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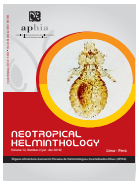

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

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ABSTRACT

Maracaya Díaz-Ungría, 1964 is an obscure genus of amphisbaenian nematodes. In this study was described a rattlesnake *Crotalus durissus* Linnaeus, 1758 parasitized by two specimens of *Maracaya belemensis* Adamson & Baccam, 1988 in Southeast Brazil. The present study records a new host and extends the geographical distribution for this nematode.

Keywords: *Crotalus durissus* – Ectopic infection – Nematode – *Maracaya belemensis* – Reptile disease

RESUMO

Maracaya Díaz-Ungría, 1964 es un género poco conocido de nematodo en anfibios. En este estudio se describe una serpiente de cascabel *Crotalus durissus* Linnaeus, 1758 parasitada por dos especímenes de *Maracaya belemensis* Adamson & Baccam, 1988 en el sureste de Brasil. El presente estudio registra un nuevo hospedero y amplía la distribución geográfica de este nematodo.

Palabras clave: *Crotalus durissus* – Enfermedad de reptiles – Infección ectópica – Nematodo – *Maracaya belemensis*

INTRODUCTION

Maracaya Díaz-Ungría, 1964 includes small nematodes parasites of amphisbaenian and lizard intestines. Three species are described in amphisbaenians in Brazil and one species in chameleon in Congo (Miranda, 1924; Diaz-Ungria, 1963; Adamson & Baccam, 1988; Bouamer & Morand, 2006; Ávila & Silva, 2010). The aim of this study is to report the first occurrence of *Maracaya belemensis* Adamson & Baccam, 1988 parasitizing a tropical rattlesnake *Crotalus durissus* Linnaeus, 1758.

MATERIAL AND METHODS

An adult female of *C. durissus* from the municipality of Pouso Alegre (22°13'48"S 45°56'11"W), Minas Gerais State, Brazil, was euthanatized using 2.5 mL of pentobarbital sodium 30 mg·mL^{-1} intracoelomically. The necropsy was performed and each organ was individually surveyed for parasites under a stereoscopic microscope. The nematodes found were fixed in hot 10% formaldehyde and clarified with Amann's Lactophenol solution. The parasites were photographed with a digital camera (AxioCam ERc 5s, Carl Zeiss) coupled to the microscope and morphological measurements performed through the photos by AxioVision 4.8 software (Carl Zeiss Vision). All measurements are in micrometer (μm) unless otherwise stated. Drawings were made on CorelDRAW X8 software using the photos as a background for a more accurate drawing. The species identification was based on Adamson & Baccam (1988) and Bouamer & Morand (2006). The helminths were deposited under the number CHIBB 8479 in the Helminthological Collection of the Institute of Biosciences (CHIBB), São Paulo State University (UNESP), municipality of Botucatu, São Paulo State, Brazil. This study was approved by the Ethics Committee in Animal Experimentation of the Federal University of Minas Gerais under the protocol number 176/2012.

RESULTS

The necropsy revealed a couple of *Maracaya belemensis* in copulation inside the aorta artery in the rattlesnake's heart. The specimens presented whitish color, rhabditoid esophagus, isthmus well-differentiated, evidenced bulb. Corpus and isthmus well-demarcated. Excretory pore prominent, at level of isthmus in male and level of bulb in female. Cuticle striated transversely from base of lip to posterior end. Tail straight, conical and thin. Male: oral opening surrounded by three lips well-chitinized. Spicules similar, equal, simple and slightly arcuate. Gubernaculum short than spicules and tapering gradually. Four pairs of precloacal papillae, and three pairs postcloacal. Female: anterior end without lips well-developed. Monodelphic, vulva after middle of body, well-developed vagina musculature. Eggs large, thin-shelled and larvae (Fig. 1). The measures are presented in Table 1.

DISCUSSION

Maracaya includes four valid species: *Maracaya graciai* Diaz-Ungria, 1963 in *Amphisbaena alba* Linnaeus, 1758 from Venezuela; *Maracaya pusilla* (Miranda, 1924) in *Amphisbaena* sp. from Brazil (Bahia State); *M. belemensis* in *A. alba* from Brazil (Pará State); and *Maracaya africana* Bouamer & Morand, 2006 in *Chamaeleo inturensis* Schmidt, 1919 from Congo.

The morphological analysis of the nematodes found in the present study permitted us to conclude that the species involved in the parasitism was *M. belemensis*. This conclusion is supported especially the shape of the spicules and gubernaculum. The male specimen differs from *M. africana* by present lips more developed and anal region smaller than the rest of the body; from *M. pusilla* by present non-bifid spicules; and from *M. graciai* by gubernaculum shape. In relation to the female, it was considered as an adult because presented larval eggs. However, the specimen presented different lips than male. Based on the drawings of Adamson & Baccam (1988), the

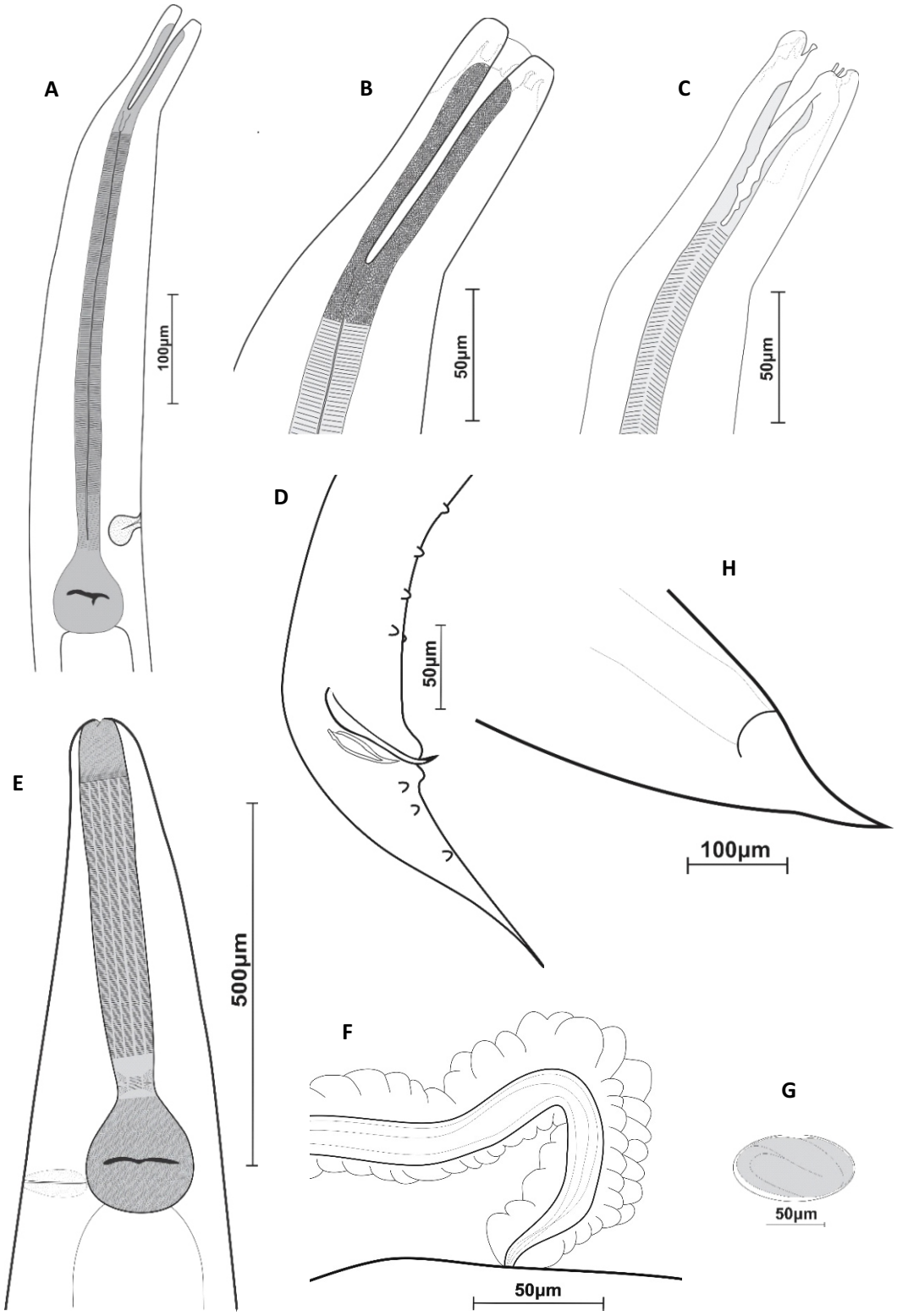

Figure 1. *Maracaya belemensis* from *Crotalus durissus*. Male: (A) esophagus, (B,C) anterior end, (D) spicule, gubernaculum and tail. Female: (E) anterior end, (F) muscular vagina, (G) larval egg, (H) tail.

Table 1. Morphometrical data of *Maracaya* spp.

Species	*Maracaya belemensis*		*Maracaya belemensis*			*Maracaya graciai*		*Maracaya pusilla*		*Maracaya africana*	
Reference	Present study		Adamson & Baccam, 1988			Diaz-Ungria, 1963		Miranda, 1924		Bouamer & Morand, 2006	
Host	*Crotalus durissus*		*Amphisbaena alba*			*Amphisbaena alba*		*Amphisbaena* sp.		*Chamaeleo inturensis*	
Origin	Brazil, Minas Gerais		Brazil, Pará			Venezuela		Brazil, Bahia		Congo	
Sex (n)	Male (n = 1)	Female (n = 1)	Male (n= 19)	Female (n = 19)	Female L4 (n = 3)	Male	Female	Male	Female	Male (n = 10)[A]	Female (n =10)[B]
Body Length (mm)	2	3.85	2.41	2.49	1.62	1.46	2.0	2.0	2.6	2.48	2.38
Width	120.26	367.47	119 (127.1)	151 (151.14)	74	130	160	240	290	88	81
Esophagus Length											
muscular	515.11	670.43				450	360	500	490	503	522
Width muscular						60	60	56	56		
Length Isthmus						65	70				
Width Isthmus	15.85	69.58									
Length bulb						105	75		92	83	73
Width bulb	58.72	170.9	85 (87.4)	102 (100.5)	57	85	80		92	62	58
Excretory pore	515.17	641.43				565	460	500	560	313	344
Lips											
Length	80	-				75	75	71	71		
Width	48.1	-									

Table 1 (continued)

Table 1 (continued)

Species	*Maracaya belemensis*		*Maracaya belemensis*			*Maracaya graciai*		*Maracaya pusilla*		*Maracaya africana* Bouamer & Morand, 2006	
Reference	Present study		Adamson & Baccam, 1988			Diaz-Ungria, 1963		Miranda, 1924			
Host	*Crotalus durissus*		*Amphisbaena alba*			*Amphisbaena alba*		*Amphisbaena* sp.		*Chamaeleo inturensis*	
Origin	Brazil, Minas Gerais		Brazil, Pará			Venezuela		Brazil, Bahia		Congo	
Sex (n)	Male (n = 1)	Female (n = 1)	Male (n = 19)	Female (n = 19)	Female L4 (n = 3)	Male	Female	Male	Female	Male (n =10)[A]	Female (n =10)[B]
Nerv ring	265.23	268.69	302 (302.16)	321 (326.18)	200	-	-	280		182	213
Tail	165.97	177.6	149 (147.1)	121 (129.9)	113	115	125-160	100	170	116	138
Spicules	90.76; 91.62	-	99 (98.4)	-		60		110	-	66	
Gubernaculum	50.22	-	44 (47.3)	-	-	35		49	-	38	
Vulva	-	2.44 mm[C]	-	-	-	-	700[D]				1.59 mm[C]
Eggs					-						
Length	-	105.22 (n=10)	-	176-202 (190.8) (n=10)	-	-	-	-	-		89
Width	-	67.92 (n=10)	-	85-123 (109.11) (n=10)	-	-	-	-	-		53

A - Holotype measures, B - Allotype measures, C - From anterior end, D - From posterior end.

female lips reported in the present study were similar to lips of immature females of the fourth larval stage of *M. belemensis*, but without cuticular expansion.

Maracaya spp. cycles are not known. However, in all records of *Maracaya*, the specimens were found parasitizing the host intestines (Miranda, 1924; Diaz-Ungria, 1963; Adamson & Baccam, 1988; Bouamer & Morand, 2006; Ávila & Silva, 2010). In the present study, the nematodes were found in the host´s aorta. We have no idea how this nematode couple reaches this site of infection, but ectopic infection with nematode species have been reported (De Ruiter *et al*., 1962; Tanabe *et al*., 1990; Oliveira-Júnior *et al*., 2004). We believe that the occurrence of *Maracaya belemensis* in snakes is accidental, a fact that could be related to the unusual labial characteristics of the female, suggesting an incomplete development, and the location of the specimens in the host.

Crotalus durissus is a snake widely distributed in Brazil, being found in all the states of the country (Costa & Bérnils, 2018), and presenting a discontinuous distribution in Central and South Americas (Uetz & Hallermann, 2018). Although widely distributed, this species inhabits preferentially open habitats, as Cerrado biome, and deforested areas where shade occurrence and vegetation cover are similar to those in Cerrado (Tozetti & Martins, 2008). Thus, habitat modification, deforestation, and habitat fragmentation have favored the expansion of this species in Brazil (Bastos *et al*., 2005; Duarte & Menezes, 2013). The diet of *C. durissus* is composed of small rodents and marsupials, and occasionally of birds and lizards. *Ameiva ameiva* Linnaeus, 1958 is the main lizard species preyed on by *C. durissus* (Sant'anna & Abe, 2007; Hoyos & Almeida-Santos, 2016; Santos & Germano, 1996), without records of predation of the genus *Amphisbaena* in the literature.

Among amphisbaenids, *A. alba* is the one with the largest distribution in South America (Vanzolini, 2002) and presents a generalist diet. In Cerrado, this species primarily eats ants, beetles, grasshoppers, crickets, insect larvae, scorpions, termites, and other invertebrates (Colli & Zamboni, 1999). Based on the literature, it is probable that *Maracaya* spp. are specific from amphisbaenians in South America (Ávila & Silva, 2010).

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