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Helminths of the lizard *Colobosauroides cearensis* (Squamata, Gymnophthalmidae) in an area of Caatinga, Northeastern Brazil

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Abstract. Lizards are hosts to a variety of parasites, but in South America only 15% of lizard species have been studied for helminths. In the present study, the component community of helminths associated with the gymnophthalmid *Colobosauroides cearensis* in an area of Caatinga (7°22'46.08" S, 38°38'47.87"W) is reported. We examined 91 specimens from the Brazilian state of Ceará, and five taxa of helminths were recovered: four Nematoda (*Parapharyngodon largitor, Spauligodon* sp., *Physaloptera* sp. and *Oswaldocruzia* sp.) and one Cestoda (*Oochoristica* sp.). *Parapharyngodon largitor* was the most prevalent species (61%), and presented the highest mean abundance of infection (1.60 ± 0.18). Lizard body size influenced the richness and abundance of helminths, while infection parameters were not related to lizard sex.

Keywords. Parasites, nematodes, cestodes, neotropical.

Parasitological studies are necessary to understand host–parasite interactions and the role of parasite species within ecosystems (Bittencourt and Rocha, 2003; Hudson, 2005). Although the richness of parasites is greater than that of hosts, they are much less studied, which means a considerable portion of the biodiversity is unknown (Poulin and Morand, 2000; Rocha et al., 2016).

Lizards are host to a variety of parasites, including helminths (Anderson, 2000; Ávila and Silva, 2010; Ávila et al., 2011; 2012). Despite the recent increase in parasitological studies in lizards (Anjos et al., 2005; Ávila and Silva, 2010; Brito et al., 2014a; Bezerra et al., 2015), the knowledge of helminths remains scarce. For example, South America harbors more than 1120 lizard species (Uetz and Hosek, 2016), but only 15% of these species have had their associated helminths studied (Ávila and Silva, 2010).

The new world lizard family Gymnophthalmidae includes 235 species (Uetz and Hosek, 2016), and less than 10% of these species have been studied regarding their parasitological aspects (Ávila and Silva, 2010). Information about parasitism in Gymnophthalmidae is punctual and usually appears in descriptions or records of new occurrences of parasites (Bursey et al., 2005; Ávila et al., 2011; Albuquerque et al., 2012). In Brazil, data on the parasitic fauna of gymnophthalmids is concentrated in studies of the Amazon (Baker and Bain, 1981; Bursey et al., 2005; Albuquerque et al., 2012; Ávila and Silva, 2013), Cerrado (Ávila et al., 2011) and Restinga (Almeida et al., 2009). In the Caatinga domain, the knowledge related to helminth communities associated with gymnophthalmids remains little explored (Brito et al., 2014a).

Colobosauroides cearensis is a semifossorial and diurnal lizard with relictual distribution in the Caatinga. To the best of our knowledge, there are no records of helminths being associated with this lizard, mainly due to its fossorial habits (Cunha et al., 1991). Herein, we present data on the helminth community composition of the

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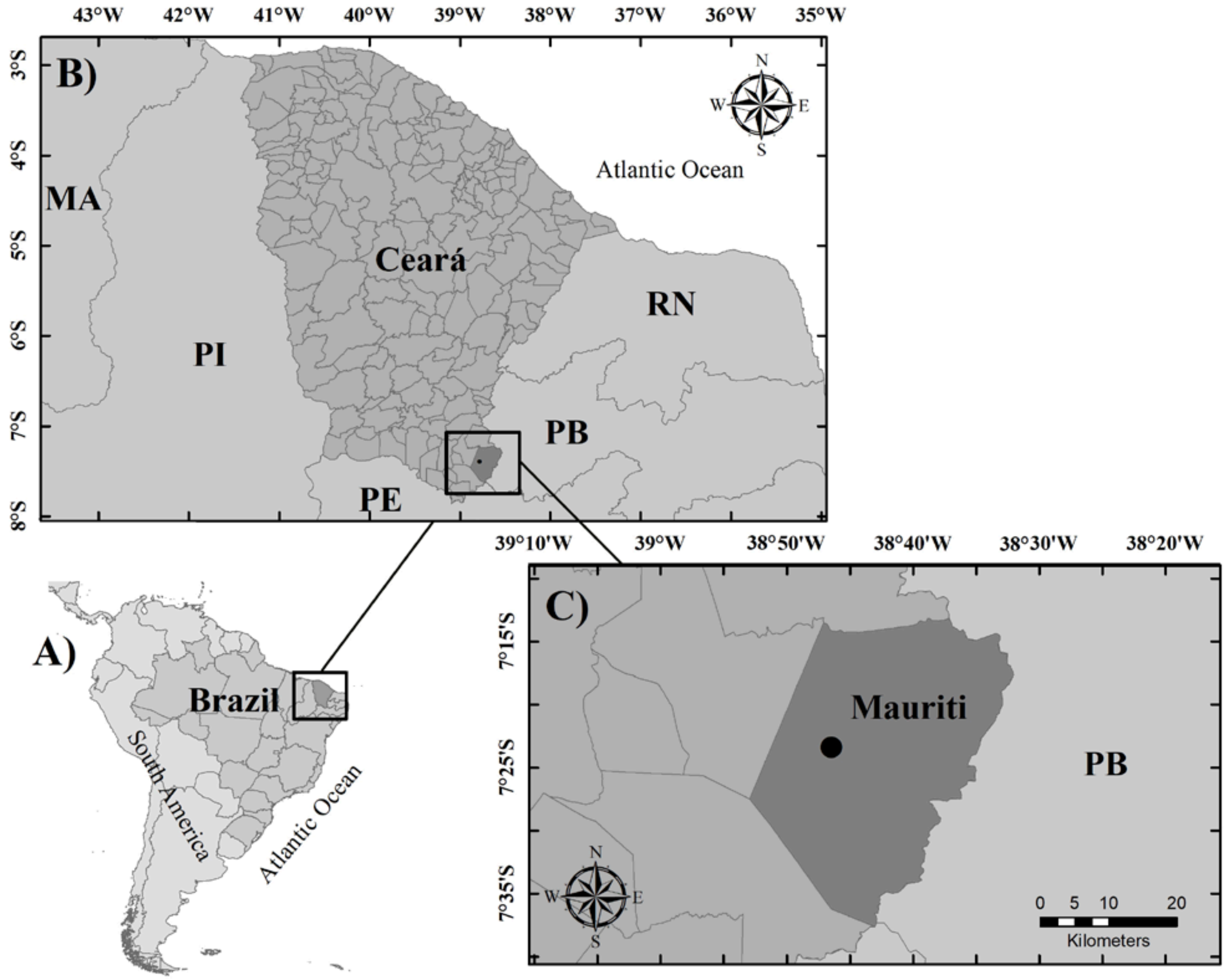

Fig. 1. Collecting site in State of Ceará (A) in Northeast Brazil; Mauriti municipality (B); Study area (C): São Miguel district.

lizard *Colobosauroides cearensis* in an area of Caatinga in the Northeast Region of Brazil.

We conducted this study in the municipality of Mauriti (7°22'46.08"S, 38°38'47.87"W), state of Ceará, Northeastern Brazil (Fig. 1). The vegetation is characterized mainly by deciduous forest and hypoxerophytic Caatinga. The local climate is hot and semiarid, with the rainy period occurring from October to April, and the mean annual precipitation ranging from 500 to 800 mm (IPECE, 2015).

We captured 91 *Colobosauroides cearensis* (39 ± 7 mm SVL) by hand during three to five-day fieldtrips from December 2015 to December 2016; this comprised 47 adult females (39.9 ± 7.5 mm SVL), 36 adult males (42.8 ± 5.5 mm SVL) and 8 juveniles (22.0 ± 0.9 mm SVL). We euthanized the lizards with a lethal injection of sodium thiopental (CFMV, 2013); these were then fixed in 10% formalin, preserved in 70% alcohol and deposited in the Herpetological Collection of the Regional University of Cariri (8451, 8452, 8453, 11453–11490; 11663–11687; 12399–12423). For each specimen, we measured the snout–vent length (SVL) with a digital caliper (± 0.01 mm) and mass to the nearest gram with a Pesola® spring scale (± 0.1 g).

We removed all organs of the respiratory and gastrointestinal tracts and examined them individually under a stereoscope for helminths. We transferred the collected helminths to 70% ethanol. We stained the cestodes with alcoholic hydrochloric acid-carmine, which were subsequently cleared in creosote, while nematodes were diaphanized in lactophenol. For each helminth species, the prevalence, mean abundance, and mean intensity of infection (following Bush et al., 1997) were estimated, where parasite mean abundance is defined as the arith-

Table 1. Mean abundance (MA), mean intensity of infection (MII) with range, prevalence (P) and site of infection of helminth community associated with the lizard *Colobosauroides cearensis* in the Caatinga, Northeastern Brazil. Values are mean ± SE. SI: small intestine; ST: stomach; LI: large intestine.

Helminth	MA	MII	P	Site of infection
Cestoda				
Oochoristica sp.	0.05 ± 0.03	1.6 ± 0.7 (1-2)	3.3%	SI
Nematoda				
Physaloptera sp.	0.09 ± 0.07	4.5 ± 3.5 (2-7)	2.2%	ST
Parapharyngodon largitor	1.60 ± 0.18	2.6 ± 1.6 (1-10)	61.0%	SI, LI, ST
Oswaldocruzia sp.	0.02 ± 0.02	2.0 ± 2.0 (-)	1.1%	SI
Spauligodon sp.	0.06 ± 0.04	2.0 ± 1.0 (1-3)	4.4%	SI, LI

metic mean of the number of individuals of a particular parasite species per host examined; mean intensity of infection is the total number of parasites found in a sample, divided by the number of hosts infected with that parasite; and prevalence (P%) is the number of hosts infected with one or more individuals of a particular parasite species divided by the total host number. Throughout the text, results are reported as means ± SE.

We used a generalized linear model with Poisson distribution (GLM) to analyze the relationship between abundance and helminth species richness with host body size and sex. We used a t-test to infer intersexual differences between SVL and mean helminth richness. All analyses were performed using the package Rcmdr in the R platform, version 2.15.0 (R Development Core Team, 2013).

We recovered 165 helminths with an overall prevalence of 69.2%. Mean overall abundance was 1.8 ± 0.2 and mean intensity of infection was 2.6 ± 1.6. The component community of helminths associated with *Colobosauroides cearensis* comprised five taxa (Table 1): one cestode, *Oochoristica* sp., and four nematodes, *Parapharyngodon largitor, Spauligodon* sp., *Physaloptera* sp. and *Oswaldocruzia* sp.

Fifty-six individuals of *C. cearensis* (32 females and 24 males) were parasitized with *Parapharyngodon largitor* (61% prevalence), with this nematode also presenting the highest mean abundance (1.60 ± 0.18). *Oswaldocruzia* sp. were the least prevalent (1.1%) and the least abundant (0.02 ± 0.02).

The relationship between lizard SVL and the mean abundance of helminths was significant ($Z = 2.604$; $P = 0.009$). Although males (42.8 ± 5.5) were larger than females (39.9 ± 7.4; $t = 2.212$; $P = 0.029$), sex did not influence mean abundance ($Z = 0.935$; $P = 0.30$). The mean richness of helminths was low (0.736 ± 0.050), with no influence of host sex ($Z = -0.068$; $P = 0.60$), but the SVL influenced helminth mean richness ($Z = 2.282$; $P = 0.02$). Intersexual differences in mean richness were not found, even when the effect of SVL was removed ($t = 0.267$; $df = 80.91$; $P = 0.70$). Moreover, no juvenile lizards were parasitized.

Our study provides the first parasitological record to the host *Colobosauroides cearensis*. Most taxa reported here were not identified to species level due to juvenile condition (*Physaloptera* sp.), bad conditions of preservation (*Oochoristica* sp. and *Oswaldocruzia* sp.) or because the present species probably represented an undescribed species (*Spauligodon* sp.). *Parapharyngodon largitor* is a generalist species, since it has been reported in several lizard species (Rodrigues, 1970; Vicente et al., 1993; Vrcibradic et al., 2002; Bittencourt and Rocha, 2003; Anjos et al., 2005; Ávila and Silva, 2010; Ávila et al., 2011).

Despite the higher prevalence, *P. largitor* presented low intensity of infection (2.6 ± 1.6), which is also noted for the genus *Parapharyngodon* in other lizard species: *Hemidactylus mabouia* (Squamata: Gekkonidae), *Phyllopezus pollicaris* (Squamata: Phyllodactylidae), *Tropidurus itambere, T. torquatus, T. hispidus* (Squamata: Tropiduridae) (Rodrigues, 1987; Anjos et al., 2005; Pereira et al., 2011; Sousa et al., 2014; Araújo-Filho et al., 2016). Higher prevalence (61%) of *P. largitor* indicates success in colonization within host populations, which suggests that this species may be important in parasite community structure (Bush and Holmes, 1986; Holmes, 1987). Specimens of genus *Oswaldocruzia* sp. are frequently found infecting the intestines of amphibians and reptiles (Santos et al., 2008). *Oswaldocruzia* sp. has direct life cycle, transmission can occur through ingestion or larvae penetration in the skin (Anderson, 2000). *Oswaldocruzia* sp. was observed parasitizing several lizards from Brazil (Ávila and Silva, 2010), including *Tropidurus semitaeniatus*, *Brasiliscincus heathi* and *Anotosaura vanzolinia* in a Caatinga area (Brito et al., 2014a; Oliveira et al., 2017). The low prevalence and intensity of infection found here suggests accidental ingestion of eggs, which could occur through tongue-flicking behavior in substrate (Menezes et al., 2004).

The other helminth taxa found in the present study have been recorded in lizards from South America (Ávila et al., 2010), which have also been reported in other gymnophthalmids: *Oochoristica* sp. (*Apoglossus* sp., *Micrablepharus maximiliani*), *Physaloptera* sp. (*Cercosaura argulus, Bachia scolecoides*), *Spauligodon* sp. (*Micrablepharus maximiliani*) (Ávila et al., 2011; Brito et al., 2014a). The infection of other gymnophthalmids by the same taxa of parasites reported here may suggest phylogenetic relationships, since phylogenetically close taxa may present similarity in the use of a niche, body shape and behavior (Wiens and Graham, 2005; Lima et al., 2012; Brito et al., 2014a).

Host body size influences the establishment of populations and communities of parasites (Poulin, 2004; Kamiya et al., 2014a; 2014b). The individual's parasitic load (Poulin and George-Nascimento, 2007) is due in part to a larger 'area' of exploration and colonization provided by larger-sized specimens (MacArthur and Wilson, 1967; Aho, 1990). In addition, another relevant factor is that larger individuals are older and have therefore suffered longer exposure to parasitic agents (Aho, 1990). Studies of lizard populations have found a positive relationship between host body size and helminth infection rates (Barreto-Lima et al., 2011; Ávila and Silva, 2013; Araújo-Filho et al., 2014; Brito et al., 2014b).

There was no variation of richness and abundance between the sexes in *C. cearensis*, contrary to findings for other gymnophthalmids (Brito et al., 2014a). Intersexual variation in parasite loads may be related to hormonal, physiological and behavioral features; for example, larger males exhibit territorial behavior and frequently engaged in combat with other individuals, which may increase stress levels while decrease their immune response, thus becoming more susceptible to parasitic agents. In addition, testosterone production could be a powerful suppressor of immune system (Zuk and McKean, 1996). However, data regarding physiological and behavioral variation are lacking for *C. cearensis*. Moreover, other studies found no relationship between the parasitic rates and the sex of the lizards (Anjos et al., 2011; Bezerra et al., 2015).

Gymnophthalmids present low helminth richness, when compared to other lizards of the superfamily Teiioidea (Goldberg et al., 2013; Teixeira et al., 2016). Small body sizes in lizards of this family could restrict available niches to colonization and habitat segregation for endoparasites. Poor helminth richness compared to other lizard species in the same family was also reported in *Cercosaura argulus* (4 spp), *Cercosaura ocellata* (1 spp), *Leposoma osvaldoi* (1 spp), *Micrablepharus maximiliani* (3 spp) e *Anotosaura vanzolinia* (1 spp) (Ávila and Silva, 2010; Brito et al., 2014a; Oliveira et al., 2017). In the present study, we found the highest helminth richness within the lizard family Gymnophthalmidae, also providing new locality and host records.

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REFERENCES

Aho, J.M. (1990): Helminth communities of amphibians and reptiles: comparative approaches to understanding patterns and processes. In: Parasite Communities: Patterns and Processes, pp. 157-195. Esch, G.W., Bush, A.O., Aho, J.M., Eds, Springer, Dordrecht, Netherlands.

Albuquerque, S., Ávila, R.W., Bernarde, P.S. (2012): Occurrence of Helminths in Lizards (Reptilia: Squamata) at Lower Moa River Forest, Cruzeiro do Sul, Acre, Brazil. Comp. Parasitol. **79**: 64-67.

Almeida, W.O., Santana, G.G., Vieira, W.L.S., Wanderley, I.C., Ribeiro, S.C. (2009): Rates of pulmonary infection by pentastomids in lizards species from a restinga habitat in northeastern Brazil. Braz. J. Biol. **69**: 197-200.

Anderson, R.C. (2000): Nematode Parasites of Vertebrates: Their Development and Transmission. New York.

Anjos, L.A., Rocha, C.F.D., Vrcibradic, D., Vicente, J.J. (2005): Helminths of the exotic lizard *Hemidactylus mabouia* from a rock outcrop area in southeastern Brazil. J Helminthol. **79**: 307-313.

Anjos, L.A., Bezerra, C.H., Passos, D.C., Zanchi, D., Galdino, C.A.B. (2011): Helminth fauna of two gecko lizards, *Hemidactylus agrius* and *Lygodactylus klugei* (GEKKONIDADE), from Caatinga biome, Northeastern Brazil. Neotrop. Helminthol. **5**: 285-290.

Araújo-Filho, J.A., Ribeiro, S.C., Brito, S.V., Teles, D.A., Sousa, J.G.G., Ávila, R.W., Almeida, W.O. (2014): Parasitic nematodes of *Polychrus acutirostris* (Polychrotidae) in the Caatinga biome, Northeastern Brazil. Braz. J. Biol. **74**: 939-942.

Araújo-Filho, J.A., Brito, S.V., Lima, V.F., Pereira, A.M.A., Mesquita, D.O., Albuquerque, R.L., Almeida, W.A. (2016): Influence of temporal variation and host condition on helminth abundance in the lizard *Tropidurus hispidus* from north-eastern Brazil. J. helminthol. **91**: 312-319.

Ávila, R.W., Souza, F.L., Silva, R.J. (2010): Helminths from seven species of lizards (Reptilia: Squamata) at the Cerrado of Mato Grosso do Sul State, Brazil. Comp. Parasitol. **77**: 67-71.

Ávila, R.W., Cardoso, M.W., Oda, F.H., Silva, R.J. (2011): Helminths from Lizards (Reptilia: Squamata) at the Cerrado of Goiás State, Brazil. Comp. Parasitol. **78:** 120-128.

Ávila, R.W., Anjos, L.A., Ribeiro, S.C., Morais, D.H., Silva, R.J., Almeida, W.O. (2012): Nematodes of lizards (Reptilia: Squamata) from Caatinga biome, northeastern Brazil. Comp. Parasitol. **79**: 56-63.

Ávila, R.W., Silva, R.J. (2010): Checklist of helminths from lizards and amphisbaenians (Reptilia, Squamata) of South America. J. Venom. Anim. Toxins Incl. Trop. Dis. **16**: 543-572.

Ávila, R.W., Silva, R.J. (2013): Helminths of lizards from the municipality of Aripuana in the southern Amazon region of Brazil. J. helminthol. **87**: 12-16.

Baker, M.R., Bain, O. (1981): *Falcaustra belemensis* n. sp. (Nematoda, Kathlaniinae) from the Lizard *Neusticums bicarinatus* L. (Teiidae) of Brazil. Bull. Mus. Nalt. Hist. Nat. **1**: 117-121.

Barreto-Lima, A.F., Toledo, G.M., Anjos, L.A. (2011): The nematode community in the Atlantic rainforest lizard *Enyalius perditus* Jackson, 1978 from south-eastern Brazil. J. Helminthol. **86**: 395-400.

Bezerra, C.H., Ávila, R.W., Passos, D.C., Zanchi-Silva, D., Galdino, C.A.B. (2015): Levels of helminth infection in the flat lizard *Tropidurus semitaeniatus* from northeastern Brazil. J. helminthol. **90**: 779-783.

Bittencourt, E.B., Rocha, C.F.D. (2003): Host-ectoparasite Specificity in a Small Mammal Community in an Area of Atlantic Rain Forest (Ilha Grande, State of Rio de Janeiro), Southeastern Brazil. Mem. Inst. Oswaldo Cruz. **98**: 793-798.

Brito, S.V., Corso, G., Almeida, A., Ferreira, F.S., Almeida, W.O., Anjos, L.A., Vasconcellos, A. (2014a): Phylogeny and micro-habitats utilized by lizards determine the composition of their endoparasites in the semiarid Caatinga of Northeast Brazil. Parasitol. research. **113**: 3963-3972.

Brito, S.V., Ferreira, F.S., Ribeiro, S.C., Anjos, L.A., Almeida, W.O., Mesquita, D. O., Vasconcellos, A. (2014b): Spatial-temporal variation of parasites in Cnemidophorus ocellifer (Teiidae) and *Tropidurus hispidus* and *Tropidurus semitaeniatus* (Tropiduridae) from Caatinga areas in northeastern Brazil. Parasitol. research. **113**: 1163-1169.

Bursey, C.R., Goldberg, S.R., Parmelee, J.R. (2005): Gastrointestinal helminths from 13 species of lizards from Reserva Cuzco Amazónico, Peru. Comp. Parasitol. **72**: 50-68.

Bush, A.O., Holmes, J.C. (1986): Intestinal helminths of lesser scaup ducks: An interactive community. Can. J. Zool. **64**: 142-152.

Bush, A.O., Lafferty, K.D., Lotz, J.M., Shostak, A.W. (1997): Parasitology meets ecology on its own terms: Margolis et al. revisited. J. Parasitol. **83**: 575-583.

CFMV. Conselho Federal de Medicina Veterinária. (2013): Métodos de Eutanásia. In: Guia brasileiro de boas práticas para eutanásia em animais, pp. 28-29. Comissão de Ética, Bioética e Bem-Estar Animal/ CFMV, Brasília, Distrito Federal.

Cunha, O.R., Lima-Verde, J.S., Lima, A.C.M. (1991): Novo Gênero e Espécie de Lagarto do Estado do Ceará (Lacertilia: Teiidae). Boi. Mus. Para. Emilio Goeldi. **7**: 163-176.

Goldberg, S.R., Bursey, C.R., Vitt, L.J., Arreola, J. (2013): Intestinal helminths of the wandering grass lizard, *Cnemidophorus gramivagus* (Squamata: Teiidae), from Brazil. Comp. Parasitol. **80**: 301-303.

Holmes, J. C. (1987): The structure of helminth communities. Int. J. Parasitol. Parasites. **17**: 203-208.

Hudson, P. (2005): Parasites, diversity, and ecosystem. In: *Parasitism & Ecosystems*, p. 232. Thomas, F., Renaud, F., Guégan, J.F., Eds, Oxford University, New York.

IPECE. Instituto de Planejamento do Estado do Ceará. (2015). Available at: www.ipece.ce.gov.br, accessed March 2015.

Kamiya, T., O'dwyer, K., Nakagawa, S., Poulin, R. (2014a): What determines species richness of parasitic organisms. A meta-analysis across animal, plant and fungal hosts. Biol. Rev. **89**: 123-134.

Kamiya, T., O'dwyer, K., Nakagawa, S., Poulin, R. (2014b): Host diversity drives parasite diversity: meta-analytical insights into patterns and causal mechanisms. Ecography **37**: 689-697.

Lima Jr, D.P., Giacomini, H.C., Takemoto, R.M., Agostinho, A.A., Bini, L.M. (2012): Patterns of interactions of a large fish-parasite network in a tropical floodplain. J. Animal Ecol. **81**: 905-913.

MacArthur, R.M., Wilson, E.O. (1967): The Theory of Island Biogeography. Princeton University, New Jersey.

Menezes, V.A., Vrcibradic, D., Vicente, J.J., Dutra, G.F., Rocha, C.F.D. (2004): Helminths infecting the parthenogenetic whiptail lizard *Cnemidophorus nativo* in a restinga habitat of Bahia State, Brazil. J. Helminthol. **78**: 323-328.

Oliveira, B.H.S., Teixeira, A.A.M., Queiroz, R.N.M., Araujo-Filho, J.A., Teles, D. A., Brito, S.V., Mesquita, D.O. (2017): Nematodes Infecting *Anotosaura vanzolinia* (Squamata: Gymnophthalmidae) from Caatinga, northeastern Brazil. Acta Herpetol. **12**: 103-108.

Pereira, F.B., Sousa, B.M., Souza, L.S. (2011): A new species of Pharyngodonidae (Nematoda) of *Tropidurus torquatus* (Squamata: Tropiduridae) from Brazil. J. Parasitol. **97**: 311-317.

Poulin, R., Morand, S. (2000): The diversity of parasites. The Quart. Rev. Biol. **75**: 277-293.

Poulin, R. (2004): Macroecological patterns of species richness in parasite assemblages. Basic Appl. Ecol. **5**: 423-434.

Poulin, R., George-Nascimento, M. (2007): The scaling of total parasite biomass with host body mass. Interl. J. parasitol. **37**: 359-364.

R Development Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL: https://www.R-project.org/.

Rocha, C.F.D., Bergallo, H.G., Bittencourt, E.B. (2016): More than just invisible inhabitants: parasites are important but neglected components of the biodiversity. Zool. **33**: 1-3.

Rodrigues, H.O. (1970): Estudo da fauna helmintológica de "*Hemidactylus mabouia*" (M. de J.) no Estado da Guanabara. Atas da Sociedade de Biologia do Rio de Janeiro **12**: 15-23.

Rodrigues, M.T. (1987): Sistemática, ecologia e zoogeografia dos *Tropidurus* do grupo torquatus ao sul do Rio Amazonas (Sauria, Iguanidae). Arq. Zool. **31**: 105-230.

Santos, J.N., Giese, E.G., Júnior, A.M., Lanfredi, R.M. (2008): A New Species of *Oswaldocruzia* (Molineidae: Nematoda) in *Chaunus marinus* (Amphibian: Bufonidae) (Linneaus, 1758) from Brazil. J. Parasitol. **94**: 264-268.

Sousa, J.G.G., Brito, S.V., Ávila, R.W., Teles, D.A., Araujo-Filho, J.A., Teixeira, A.A.M., Anjos, L.A., Almeida, W.O. (2014): Helminths and Pentastomida of two synanthropic gecko lizards, *Hemidactylus mabouia* and *Phyllopezus pollicaris*, in an urban area in Northeastern Brazil. Braz. J. Biol. **74**: 943-948.

Teixeira, A.A.M., Brito, S.V., Teles, D.A., Ribeiro, S.C., Araujo-Filho, J.A., Lima, V.F., Pereira, A.M.A., Almeida, W.O. (2016): Helminths of the Lizard *Salvator merianae* (Squamata, Teiidae) in the Caatinga, Northeastern Brazil. Braz. J. Biol. **77**: 312-317.

Uetz, P., Hosek, J. (2016): The Reptile Database. Available at: http://www.reptiledatabase.org. [Accessed on 7 may 2017]

Vicente, J.J., Rodrigues, H.O., Gomes, D.C., Pinto, R.M. (1993): Nematóides do Brasil. Parte III: Nematóides de Répteis. Rev. Bras. Zool. **10**: 19-168.

Vrcibradic, D., Rocha, C.F.D., Bursey, C.D., Vicente, J.J. (2002): Helminths infecting *Mabuya agilis* (Lacertilia, Scincidae) in a 'restinga' habitat (Grumari) of Rio de Janeiro, Brazil. Amphib-Reptil. **23**: 109-114.

Wiens, J.J., Graham, C.H. (2005): Niche conservatism: integrating evolution, ecology, and conservation biology. Annu. Rev. Ecol. Evol. Syst. **36**: 519-539.

Zuk, M., McKean, K.A. (1996): Sex differences in parasite infections: patterns and process. Internation J. Parasitol. **26**: 1009-1024.