Erythrolamprus miliaris (Reptilia, Serpentes, Dipsadidae) (Linnaeus, 1758) and *Bothrops jararacussu* (Reptilia, Serpentes, Viperidae) (Lacerda, 1884) parasitized by *Ophidascaris trichuriformis* Vaz, 1935 (Nematoda, Rhabditida, Ascarididae) in a disturbed area of the State of São Paulo, Brazil

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Brazil is a megadiverse country that harbors 760 formally described reptile species, of which 386 are snakes (Bérnils and Costa, 2012). Of the total number of reptiles that occur in Brazil, 30% occur in the state of São Paulo (southeastern Brazil), 42 of them being snakes. Thirty-two species of reptiles are included in the List of Threatened Species of the State of São Paulo (Zaher *et al.,* 2011). *Erythrolamprus miliaris* (Linnaeus, 1758) is an aglyph dipsadid snake, that has a wide distribution (Dixon, 1983). It inhabits forested and open areas, as well as rural areas (Martins and Oliveira, 1998; Kunz and Ghizoni-Jr., 2008; Nogueira *et al.,* 2010). Furthermore, this species has semi-aquatic habits, and can be active during the day and night (Sazima and Manzini, 1995; Yanosky *et al.,* 1996; Martins *et al.,* 2008). *Erythrolamprus miliaris* has a generalized diet, preying on anurans (including tadpoles), fish, lizards, and insects (Achaval and Olmos, 1997; Carreira, 2002; Toledo *et al.,* 2007). Despite the wide distribution of this water snake, information about the ecological relationships between internal parasites and this species are few, scarce, and succinct (Vicente *et al.,* 1993). Recent studies of Mati *et al.* (2015), reported 11 species of nematodes from *E. miliaris* for the Neotropical region. Of those species of nematodes, six occur in southeastern Brazil, belonging to five different families. In this study we describe the occurrence and the parasitic relationship of one helminth species in individuals of *E. miliaris* from the Atlantic forest of the State of São Paulo, Brazil. We also report for the first time the occurrence of this nematode in *Bothrops jararacussu,* representing the first record of this parasite in a viper.

Fieldwork was undertaken in the proximity of the municipality of Sete Barras, at the Etá Farm (24.30264 S, 047.96106 W), State of São Paulo, southeastern Brazil. During fieldwork carried out between April 2013 and March 2014 (under licenses from SISBIO nos. 23225-1, 16593-1, 21526-1 and 37820), snakes were captured using pitfall traps. They were transported to the laboratory and killed following humane protocols (Meyer, 2015). Afterwards, individuals were fixed in formalin 10% and preserved in alcohol 70%.

A total of 68 *E. miliaris* were sampled, examined and went through necropsy, and their gastrointestinal tracts and body cavities were surveyed under a stereomicroscope to assess the presence of helminths. Snakes were found in a wide variety of microhabitats, from temporary ponds to river margins and grasslands in open and forested habitats. Nematodes were preserved in 100% ethanol and were later cleared with lactophenol. They were identified under a Leica M205A stereomicroscope using the taxonomical keys of Vicente *et al.* (1993a), Vicente *et al.* (1993b), and according to Mascarenhas (2013), Wolf (2014), and Freitas (1968). Descriptive statistics was obtained with Quantitative parasitology software, version 3.0 (Rózsa *et al.,* 2000). Prevalence, mean abundance and mean

Table 1: Nematode species reported infecting *Erythrolamprus miliaris* in Brazil.

Nematode	Location in the host	Locality	Reference
Acanthorhabdias acanthorhabdias	Lungs	Rio de janeiro	Fernandes & Souza, 1929
Pseudocapillaria (Pseudocapillaria) amarali	Small intestine	Rio de janeiro	Freitas & Lent, 1934
Aplectana travassosi	Small intestine	Rio de janeiro	Baker, 1980
Ophidascaris trichuriformis	Stomach	São Paulo	Freitas, 1968
Strongyloides ophidae	Intestine	Minas Gerais	Mati *et al.,* 2015
Paracapillaria (Ophidiocapillaria) cesarpintoi	Intestine	Minas Gerais	Mati *et al.,* 2015

intensity of infection were determined. Three specimens of helminths were prepared for Scanning Electron Microscopy (SEM). Micrographs were taken using a QUANTA 250 (FEI Company, Holanda) equipment of the Laboratory of Cellular Biology, of the Instituto Butantan, São Paulo, Brazil.

Of the 63 specimens of *E. miliaris* obtained, 28 revealed nematode parasites, identified as *Ophidascaris trichuriformis* Vaz, 1935 (Fig. 1), between the stomach and the proximal small intestine. Of the 28 infected *E. miliaris* (prevalence = 44.4%), 18 were females and 10 were males. The mean abundance of parasites was 9.05 ± 3.88, and the mean intensity of infection was 20.38 ± 10.08.

The genus *Ophidascaris* belongs to the family Ascarididae and consists of ophidian roundworms that are generally white to yellow in color, with three strong "lips" and interlabia. These nematodes develop in the stomach region were they attach and therefore can cause severe damage to the host in hyper-infestation (Baylis, 1921). *Ophidascaris trichuriformis,* found in this study, is a medium to large nematode, with the anterior portion of the body being thinner and posterior portion wider. This species has wide lips in all stages (Fig. 1A and 1D), a tail with a small conical cuticular protrusion in the larvae, and 30 to 40 caudal buds or papillae in the adults (Fig. 1B and 1C) (Vaz, 1935).

In the evaluation of the stomach content of *E. miliaris* specimens, 52 anurans were found, being the main food source of this species. Furthermore, a specimen of *Bothrops jararacussu* Lacerda, 1884, that feeds mainly on mice, but occasionally also captures anurans, lizards and other small mammals (Sazima, 1991; Andrade and Abe, 1999; Martins and Sazima, 2008), was also infected with *O. trichuriformes*. In this study other individuals of *Bothrops jararacussu* were found preying upon anurans, nonetheless, nematodes were not found in these snakes. Nematodes of the family Ascaridae are known for their migratory habits within their host (generally liver, heart, lungs, and finally guts) (Sprent, 1954). The genus *Ophidascaris*

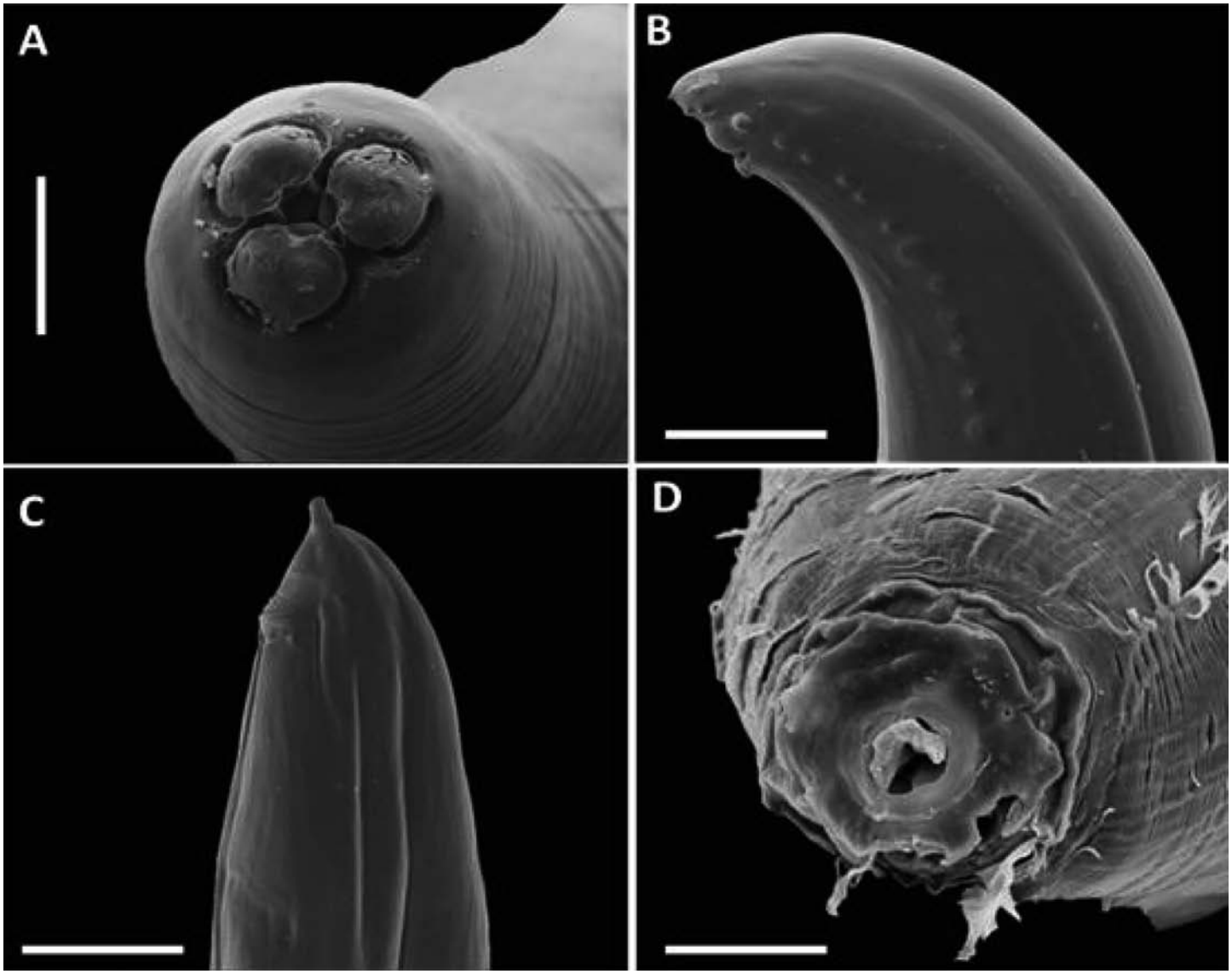

Figure 1: Scanning electron microscopy of *Ophidascaris trichuriformis* A. Cephalic region of female; B. Posterior region of female; C. Posterior region of larva; D. Cephalic region of larva with host tissue. Scale bars: A, B: 300 μm; C: 10 μm, D: 30 μm.

has these migratory habits as well, and species of this genus use amphibian and mammalian species as intermediate hosts (Sprent, 1953). In the locality where *E. miliaris* was found, frogs and mice may be the main intermediate host for *O. trichuriformes*. Moreover, *Bothrops jararacussu* is a new host record of this nematode, ours being the first record of an infected viper. *Ophidascaris trichuriformes* has been recorded parasitizing dipsadid snakes such as *Xenodon merremii, X. severus, X. neuwiedii, X. rabdocephalus, X. dorbigny, Leptodeira annulata, Thamnodynastes pallidus, Erythrolamprus poecilogyrus* and the boid *Boa constrictor* in South America (Sprent, 1988). Additionally, *O. trichuriformes* causes lesions around the area of fixation. These lesions can develop in necrosis, fibrosis, and eosinophilic gastritis (Vaz, 1935; Freitas 1968). The prevalence of this parasite in this study was relatively high (44.4%) which could indicate that this parasite can be a bioindicator of population health, meaning that the snakes captured around artificial water bodies and disturbed areas (farming and crops) are more likely to be infected by these nematodes due to the optimal conditions for the parasite's transmission. Finally, *E. miliaris* has been recorded as host of other nematode species in Brazil (Table 1); however, none of these parasites were found in our study area. We recommend additional studies prioritizing the ecological relationships and epidemiology of this host-parasite association in dipsadids and vipers.

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