; subcaudals divided; upper labials 8, 4<sup>th</sup> and 5<sup>th</sup> enter orbit; temporals normally 2+3. Meristics of specimens examined are summarised in Table 1. Characters useful for distinguishing among species of *Oxyrhopus* occurring in the Guiana Shield region are in Table 2. Details of each species are presented below.

### *Oxyrhopus occipitalis* (Wagler)

#### Taxonomic history

*Oxyrhopus occipitalis* was originally described from Rio Solimões, Amazonas, Brazil (Hoogmoed & Gruber, 1983). Bailey (1970) synonymised *O. occipitalis* with *O. formosus*, despite his stated belief that

TABLE 1: Ranges of measurements of *Oxyrhopus* adults from Guyana.

	SVL (mm)	Tail length (mm)	Ventrals	Subcaudal pairs	Lower labials (contact shields)	Maxillary Teeth
<i>O. melanogenys</i> M (N = 6)	362-610	106-184	185-190	82-92	10 (6)	7-9 + 2
<i>O. melanogenys</i> F (N = 5)	385-650	100-190	187-197	67-80	8-10 (5-6)	10 + 2
<i>O. occipitalis</i> M (N = 2)	418-444	114-129	173-178	71-73	7-9 (5)	7-8 + 2
<i>O. occipitalis</i> F (N = 1)	442	104	186	66	9-10 (5)	7 + 2
<i>O. petola</i> M (N = 4)	442-798	126-250	204-211	84-101	10 (6)	8-9 + 2
<i>O. petola</i> F (N = 1)	634	132	211	65	10 (6)	8 + 2

TABLE 2: Characters for identification of *Oxyrhopus* in the Guiana Shield. Some information is from Hoge *et al.* (1973), Chippaux (1986), Zaher & Caramaschi (1992) and Starace (1998). *Oxyrhopus formosus* and *O. trigeminus* are included for comparison only.

	<i>O. occipitalis</i>	<i>O. formosus</i>	<i>O. petola</i>	<i>O. melanogenys</i>	<i>O. trigeminus</i>
Ventrals	173-197	173-191	180-214	180-200	174-220
Subcaudals	66-78	66-78	65-114	67-92	53-81
Body Colour Pattern	red with pale orange bands	yellow, orange or red with black bands	red with black bands	triads of black bands	triads of black bands
Snout Colour	yellow	yellow, orange or red	black	black	white with black spots
Top of Head Colour	medium to dark brown	yellow, orange or red	black	black	black
White bands of triads	—	—	—	< black bands	= black bands
Outer black bands of triads	—	—	—	< central band	= central band
Black bands contact ventrals	—	yes	yes	yes	no

the latter consists of a complex of species. *Oxyrhopus occipitalis* was revalidated by Hoge *et al.* (1973).

*Oxyrhopus occipitalis* differs from *O. formosus* by its slender body form (more robust in *O. formosus*), snout yellow and top of head brown (entire head yellow or cream), adults red with very faint body bands (adults with prominent black bands)(Table 2).

Of the two species, only *O. occipitalis* occurs in the Guiana Shield. All of the *Oxyrhopus* from the Guiana region that have been identified as *O. formosus* are actually *O. occipitalis*. We include *O. formosus* in Table 2 only to summarise differences between it and *O. occipitalis*.

Material examined – two males, one female (Appendix).

**Morphology**

Maximum total length in our sample is 573 mm; maximum reported length is 996 mm (Hoge *et al.*, 1973). Lower labials 7-10, five in contact with shields; preoculars 1; postoculars 2. Tail length 21-23% of total length in males, 19% in female. Measurements are in Table 1.

**Colour and Pattern**

Dorsal ground colour red or reddish orange; snout and supralabials yellow; top of head medium to dark brown. A white anterior body band (sometimes obscure), 3-4 dorsal scales in width, approximately 2 cm behind the head. Faint, pale orange body bands with very narrow dark borders; width of pale orange bands equal to the length of 2-4 dorsal scales. Bands are usually symmetrical, but in one specimen there is a half-band, on one side only, between otherwise symmetrical bands. Bands on body 15-17, on tail 5-6. Underside of head yellowish orange. Venter white; dorsal pigment barely touches the edges of some ventrals. Underside of tail banded orange and white, corresponding to dorsal pale orange bands and red ground respectively (Fig. 1A-C).

There is considerable ontogenetic change in colour pattern. In most cases bands are prominent in juveniles but become inconspicuous in adults (Martins & Oliveira, 1999). However, a juvenile with the typical adult pattern of inconspicuous bands has been reported from southern Venezuela (C.L. Barrio-Amorós, pers. comm.). Bands are often more visible



FIGURE 1: *Oxyrhopus occipitalis* and *O. melanogenys* from Guyana: A. Dorsolateral view of *O. occipitalis* (IRSNB 17913) in life (photo by PJRK), B. Ventral view of *O. occipitalis* (IRSNB 17913) in life (photo by PJRK), C. Dorsolateral view of *O. occipitalis* (SMNS 12111) in life (photo by RE), D. Dorsolateral view of *O. melanogenys* (CSBD HR 700) in life (photo by D.B. Means).

in preservative, less conspicuous on living specimens. Photographs are in Starace (1998 [as *O. formosus*]), Martins & Oliveira (1999 [as *O. formosus*]) and Campbell & Lamar (2004).

### Distribution in the Guiana Shield

Because *Oxyrhopus occipitalis* has been confused with *O. formosus*, reports of the latter species in the Guiana Shield region must be discounted. There are no confirmed records of *O. formosus* in the Guiana Shield region. *Oxyrhopus occipitalis* has been reported from Amazonas, Brazil (Jorge da Silva & Sites, 1995), Amapá, Brazil (Avila-Pires, 2005 [as *O. formosus*]), Amazonas, Venezuela (McDiarmid & Paolillo, 1988 [as *O. formosus*]), Bolívar, Venezuela (Mattei & Barrio, 1999 [as *O. formosus*]), Surinam (Avila-Pires, 2005 [as *O. formosus*]) and French Guiana (Gasc & Rodrigues, 1980; Chippaux, 1986; Starace, 1998 [as *O. formosus*]).

This paper reports the first records of *O. occipitalis* from Guyana. Specimens were collected in forest; habitat description is in Ernst *et al.* (2005) and Kok

& Kalamandeen (2008). Distribution in Guyana is mapped in Fig. 2.

### *Oxyrhopus melanogenys* (Tschudi)

#### Taxonomic history

*Oxyrhopus melanogenys* was originally described from the southwestern Amazon region. This species has been confused with the similar-appearing *O. trigeminus*. *Oxyrhopus melanogenys* can be distinguished from *O. trigeminus* by its entirely black head (snout white with black spots in *O. trigeminus*), by the outer black bands of the triads narrower than the central black band (all three black bands equal) and by the white bands of triads narrower than the black bands (equal to the black bands)(Table 2).

Historical reports of *O. trigeminus* in Guyana are based on two specimens (BMNH 1990.19 and 1990.20) from “Demerara” (= Georgetown, Guyana) donated by Captain E. Sabine between 1818 and 1824. However, the “Demerara” locality must be regarded as highly dubious, because numerous specimens donated by Sabine to BMNH, purportedly from Demerara, are really from other localities (Underwood, 1993; C. McCarthy, pers. comm.). Donnelly *et al.* (2005) reported a specimen of *Oxyrhopus trigeminus* from Iwokrama in central Guyana, but the specimen was re-identified as *O. melanogenys* by RDM and AL. Lancini (1979) and Kornacker (1999) mentioned *O. trigeminus* from Venezuela (photograph in Kornacker, 1999), but Zaher & Caramaschi (1992) demonstrated that these are really *O. melanogenys*. All other known specimens of *O. trigeminus* are from south of the Amazon River (Zaher & Caramaschi, 1992).

Consequently, we exclude *O. trigeminus* from the fauna of Guyana and the Guiana Shield. Any reports of *O. trigeminus* from the region are actually of *O. melanogenys*. We include *O. trigeminus* in Table 2 only to point out differences between it and *O. melanogenys*.

A taxon identified as *Oxyrhopus* aff. *melanogenys* has been reported from the Guiana Shield (Zaher & Caramaschi, 1992; Starace, 1998). There are no significant morphological differences between *Oxyrhopus melanogenys* and *O. aff. melanogenys*. The two taxa differ solely in the degree of fusion of anterior triads, a character that we feel insufficient to distinguish between species. We therefore consider *O. aff. melanogenys* to be *O. melanogenys*.

Material examined – Six males, five females and one juvenile (Appendix).

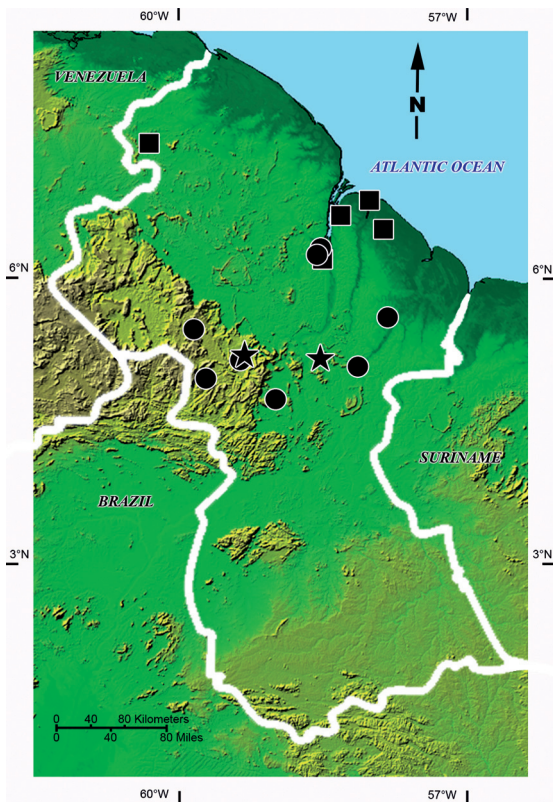


FIGURE 2: Distribution of *Oxyrhopus* in Guyana. Stars = *O. occipitalis*; circles = *O. melanogenys*; squares = *O. petola*. Locations are from Donnelly *et al.* (2005), Means & Kalamandeen (2007), MacCulloch & Lathrop (2009) and the Appendix.

## Morphology

Maximum total length in our sample is 810 mm; maximum reported length is 930 mm (Starace, 1998). Lower labials 10; six in contact with shields. In AMNH 152279 and 152280 the uppermost posterior temporal on the left side is fused with the adjacent posterior scale to produce an elongate scale, equal in length to the parietal; temporals on the right side are normal. IRSNB 17940 has a similar scale fusion on both sides of the head. Measurements of adults are in Table 1. The single juvenile measures 183 mm SVL, tail 49 mm, with 190 ventrals and 82 subcaudal pairs. The tail of the juvenile is 21% of its total length, vs. 23-27% in adult males and 20-22% in adult females.

## Colour and Pattern

*Oxyrhopus melanogenys* has a triad colour pattern (a triad is a repeating series of bands, black-white-black-white-black, separated by red or orange interspaces) (Figs. 1D, 3). In all but one *O. melanogenys* examined (n = 10) the body bands anterior to the triads are symmetrical (nuchal red/orange, black, white, black, red/orange, then triads). In CSBD HR700 some of the body bands anterior to the triads are asymmetrical. In all other specimens, symmetry breaks down in the first triad; the anterior white band of this triad is symmetrical, but the posterior is not. In many individuals all subsequent triads, anterior to the vent region, are asymmetrical. The vent is in the central black band of a triad; this is the first symmetrical triad in all but two snakes; in these two individuals (AMNH 140898, MAD 1368) the triad anterior to the triad that straddles the vent is also symmetrical. In three specimens, AMNH 8094, AMNH 98211 and MAD 1368, triads become symmetrical just posterior to the midpoint between snout and vent, then become asymmetrical again, then once again symmetrical at the vent triad or the triad anterior to it. Triads anterior to vent 15.5-20.5; triads on the tail are difficult to count because tails become very dark, with triads indicated by only a few light flecks (Fig. 3). In IRSNB 17941 and CSBD HR700, the anterior colour pattern consists of white body bands on a dark background, with triads detectable only posteriorly (2.5 anterior to vent in IRSNB 17941, 4.5 in CSBD HR700), when red interspaces become visible laterally. In AMNH 8094, AMNH 98211, MAD 1368 and ROM 39439, the nuchal band is complete and symmetrical, broader laterally than middorsally. In AMNH 140898, 152279 and 152280 the nuchal band and the next interspace are present laterally

but incomplete dorsally. In AMNH 98211, AMNH 152279, AMNH 152280 and ROM 39439, the interspaces between the anteriormost triads do not extend up to the middorsal line. In IRSNB 17912 and IRSNB 17941 the nuchal band is incomplete, only barely distinguishable laterally. In IRSNB 17912 the next interspace is present, but red bands are then absent until slightly posterior to the midpoint between snout and vent. In IRSNB 17941 the next red interspace is absent, red bands are absent except at the very end of the body where two red bands are barely distinguishable laterally. The width of the interspaces between triads is variable, even within the same individual; in some cases they are equal to the outer black triad bands and in others they are wider, equal to the central black bands. In most specimens, dark pigment is present on outer edges of ventrals anteriorly, extending further onto ventrals posteriorly, often extending across ventrals that are immediately anterior to vent. In AMNH 8094 and AMNH 140898 the dark bands touch only the outer edges of ventrals.

In general, larger, presumably older, individuals have less prominent markings than do smaller, younger specimens. Partial melanism was reported by Starace (1998), who noted that the nuchal band is always present in partially melanistic individuals; similar melanism was observed in central French Guiana by PJRK (unpublished data).

Because of its triad colour pattern, *Oxyrhopus melanogenys* is considered a coral snake mimic. A summary of this mimicry is in Campbell & Lamar (2004). Photographs are in Zaher & Caramaschi (1992), Starace (1998), Kornacker (1999 [as *O. trigeminus*]), Campbell & Lamar (2004) and MacCulloch & Lathrop (2009).

## Distribution in the Guiana Shield

Zaher & Caramaschi (1992) map the distribution of *Oxyrhopus melanogenys*. Additional locations in the Guiana Shield, other than Guyana, are in Starace (1998) and Gorzula & Señaris (1999). *Oxyrhopus melanogenys* is a forest dweller; habitat description is in Donnelly *et al.* (2005) and Kok & Kalamandeen (2008). Distribution in Guyana is mapped in Fig. 2.

## *Oxyrhopus petola* (Linnaeus)

### Taxonomic history

*Oxyrhopus petola* has a very large range, occurring from Mexico to Bolivia. Several subspecies have

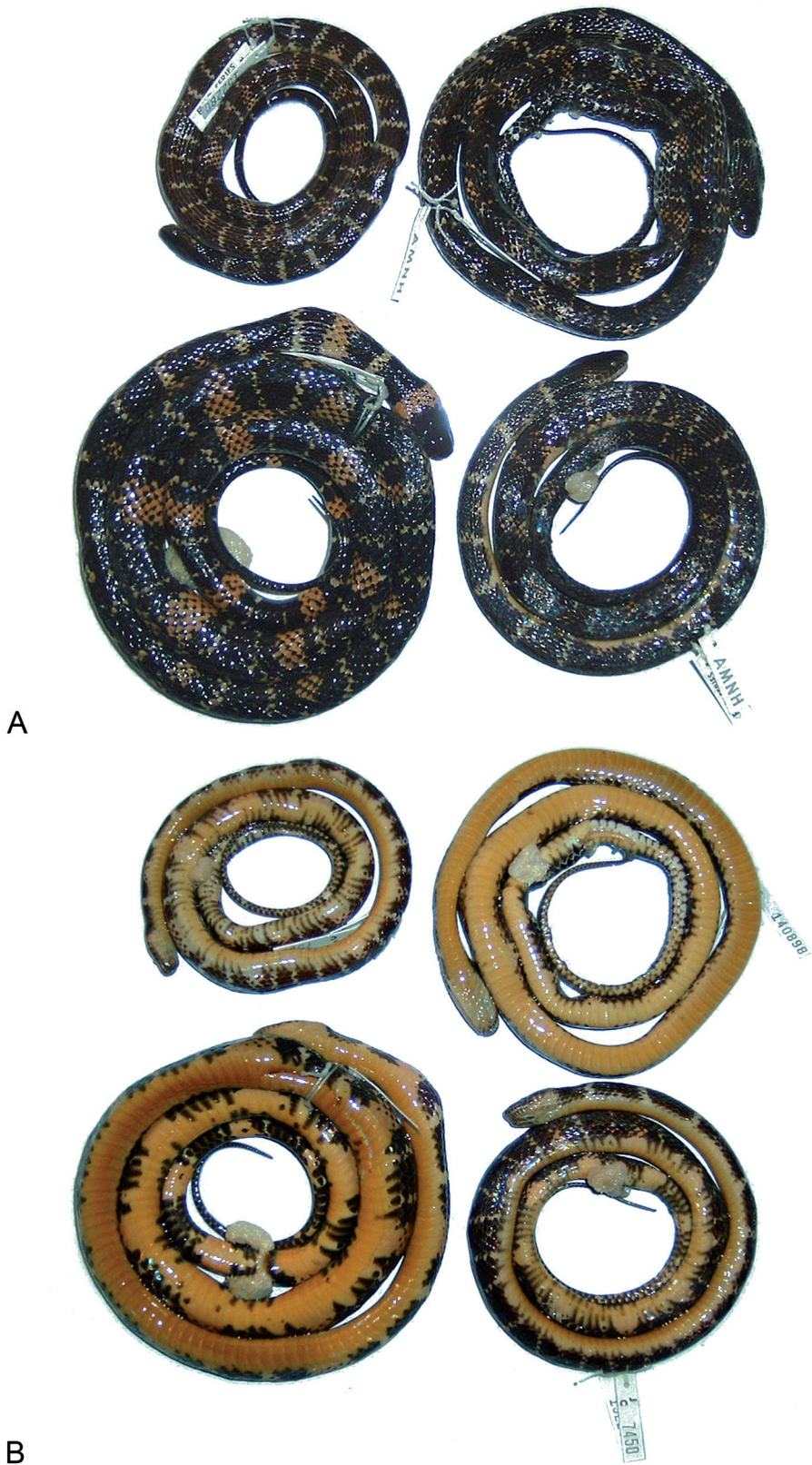


FIGURE 3: Preserved *Oxyrhopus melanogenys* from Guyana: A. Dorsal view, B. Ventral view. Top left AMNH 152280; top right AMNH 140898; lower left ROM 39439; lower right AMNH 152279 (photos by AL).

been described, usually based on colour pattern (Bailey, 1970). Chippaux (1986) expressed doubts about the criteria used to define the subspecies, stating that *O. petola* might be a highly variable taxon, or a complex of species.

Material examined – four males, one female, one juvenile (Appendix).

### Morphology

Maximum total length in our sample is 1048 mm, maximum reported length is 1100 mm (Moonen *et al.*, 1979). Lower labials 10, six in contact with shields; preocular 1; postoculars 2. Measurements of adults are in Table 1. The juvenile measures 196 mm SVL, tail 60 mm, ventrals 214, subcaudal pairs 95. Relative tail length in 22-24% in males, 17% in the female, 24% in the juvenile.

### Colour and Pattern

Terminology used to describe the colour pattern of *Oxyrhopus petola* has been inconsistent. Beebe (1946) and Abuys (1985) describe the pattern as red bands on a black ground; Roze (1966), Chippaux (1986) and Starace (1998) describe the pattern as alternating black and red bands; Bailey (1970) and Kornacker (1999) describe the species as having black bands with red interspaces. We follow the latter in the interest of consistency within the genus *Oxyrhopus*, in which the arrangement of black bands is often diagnostic.

Relative widths of bands and interspaces are variable. Bailey (1970) stated that in *Oxyrhopus petola* from northern South America "...[black] bands [are] approximately equal in length, separated by interspaces about one scale wide". In specimens from French Guiana and Venezuela the interspaces are approximately equal in size to the black bands (Roze, 1966; Chippaux, 1986; Starace, 1998; Kornacker, 1999). Abuys (1985) showed a photo of an individual with very narrow and asymmetrical interspaces, and stated that interspace width is variable in specimens from Surinam. The bands are wider than the interspaces in an individual from Surinam photographed by Moonen *et al.* (1979). In some individuals very narrow white bands are present between the black bands and the red interspaces (Beebe, 1946; Kornacker, 1999). Melanism was reported by Abuys (1985) and Chippaux (1986). Esqueda *et al.* (2007) reported partial albinism in a specimen from Venezuela.

In specimens from Guyana the interspaces are red or reddish brown and the black bands are approximately 2X the width of the interspaces (bands 3-6 scales in width, interspaces 1-3 scales). Bands and interspaces may be asymmetrical. Venter whitish, immaculate, with dorsal black bands contacting the outer ends of the ventrals (Fig. 4).

### Distribution in the Guiana Shield

*Oxyrhopus petola* is found throughout the Guiana Shield, except Delta Amacuro, Venezuela (Roze, 1966; Bailey, 1970; Chippaux, 1986; Starace, 1998; Kornacker, 1999; Avila-Pires, 2005; Donnelly *et al.*,



FIGURE 4: Preserved *Oxyrhopus petola* from Guyana: A. Dorsal view of CSBD HR 89, B. Ventral view of CSBD HR 89 (photos by MK).

2005). More detailed distribution records have been reported by several authors, from habitats ranging from forest to savannah to towns (Beebe, 1946; Roze, 1966; Moonen *et al.*, 1979; Abuys, 1985; Starace, 1998; Gorzula & Señaris, 1999). Fig. 2 shows distribution in Guyana.

### Remarks

Although some recent work has contributed to the understanding of the systematics and distributions of *Oxyrhopus*, species identifications can still be problematic. Some widespread taxa, such as *O. formosus*, *O. melanogenys* and *O. petola*, may contain more than one species. Further study using morphological and molecular methods will be necessary to determine this.

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### RESUMO

*Existe uma considerável confusão sobre a taxonomia e distribuições de Oxyrhopus no norte da América do Sul. Os espécimes e registros de Oxyrhopus da Guyana foram examinados. Oxyrhopus melanogenys, O. occipitalis e*

*O. petola ocorre na Guyana. Os dados de morfologia e coloração destas espécies são apresentados. As distribuições destas espécies e caracteres para distinguir essas espécies são discutidos.*

**PALAVRAS-CHAVE:** *Oxyrhopus formosus; Oxyrhopus occipitalis; Oxyrhopus melanogenys; Oxyrhopus petola; Oxyrhopus trigeminus; Guyana.*

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## APPENDIX

### Specimens examined

*Oxyrhopus formosus*: BRAZIL, Bahia, BMNH 73.8.25.3; COLOMBIA, Santa Rita, N. of Medellin, BMNH 98.10.27.5-6.

*Oxyrhopus melanogenys*: GUYANA, Kalacoon, 6°24'N, 58°39'W, AMNH 8094; Kartabo, 6°21'N, 58°41'W, AMNH 98211; Dubulay Ranch, 5°41'N, 57°52'W, AMNH 140898; Berbice River, 5°05'N, 58°14'W, AMNH 152279, 152280; Iwokrama, 4°45'N, 59°01'W, CSBD HR 251; Wokomung, 4°56'N, 59°55'W, CSBD HR 700; Kaieteur, 5°11'N, 59°28'W, IRSNB 17912; Kaieteur, 5°08'N, 59°25'W, IRSNB 17940, 17941; Iwokrama, 4°45'N, 59°01'W, MAD 1386; Ayanganna, 5°26'N, 60°00'W, ROM 39439.

*Oxyrhopus occipitalis*: GUYANA, Kaieteur, 5°11'N, 59°28'W, IRSNB 17913, ROM 42995; Mabura Hill, 5°09'N, 58°42'W, SMNS 12111.

*Oxyrhopus petola*: GUYANA, Maripa, 6°46'N, 58°25'W, AMNH 18164; Lama Creek, 6°33'N, 57°57'W, AMNH 36099, 36524; Georgetown, 6°48'N, 58°10'W, AMNH 36140; Kartabo, 6°21'N, 58°41'W, AMNH 98210; Baramita, 7°22'N, 60°29'W, CSBD HR 89.