Pulmonary infection in two sympatric lizards, *Mabuya arajara* (Scincidae) and *Anolis brasiliensis* (Polychrotidae) from a cloud forest in Chapada do Araripe, Ceará, Northeastern Brazil

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Abstract

The parameters of infection by lung parasites from two sympatric lizards, *Mabuya arajara* and *Anolis brasiliensis*, from the Atlantic Rainforest of the lower slope of Chapada do Araripe in Northeastern Brazil were analyzed between September, 2009 and July, 2010**.** A total of 202 lizards were collected. 125 specimens were from *Mabuya arajara* and 77 from *Anolis brasiliensis. M. arajara* was infected by the pentastomid *Raillietiella mottae* while *A. brasiliensis* was infected by the nematode *Rhabdias* sp., with an overall prevalence of 1.6% and 28.6%, respectively. The mean intensity of infection by *Rhabdias* sp. was 3.63 ± 2.58 (range 1-15). The body size and sex of lizards did not influence the intensity of infection by *Rhabdias* sp. The overall prevalence was also not different between males and females hosts in *A. brasiliensis*. Both *Anolis brasiliensis* and *Mabuya arajara* represent a new host to *Rhabdias* sp. and *Raillietiella mottae*, respectively.

Keywords: lizard, pulmonary infection, pentastomida, nematoda.

Infecção pulmonar em dois lagartos simpátricos, *Mabuya arajara* (Scincidae) e *Anolis brasiliensis* na mata-úmida da Chapada do Araripe, Ceará, Nordeste do Brasil

Resumo

Os parâmetros de infecção por parasitas pulmonares em dois lagartos simpátricos, *Mabuya arajara* e *Anolis brasiliensis*, da floresta úmida da encosta da Chapada do Araripe, Nordeste do Brasil, foram analisados entre setembro de 2009 e julho de 2010. Um total de 202 lagartos foi coletado, sendo 125 espécimes de *Mabuya arajara* e 77 de *Anolis brasiliensis. M. arajara* estava infectado pelo pentastomídeo *Raillietiella mottae*, enquanto *A. brasiliensis* apresentava infecção pelo nematódeo *Rhabdias* sp., com prevalência total de 1,6% e 28,6%, respectivamente. A intensidade média de infecção por *Rhabdias* sp. foi 3,63 ± 2,58 (amplitude 1-15). O tamanho e o gênero dos lagartos não influenciaram a intensidade de infecção por *Rhabdias* sp. A prevalência também não apresentou diferença entre machos e fêmeas em *A.brasiliensis*. Ambos, *Anolis brasiliensis* e *Mabuya arajara*, representam novos hospedeiros para *Rhabdias* sp. e *Raillietiella mottae*, respectivamente.

Palavras-chave: lagarto, infecção pulmonar, pentastomida, nematoda.

1. Introduction

Over the last decade, more research has been carried out concerning lizard parasites from South American regions (Ávila and Silva, 2010) and there is a growing body of research of ecological information about lung parasites (Vrcibradic et al., 2002a, b; Dias et al., 2005; Goldberg et al., 2006a, b; Anjos et al., 2007; Almeida et al., 2008a, 2009a) including pentastomids (Anjos et al., 2007, 2008; Almeida et al., 2008a, b, c, 2009a; Bursey et al., 2010).

Mabuya arajara Rebouças-Spieker, 1981 (Scincidae) can be found in mesic environments of high-altitude areas (called "Brejos-de-Altitude") from the state of Ceará, Northeastern Brazil (Roberto and Loebmann, 2010), including the Chapada do Araripe located in the south of the state.

Anolis brasiliensis Vanzolini and Williams, 1970 (Polychrotidae) can be found in open formations of the Amazon region (Ávila-Pires, 1995) and Cerrado (Mesquita et al., 2008), with an isolated population in Chapada do Araripe (Willians and Vanzolini, 1980; Ribeiro et al., 2008).

Despite the numerous studies on lizard parasites in Brazil (Rocha, 1995; Ribas et al., 1998; Vrcibradic et al., 1999; Vicente et al., 2000; Vrcibradic et al., 2001; Vicente et al., 2002; Vrcibradic et al., 2002a, b; Rocha and Vrcibradic, 2003; Rocha et al., 2003; Anjos et al., 2005; Bursey et al., 2010), most focus on species of lizards restricted to biomes and ecosystems from the Southeast region. In relation to lung parasites, only two host species were studied in skinks, *Mabuya agilis* (Raddi, 1823), which was recorded as a host of an unidentified species of the pentastomid *Raillietiella* sp. (Vrcibradic et al., 2002a, b) and *Trachylepis atlantica* (Schmidt, 1945), recorded as a host of *Raillietiella freitasi* (Motta and Gomes, 1968) (Bursey et al., 2010). Polychrotid lizards are commonly recorded as hosts of lung parasites of the genus *Rhabdias* (Torres-Ortiz, 1980; Bundy et al., 1987; Dobson et al., 1992; Bursey et al., 2003, 2005; Goldberg et al., 2006a, b; Ávila and Silva, 2010), but *A. brasiliensis* was recorded as being infected only by the gastrointestinal nematode *Subulura lacertilia* Vicente, Van-Sluys, Fontes and Kiefer, 2000 (Ávila and Silva, 2011). In this study, we investigated the species of pulmonary parasites associated with *M. arajara and A. brasiliensis* in Chapada do Araripe, Northeast Brazil for the first time.

2. Material and Methods

This study was carried out on the slope of Chapada do Araripe in the tropical subperennial cloud forest (Rainforest). Lizards were sampled in two areas from the municipality of Crato (07° 15' 19.6" S and 39° 28' 13.9" W and 07° 16' 50.7" S and 39° 26' 18.6" W) and two area of municipality of Barbalha (07° 21' 49.7" S and 39° 17' 51" W and 07° 19' 58.5" S and 39° 24' 38.4" W), Northeast Brazil. Lizards were collected by hand or with a shotgun from September, 2009 to July, 2010. The specimens were euthanized with a lethal injection of lidocaine, the snout-vent length (SVL) measured with a digital calliper (accuracy of 0.01 mm), fixed in formalin 10% and preserved in 70% alcohol. Voucher specimens were deposited in the Laboratório de Zoologia da Universidade Regional do Cariri (LZ-URCA: 599-621; 677-738).

A total of 202 lizards were collected, where 125 specimens were of *Mabuya arajara* and 77 of *Anolis brasiliensis.* Among the specimens of *M. arajara,* 63 were males (SVL 80.3 ± 10.2, range 50-103 mm), 55 were females (SVL 89.4 ± 11.9, range 54-114 mm) and seven were juveniles (SVL 49.7 ± 5.7, range 44-59 mm). Concerning *A. brasiliensis*, 49 were males (SVL 57.6 ± 6.9, range 35-72 mm) and 28 were females (SVL 57.7 ± 5.9, range 46-67 mm).

The lungs of the lizards were removed and then examined for the presence of parasites using an optical stereomicroscope. The parasites found were removed, counted and preserved in 70% alcohol to identify later. Pentastomids were cleared in glycerol, mounted on Hoyer medium at semi-permanent slides and examined with a light microscope. Nematodes were cleared in phenol, identified and voucher specimens were deposited in the Laboratório de Zoologia da Universidade Regional do Cariri (LZ-URCA: 1-4).

The prevalence and mean intensity of infection were determined according to Bush et al. (1997). The effect of the host body size (snout-vent length – SVL) on the intensity of the infection was tested by a Pearson correlation. The Z-test was used to evaluate the differences in prevalence and intensity of infection between the sexes. A discrepancy index (D) was calculated as suggested by Poulin (1993). The index has a minimal value of zero (D = 0) when all hosts have the same number of parasites. When all parasites are found in a single host, the aggregation is maximal (D = 1). This index was calculated using the Quantitative Parasitology 3.0 software (Rózsa et al., 2000).

The descriptive statistical analysis utilized throughout the text included mean ± SD (standard deviation). The statistical analyses were performed using the program BioEstat 5.0.

3. Results

Analysing the lungs of *Mabuya arajara* revealed that only two adult females (SVL 92.2 mm and 101.6 mm) were infected by the pentastomid *Raillietiella mottae* Almeida et al. (2008) (overall prevalence was 1.6%) and the intensity of infection ranged from one to three.

In *Anolis brasiliensis,* one unidentified species of the nematode *Rhabdias* sp. was found in the lungs of 22 lizards (overall prevalence was 28.6% and mean intensity of infection was 3.63 ± 2.58; range 1-15 mm): 15 males (prevalence was 30.6%; mean intensity of infection of 3.0 ± 3.1; range 1-13 mm) and seven females (prevalence of 25%; mean intensity of infection of 5.0 ± 5; range 1-15 mm). There was no significant difference in the prevalence of *Rhabdias* sp. between males and females (Z = 0.22; P = 0.82), as well as in the intensity of infection between males and females (Z = 0.97; P = 0.33). The discrepancy index (D) of this suprapopulation of *Rhabdias* sp. was 0.837. Lizard SVL

had no effect on the intensity of the infection (R = 0.10; P = 0.53; N = 22).

4. Discussion

Mabuya arajara represents a new host for the pentastomid *Raillietiella mottae*. This parasite has been reported for a several species of lizard hosts, such as *Tropidurus hispidus* (Spix, 1825), *T. semitaeniatus* (Spix, 1825), *Phyllopezus periosus* Rodrigues, 1986, *P. pollicaris* (Spix, 1825), *Micrablepharus maximiliani* (Reinhardt and Luetken, 1862) and *Hemidactylus mabouia* (Moreau of Jonnès, 1818) (Almeida et al., 2009b). At the Chapada do Araripe, *R. mottae* was recorded at hosts from an anthropogenic area (Almeida et al., 2009b) and from an undisturbed area (present study). According to Poulin (2007), the evolution of parasite life-history strategies and the strategies of host exploitation promote a trade-off between a strategy of specialization on host species (generally with high prevalence) or a strategy of parasitized several host species (generally with low prevalence). This species of pentastomid seems to adopt the second strategy as it was recorded from various lizard species from different degrees of environmental conservation.

Indeed, *M. arajara* showed the lower prevalence recorded for raillietiellids in Brazil (prevalence 1.6%), suggesting that this is not a common host of *R. mottae* (Almeida et al., 2009b).

Nematode *Rhabdias* sp. are commonly reported in infecting lizards, especially the genus *Anolis* (Torres-Ortiz, 1980; Bundy et al., 1987; Dobson et al., 1992; Bursey et al., 2003, 2005; Goldberg et al., 2006a, b; Vrcibradic et al., 2007, 2008; Almeida et al., 2009b; Ávila et al., 2011). Here we showed that *A. brasiliensis* is a new host for the genus *Rhabdias*. An unidentified species of *Rhabdias* was recorded infecting the tropidurid *T. hispidus* with low prevalence (2.5%) at open areas on the slope of the Chapada do Araripe (Almeida et al., 2009b). The population of *A. brasiliensis* showed a higher prevalence. The environmental conditions play a fundamental role on survivors of free-living and infecting stages of *Rhabdias* (Anderson, 2000). Thus, the environmental conditions and ecological traits of lizard hosts could determine the infection rates by this pulmonary parasite.

Rhabdias sp. represents the second species of parasite that infects the lizard *A. brasiliensis*. To date, only the nematode *Subulura lacertilia* Vicente, Van-Sluys, Fontes and Kiefer, 2000 was known to infect the intestines of this lizard species (Ávila and Silva, 2011). The prevalence (28.57%) of *Rhabdias* sp. did not show the *status* of *core* species (<50%) (Aho, 1990). However, they were similar to those found in *Anolis punctatus* Daudin, 1802 (38% N = 8, Goldberg et al., 2006b), *Enyalius bilineatus* Dumeril and Bibron, 1837 (33.3% N = 27, Vrcibradic et al., 2007), and *E. iheringii* Boulenger, 1885 (33.3% N = 6, Vrcibradic et al., 2008), and high in comparison with *T. hispidus* (2.5% N = 80, Almeida et al., 2009b), *Anolis fuscoauratus* D'Orbigny (1.8% N = 69, Goldberg et al., 2006a) and *E. perditus* Jackson, 1978 (14.3% N = 14, Vrcibradic et al., 2008).

To some species of lizards, the sex and body size of hosts could influence the rate of infection (Anjos et al., 2005; Sousa et al., 2007; Barreto-Lima et al., 2011), nevertheless this relationship was not found for this lizard host. Features of hosts such as ecological and physiologic characteristics could determine the differences observed in the relationships between body size and intensity of infection (Aho, 1990; Poulin, 2007).

The suprapopulation of *Rhabdias* sp. showed an aggregated distribution pattern. According to Poulin (1993), the host population with low prevalence rates the aggregation of parasites which tend to be higher, as shown for this population of *A. brasiliensis*.

Mabuya arajara and *A. brasiliensis* are sympatric at the area sampled in the Chapada do Araripe. Nevertheless, they do not share the same fauna of pulmonary parasites. It is known that infection by helminths is directly influenced by extrinsic and intrinsic factors such as the way of foraging, the use of the microhabitat (Ribas et al., 1998; Anjos et al., 2005), diet composition (Rocha, 1995), phylogeny of hosts (Poulin and Mouillot, 2003) and environmental components such as the climate (Ribas et al., 1995). Perhaps, ecological (such as the use of the habitat and diet) and phylogenetic differences can act in a way to impede overlapping of the niche (Pianka, 1973) and, thus reflect in the composition of the communities of parasites of these lizards.

The lungs of the lizards infected by both species of parasites did not show clear signs damage of cells or tissues of this organ. Virtually all free living animals are subject to infections/infestations by parasites as these parasite animals could represent 40% of richness in this community and exceed, in terms of number, all free-living ones (Poulin and Morand, 2004). Therefore, at low prevalence and intensity of infections, healthy hosts should not have symptoms and pathologies caused by presence of parasites (Bush et al., 2001; Poulin, 2007).

Thus, studies of other groups of endoparasites and ectoparasites are crucial to understand the ecological role of the hosts in the differentiation and structuration of the associated parasite communities.

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