Helminths infecting the cat-eyed snake Leptodeira annulata Linnaeus 1758 (Squamata: Dipsadidae) in a semiarid region of Brazil

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Summary

Snakes have diverse feeding and living habits, being exposed to a variety of endoparasite communities. However, more studies are still necessary to document these relationships. We examined 18 specimens of the cat-eyed snake Leptodeira annulata from a semi-arid region in Northeast Brazil. Eight taxa of parasites were found, with higher prevalence of cystacanths (Acanthocephala). Five nematode species (Hexametra boddaertii, Oswaldocruzia sp., Oxyascaris sp., Physaloptera sp. and Raillietnema spectans) and the pentastome Raillietiella furcocerca represent a new parasitism record for the host studied. Our results also showed that L. annulata could act as paratenic host for acanthocephalans. These results contribute to the knowledge of the helminth fauna of L. annulata.

Keywords: parasites, nematoda, neotropical, Pentastomida, snakes, reptiles

Introduction

Parasitism is one of the most common life styles with parasites representing a considerable portion of the world’s biomass, but these organisms were for a long time neglected in biodiversity surveys (Poulin & Morand, 2004; Dobson et al., 2008; Kuris, 2008). Given the importance of these organisms structuring communities in ecosystems, as well provide data on ecology of the host (Poulin, 1999; Brooks & Hoberg, 2000), there has been a recent increase of studies on the fauna of endoparasites especially of reptiles in Brazil (Anjos et al., 2011; Albuquerque et al., 2012; Ávila et al., 2012; Teles et al., 2015). Such studies provide information about the ecology, natural history, life cycle, and evolution of host-parasite systems. However, the lack of studies on helminths associated with vertebrate organisms is still evident, being necessary more studies in the area (Mati et al., 2015).

The endoparasite fauna can be related, among other factors, to the diet and microhabitat of hosts (Brito et al., 2014; Ribas et al., 1998). Snakes have very diverse feeding habits, being exposed to a wide variety of parasites (Aho, 1990; Jiménez-Ruiz et al., 2002). Leptodeira annulata (Linnaeus 1758) is a semi-arboreal reptile, distributed from Mexico to eastern of South America (Duellman, 1958) and along all biomes of Brazil, such as the Amazon, Atlantic forest, Cerrado, and Caatinga (Bertoluci et al., 2009; Bernarde et al., 2012; Cole et al., 2013; Mesquita et al., 2013). Studies on L. annulata address aspects like foraging, diet and reproduction (Martins & Oliveira, 1998; Mesquita et al., 2013; Silva-Neta et al., 2015), but data on the parasitic fauna are scarce with records only Ophidascaris trichuriformis Vaz, 1935 (Sprent, 1988) and Renifer heterocoeolum Travassos, 1921 (Pinto et al., 2012). In this context, species inventory are important tools serving as a base for ecological studies, enabling the knowledge of what and how many species are part of an ecosystem and providing essential information about the diversity of organisms (Poulin et al., 2015). Aiming at filling the gap in the knowledge of the parasite fauna of L. annulata, this study analyzed the helminth fauna as-
associated with individuals from the Southern region of Ceará State, Brazil.

Material and Methods

This study was carried out with samples from the Herpetological Collection of Universidade Regional do Cariri (URCA-H- 1981; 3279; 4532; 4907; 4910; 4911; 4913; 4914; 4915; 5541; 5631; 6742; 6847; 7521; 7889; 7900; 8014; 11228). The specimens were collected from 2012 to 2014 in the municipality of Aiuaba (n=4) (6° 34’ 25” S, 40° 07’ 25” W, WGS84), Barro (n=4) (7° 10’ 36” S, 38° 46’ 54” W, WGS84), Farias Brito (n=8) (6° 55’ 50” S, 39° 33’ 56” W, WGS84), Jati (n=1) (7° 41’ 10” S, 39° 00’ 57” W, WGS84) and Mauriti (n=1) (7° 23’ 21” S, 38° 46’ 28” W, WGS84) all located in the Southern region of Ceará State, Brazil (Fig. 1). Study area is characterized by hot semi-arid tropical climate and mild hot semi-arid tropical climate (IPECE, 2016). A total of 18 specimens of \textit{L. annulata} being eight females (mean snout-vent length 541.2 mm) and eleven males (447.5 mm SVL) were euthanized with a lethal injection of sodium thiopental (CFMV, 2013) necropsied and had the liver, lung, heart, mouth, larynx, stomach, large and small intestine, coelomic cavity, and kidneys checked for presence of parasites under the stereomicroscope. The parasites found were processed to separate them completely from the host tissue and stored in 70 % ethanol.

Aiming to perform the taxonomic identification of the helminths obtained, different preparation methods were carried out according to the taxonomic group. Cystacanths were, stained with carmine and preserved in 70 % ethanol. The cestode was also stained with carmine and fixed between slide and coverslip. The nematodes were mounted in temporary slides with Amman’s lactophenol or lactic acid. The pentastomes were cleared using Hoyer’s solution and preserved in 70 % ethanol. The slides were examined with optical microscope and the specimens were identified using the keys for identification of Yamaguti (1959, 1961, 1963), Vicente et al. (1993), Gibbons (2010), Rego (1983). Samples of all parasites were deposited in the Helminthological Collection of the laboratory of Zoology of Universidade Regional do Cariri, URCA, Ceará State, Brazil.

The parasitological descriptors of prevalence (P), mean abundance (MA), mean intensity of infection (MII), richness, and range of intensity of infection (RII) were calculated according to Bush et al. (1997).

Ethical Approval and/or Informed Consent

The collection of specimens was authorized by Instituto Chico Mendes de Conservação da Biodiversidade-ICMBio (Authorization number 29613-1) and by the ethics committee of Universidade Regional do Cariri (CEUA/URCA, process No. 00260/2016.1), the
research related to animals has been complied with all the relevant national regulations and institutional policies for the care and use of animals.

**Results**

A total of 153 parasite specimens were collected with total prevalence of 78.9 % and mean intensity of infection of 10.20 ± 2.81. The component community associated with 153 parasite specimens was comprised of eight taxa: 18 specimens of nematodes distributed in five taxa (Hexametra boddartii, Baird 1860, Raillietnema spectans Gomes 1964, Oswaldocruzia sp., Oxyascaris sp., and Physaloptera sp.), three pentastomes of the species Raillitiella furcocerca Diesing, 1863, one unidentified cestode, and 131 unidentiﬁed cystacanths (Acanthocephala) (Table 1). The cystacanths showed the highest prevalence (63.2 %), intensity (10.92 ± 3.28), and mean abundance (6.9). The cysts could not be identiﬁed at species level because the shape and number of the hooks in the proboscis could not be determined. The cestode was found in one female host specimen (SVL = 544.36), showing the lowest values of prevalence (5 %), intensity (1), and mean abundance (0.05), but the parasite specimen could not be identiﬁed at species level due to poor conditions of preservation.

**Discussion**

Studies that investigated the helminth fauna of some snake species from the Neotropical region such as McAllister et al. (2010a, 2010b), Bursey and Brooks (2011) did not record any infection in L. annulata. This fact may be due to the low number of individuals studied, because in the present study, L. annulata presented higher richness (8 parasite taxa) compared to studies of endoparasites for other snake species (Avila et al., 2013; Nasiri et al., 2014).

**Table 1.** Prevalence (P), mean intensity of infection (MII) with standard error (SE), (MA) mean abundance, (IS) infection site, and (RII) range of intensity of infection of the helminths associated with the snake Leptodeira annulata from the South region of Ceará State, Brazil.

| Helminth Family | Species | P (%) | MII ± SE | MA | IS | RII |
|-----------------|---------|-------|---------|----|----|-----|
| Acanthocephala  | Cystacanth | 66.7  | 10.92 ± 3.28 | 7.28 | BC | 2 – 37 |
| Cestoda | Unidentiﬁed cestode | 5.6  | 1 | 0.05 | SI | 1 – 1 |
| Nematoda | Hexametra boddartii | 5.6  | 1 | 0.05 | L | 1 – 1 |
| | Oswaldocruzia sp. | 5.6  | 2 | 0.11 | LI | 1 – 2 |
| | Oxyascaris sp. | 5.6  | 2 | 0.11 | SI | 1 – 2 |
| | Physaloptera sp. | 5.6  | 1 | 0.11 | ST | 1 – 2 |
| | Raillietnema spectans | 5.6  | 11 | 0.61 | LI | 1 – 11 |
| Pentastomida | Raillitiella furcocerca | 11.1 | 1.5 ± 0.5 | 0.17 | L | 1 – 3 |

Infection sites: body cavity (BC), large intestine (LI), small intestine (SI), stomach (ST), lung (L).
Lachesis sp. (Motta, 1963; Rego, 1983) Mastigodyra bisfossatuum (Raddi, 1820), Philodymas nattereri (Steindacher, 1870). Pseudoboa nigra (Duméril, Bibron and Duméril, 1854), Thammodynastes chausquenis (Bergna and Alvarez, 1993), Thammodynastes chausquenis (Bergna and Alvarez, 1993), Xenodon merremii (Wagler, 1824). (Alcantara et al., 2014; Almeida et al., 2008b; Esslinger, 1986). The present study represents the first record of R. furcocerca infecting L. annulata. This study presents new records for the nematodes H. boddaertii, Oswaldocruzi sp., Oxyascaris sp. and R. spectans in L. annulata, the first record of a cestode in L. annulata, and the first record of infection by the pentastome R. furcocerca in this snake species. These records have the importance of being part of the first studies for the Caatinga area in Northeast of Brazil with this species, and also contribute significantly to the knowledge of the parasitic fauna of L. annulata in the Neotropical region providing data on the helminths associated with this snake species.

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Conflict of interest

Authors state no conflict of interest.

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