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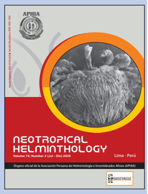

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

ENDOPARASITES OF *ENYALIUS BIBRONII* BOULENGER, 1885 (SQUAMATA: LEIOSAURIDAE) IN THE SEMI-ARID CAATINGA OF NORTHEASTERN BRAZIL

ENDOPARÁSITOS DE *ENYALIUS BIBRONII* BOULENGER, 1885 (SQUAMATA: LEIOSAURIDAE) EN LA CAATINGA SEMIÁRIDA DEL NORESTE DE BRASIL

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ABSTRACT

Studies on parasites are essential tools for understanding the ecological dynamics of variations in population abundance, structural changes in communities, and the coevolutionary processes of their hosts. They play a fundamental role in modulating biodiversity and serve as excellent models for studying host-parasite relationships. In this context, we used samples collected in species surveys in four protected areas to describe the endoparasite communities of *Enyalius bibronii*

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Boulenger, 1885 (Squamata: Leiosauridae) in the Caatinga domain of northeastern Brazil and investigated the factors that influence the composition of these communities. We analyzed 166 specimens of *E. bibronii*. The composition of endoparasites varied between sampling sites, but we identified six parasitic species, with *Physaloptera lutzi* Cristófaro, Guimaraes & Rodrigues, 1976 and *Parapharyngodon alvarengai* Freitas, 1957 present in three of these sites. The relation between host size and parasite abundance was significant in some areas, while in others it was not. The parasite community described indicates relatively low diversity. However, our data present several new parasite records infecting *E. bibronii*. We highlight the unique parasite composition in each area, emphasizing the need for future studies to evaluate parasite distribution comprehensively**.**

Keywords: Helminths – Lizard – Nematodes – Parasites – Sauria

RESUMEN

Los estudios sobre parásitos son herramientas esenciales para comprender la dinámica ecológica de las variaciones en la abundancia de las poblaciones, los cambios estructurales en las comunidades y los procesos coevolutivos de sus huéspedes. Desempeñan un papel fundamental en la modulación de la biodiversidad y sirven como excelentes modelos para estudiar las relaciones entre huéspedes y parásitos. En este contexto, utilizamos muestras recogidas en estudios de especies en cuatro áreas protegidas para describir las comunidades de endoparásitos de *Enyalius bibronii* Boulenger, 1885 (Squamata: Leiosauridae) en el dominio Caatinga del noreste de Brasil e investigamos los factores que influyen en la composición de estas comunidades. Analizamos 166 especímenes de *E. bibronii*. La composición de los endoparásitos varió entre los sitios de muestreo, pero identificamos seis especies parasitarias, con *Physaloptera lutzi* Cristófaro, Guimaraes & Rodrigues, 1976 y *Parapharyngodon alvarengai* Freitas, 1957 presentes en tres de estos sitios. La relación entre el tamaño del huésped y la abundancia de parásitos fue significativa en algunas áreas, mientras que en otras no lo fue. La comunidad de parásitos descrita indica una diversidad relativamente baja. Con todo, nuestros datos presentan varios registros nuevos de parásitos que infectan a *E. bibronii*. Destacamos la composición única de parásitos en cada área, enfatizando la necesidad de estudios futuros para evaluar la distribución de los parásitos de manera integral.

Palabras clave: Helmintos – Lagarto – Nematodos – Parásitos – Sauria

INTRODUCTION

Studies on parasites have been gaining prominence, and numerous researchers have focused on understanding how parasites can influence their hosts and their intra- and interspecific relationships (Marcogliese, 2004; Lacerda *et al.*, 2023). For a long time, parasites were studied solely for epidemiological purposes. However, parasites can provide important information about the host and its habitat, with their effects ranging from subtle to profound, demonstrating the importance and plasticity of these organisms' roles in the ecosystem (Marcogliese, 2004).

These organisms are essential tools for understanding ecological dynamics in population abundance variations, structural changes in communities, and the coevolutionary processes of their hosts (Cardoso *et al.*, 2016; Bower *et al.*, 2019; Ebert & Fields, 2020). Among other aspects, parasites play a crucial role in modulating biodiversity and serve as excellent models for studying host-parasite relationships (Robar *et al.*, 2010; Cardoso *et al.*, 2016).

Parameters such as parasite abundance and richness can be influenced by the geographical area in which their hosts are found (Timi *et al.*, 2010). These parasitic aspects are also closely related to the phylogeny and life history of the hosts (Poulin, 2007; Brito *et al.*, 2014b). Because parasites are among the first to be affected by a decrease in their host's energy load—caused by various factors, such as a decrease in nutrient supply (Poulin, 2014; Campião *et al.*, 2015)— these influences can range from competition for parasite habitat to hormonal changes in the host that can affect parasite reproduction rates, affecting parameters such as parasite abundance and richness (Campião *et al.*, 2015; Oliveira *et al.*, 2025). Additionally, alterations in natural ecosystems affect parasite transmission patterns, facilitating their occurrence and dispersal (Poulin, 2007). Therefore, understanding the diversity and distribution of parasites is crucial for comprehending the role of host-parasite ecological interactions in ecosystem dynamics (Poulin & Krasnov, 2010; Cabral *et al*., 2018; Campião *et al*., 2015; Lehun *et al*., 2023).

The genus *Enyalius* Wagler, 1830 currently comprises eleven species. These lizards have a broad distributions across the Atlantic Forest; however, some species are also found in patches of the Caatinga and in gallery forests of the Cerrado (Jackson, 1978; Bertolotto *et al*., 2002; Rodrigues *et al*., 2006). They are diurnal lizards that primarily feed on arthropods, although they may also consume other prey types, and are commonly found on tree trunks (Jackson, 1978; Malheiro *et al.,* 2024).

Despite its widespread occurrence in the Caatinga and also in neighboring biomes (Cerrado and Atlantic forest), there are few studies on the ecology of *Enyalius bibronii* Boulenger (1885) or its associated helminths (Gogliath *et al*., 2010). This occurs because 53% the Caatinga has never been sampled for lizards (Uchoa *et al*., 2022), and the consequent lack of specimens in collections hampers our understanding of species natural histories and of their associated helminth fauna. Species inventories are the foundation of natural history research and therefore essential for understanding the diversity and functioning of organisms, whether they are hosts or parasites (Ribeiro *et al*., 2012b; Araújo-Filho *et al*., 2014; Lima *et al*., 2017; Segalla *et al*., 2021; Lacerda *et al*., 2023). In this context, we used samples collected in species surveys of protected areas to describe endoparasite communities of *E. bibronii* in four Conservation Units within the Caatinga domain in northeastern Brazil and to investigate the factors influencing the composition of these communities.

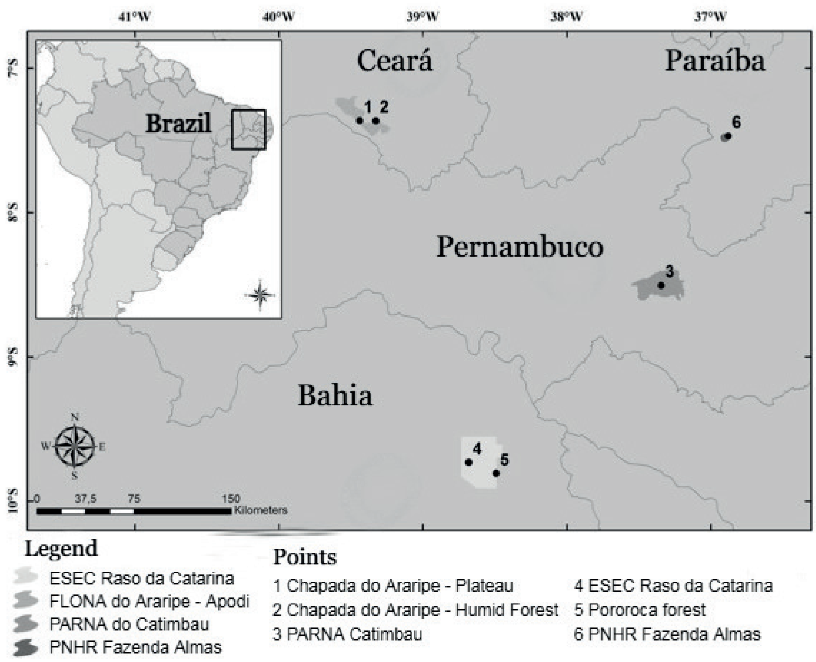

Figure 1. Map showing study sites in Northeastern Brazil: Chapada do Araripe (CE), PARNA Catimbau (PE), ESEC Raso da Catarina (BA), and PNHR Fazenda Almas (PB).

MATERIAL AND METHODS

Study Areas

Chapada do Araripe

Chapada do Araripe is located between the states of Ceará, Pernambuco, and Piauí, with a total of 972,605 has and altitudes ranging from 850 to 1000 meters and characterized by caatinga vegetation on lower areas, humid forests on steeper areas subject to orographic rains, and a vast plateau of cerrado on its top, with associated natural water springs, endemic species, and fossil formations (MMA, 2007). The temperature averages around 24°C, with a rainy season from January to June and a dry season from July to December, with an annual rainfall average of 1100 mm^3.

We conducted sampling in two areas of the chapada: on the plateau of the Chapada do Araripe, in a Cerrado/ Cerradão environment (7°21'55"S, 39°26'26"W; 913 m altitude), and in a humid forest area located on the slope

(7°21'56"S, 39°19'42"W; 760 m altitude), both within the Ceará portion of the region.

We collected the lizards during the dry season, in November 2012 and October 2013, using active searches and pitfall traps (N = 30 sets, each with four buckets, totaling 120 buckets of 30 l) and 70 glue traps, with traps operating for a total of 30 days. During the rainy season, we used pitfall traps from January to June 2016 (N = 15 sets, each with four buckets, totaling 60 buckets of 30 l).

Catimbau National Park (PARNA)

Located in the state of Pernambuco, northeastern Brazil, the park extends over total of 62,294 has with characteristic caatinga vegetation. It has predominantly warm annual temperatures (averaging above 18°C), with rainfall concentrated between April and June (Cavalcanti & Corrêa, 2014).

We collected the lizards in March and April 2013 using pitfall traps (N = 37 sets, each with four buckets, totaling 148 buckets of 30 l) and 148 glue traps (see Pedrosa *et al.*, 2014, for sampling details and other species found in the region).

Raso da Catarina Ecological Station (ESEC)

The Raso da Catarina Ecological Station is located in the state of Bahia. In the middle of the Caatinga domain, its territory comprises 104,844 has, made up of sandy soils and latosols with limited surface water. The climate is semi-arid, with an annual precipitation of 650 mm and a rainy season from December to July, averaging 450 mm (Velloso *et al.*, 2002).

We collected the lizards in March and April 2012 using pitfall traps (N = 37 sets, each with four buckets, totaling 148 buckets of 30 l) and 148 glue traps (see Garda *et al.*, 2013, for sampling details and other species found in the region). These were installed near the conservation unit's headquarters (9°43'53.67"S, 38°40'58.24"W; 603 m altitude) and in a region locally known as Mata da Pororoca (9°48'29.0"S, 38°29'32.04"W; 701 m altitude).

Private Natural Heritage Reserve (PNHR) Fazenda Almas

PNHR Fazenda Almas, located in the Cariri region of Paraíba, covers a total area of 3,505 has. It has an average annual rainfall of 560 ± 230 mm, concentrated between February and April. The vegetation varies from dense to open arboreal Caatinga. The average annual temperature is 26°C, and the relative humidity does not exceed 75% (Barbosa *et al.*, 2007). The reserve is considered the oldest private conservation area in the state and the fourth largest in northeastern Brazil.

We collected the lizards in September 2007, January 2008, and July 2009 using pitfall traps arranged in lines (N = 6 lines, each with 10 buckets, totaling 60 buckets of 60 l) installed within the PNHR (7°28'15"S, 36°52'51"W). At all sampling sites (Fig. 1), we also conducted both diurnal and nocturnal active searches while using the traps.

Laboratory Procedures

We euthanized the captured lizards following ethical procedures established by Beaupre *et al.* (2004) We then measured snout-vent length (SVL) and tail length (TL) from each specimen with a digital caliper (precision: 0.01 mm) and weighed individuals with spring scales (precision: 0.1 g). Animals were euthanized using pentobarbital lethal injection onto the abdomen and then fixed in 10% formalin, following Auricchio & Salomão (2002).

Next, we performed necropsies, carefully examining all organs (lungs, intestines, stomach, liver) and body cavities for parasites. We sexed each lizard through direct gonadal analysis. We counted and stored endoparasites in 70% ethanol. For identification, we followed specialized methodologies specific to each taxonomic group (Yamaguti, 1971; Schmidt, 1986; Vicente *et al.*, 1991, 1993; Andrade, 2000). We deposited endoparasites in the Parasitology Collection of the Laboratory of Biology and Ecology of Wild Animals at the Federal University of Cariri.

Statistical Analyses

We followed the definitions of Bush *et al.* (1997) to analyze prevalence (P), abundance (ABG), and mean intensity of infection (IMI). We also calculated the overall aggregation index and the index for each species, following Poulin (1993).

$$D = 1 - \frac{2\sum_{i=1}^{n}(\sum_{j=1}^{i} xj)}{\bar{X}\,N(N+1)}$$

We represented the value of X as the number of parasites in host J (with hosts ranked in ascending order of infection) and N as the total number of hosts. This continuous metric varies from 0— when parasites are uniformly distributed among hosts— to 1— when all parasites aggregate in a single host. We conducted these analyses using the software *Quantitative Parasitology* (Rózsa *et al.*, 2000).

We analyzed the influence of snout-vent length (SVL) on parasite abundance using a simple linear regression. To assess the influence of host's sex and seasonality, we applied a Generalized Linear Model (GLM) assuming a Poisson distribution of errors. We performed all statistical analyses using the "R Commander" package (R Core Team, 2023), considering a significance level of $p < 0.05$.

Ethic aspects: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guides on the care and use of laboratory animals.

RESULTS

We analyzed 166 specimens of *E. bibronii*, including 40 from Chapada do Araripe, 47 from PARNA Catimbau, 30 from ESEC Raso da Catarina, and 49 from PNHR Fazenda Almas. Among them, 64 individuals were infected by at least one species of endoparasite, resulting in an overall infection prevalence of 38.6%. We identified seven endoparasites species in the helminth fauna of *E. bibronii*. The endoparasite composition varied between sampling sites, but *Physaloptera lutzi* Guimarães & Rodrigues, 1976, and *Parapharyngodon alvarengai* Freitas, 1957, were present in three different locations (see Table 1).

Among the sampled locations, Chapada do Araripe had the highest prevalence, with 67.5% (N = 27/40), followed by PARNA Catimbau with 37.04% (N = 16/47), PNHR Fazenda Almas with 30.61% (N = 15/49), and ESEC Raso da Catarina with 10% (N = 3/30). When comparing mean infection intensity, we observed the highest values in Chapada do Araripe (12.51 ± 11.89), followed by PARNA Catimbau (4.81 ± 4.26), ESEC Raso da Catarina (2.33 ± 1.30), and PNHR Fazenda Almas (2.06 ± 1.20). The aggregation index showed that parasites were highly clustered in all locations: Chapada do Araripe IA = 0.91, PARNA Catimbau IA = 0.95, PNHR Fazenda Almas IA = 0.93, and ESEC Raso da Catarina IA = 0.98.

The influence of sex and collection period (dry and wet seasons) on parasitism was assessed simultaneously only for PNHR Fazenda Almas and Chapada do Araripe, as all other sites lacked samples across seasons. In Chapada do Araripe, males were significantly more infected than females (Z = 4.326, df = 31, P < 0.001), we observed that the abundance of parasites was significantly higher during the wet season (Z = 3.413, df = 31, P < 0.001). The interaction between sex and seasonality was also significant, with males being more infected during the wet season (Z = -2.896, df = 31, P = P < 0.01). However, in PNHR Fazenda Almas parasite abundance was not influenced by sex (Z = -0.008, df = 41, P = 0.994), seasonality (Z = 0.175, df = 41, P = 0.861), or their interaction (Z = 0.008, df = 41, P = 0.994) (Table 2).

In our linear regression, we found no significant relation between host size and parasite abundance in Chapada do Araripe (t = 0.768, *Df* = 30, p = 0.448) or ESEC Raso da Catarina (t = 0.865, *Df* = 27, p = 0.395). However, in PNHR Fazenda Almas, we detected a significant result (t = 2.067, *Df* = 40, p = 0.0453).

DISCUSSION

The parasite community described for *Enyalius bibronii* consists of seven endoparasite species, indicating relatively low diversity. This pattern is similar to that observed in congeners, such as *E. bilineatus* (Duméril & Bibron, 1837) (n = 7, Vrcibradic *et al*., 2007; Barreto-Lima & Anjos, 2014) and *E. brasiliensis* (Lesson, 1830) (n = 2, Dorigo *et al*., 2014), supporting the claim by Dorigo *et al*. (2014) that *Enyalius* spp. host a relatively poor helminth fauna. This trend becomes even more evident when considering individual collection sites: Chapada do Araripe (n = 5), PARNA Catimbau (n = 2), PNHR Fazenda Almas (n = 3), and ESEC Raso da Catarina (n = 1). However, our data present several new parasite records infecting *E. bibronii*. Previously, the only recorded parasite in this lizard was the nematode *Physaloptera retusa* (Rudolphi, 1819) (Teixeira *et al*., 2020). Future studies may reveal a higher diversity of parasites. Additionally, our results provide the first records of *Subulura lacertilia* Vicente, Van Sluys, Fontes & Kiefer, 2000, *P. alvarengai*, *Onchocercidae* larvae, and the pentastomid *Raillietiella mottae* Almeida, Freire & Lopes, 2008, infecting *Enyalius* spp.

The most prevalent parasite was *Strongyluris oscari* Travassos, 1923 (P = 60%). This species infects the stomach and intestines and has a heteroxenous life cycle, using arthropods as intermediate hosts (Anderson, 2000). It is a well-documented parasite in South American lizards (Ávila & Silva, 2010). Within *Enyalius*, it has been reported in *E. perditus* Jackson, 1978 (Sousa *et al*., 2007; Vrcibradic *et al*., 2008; Barreto-Lima *et al*., 2012) with a high prevalence (P = 58%, Sousa *et al*., 2007) and in *E. iheringii* Boulenger, 1885 (P = 16.7%, Vrcibradic *et al*., 2008) and *E. bilineatus* (Duméril & Bibron, 1837) (Barreto-Lima & Anjos, 2014) with lower prevalence. Although *S. oscari* is considered a common parasite in *Enyalius* (Barreto-Lima & Anjos, 2014), our study found infections only in one of the four sampling areas (Chapada do Araripe), suggesting that infection rates may be influenced by local environmental factors, as well as the distribution of the parasite and its hosts (Oliveira *et al*., 2023).

Table 1- Parasite species found in *Enyalius bibronii* sampled in Chapada do Araripe (Ceará State), PARNA Catimbau (Pernambuco State), PNHR Fazenda Almas (Ceará State), and ESEC Raso da Catarina (Bahia State), presenting their infection rates: mean intensity of infection+ standard error (IMI+SE), prevalence (P), overall abundance (ABG), and amplitude of the class (AMC).

SPECIES	Chapada do Araripe				PARNA Catimbau				PNHR Fazenda Almas				ESEC Raso da Catarina			
INDEX	IMI+SE	P(%)	ABG	AMC	IMI+SE	P(%)	ABG	AMC	IMI+SE	P(%)	ABG	AMC	IMI+SE	P(%)	ABG	AMC
NEMATODA																
Heterakidae																
Strongyluris oscari Travassos, 1923	11.45±9.89	60	275	1-33	-	-	-	-	-	-	-	-	-	-	-	
Physalopteridae																
Physaloptera retusa Rudolphi, 1819	10.5±17.69	10	42	1-37	-	-	-	-	-	-	-	-	-	-	-	-
Physaloptera lutzi Guimaraes, Cristófaro and Rodrigues, 1976	8±9.89	5	16	1-15	4.5±6.1	31	63	1-25	-	-	-	-	2.33±2.30	10	7	1-5
Pharyngodonidae																
Parapharyngodon alvarengai Freitas, 1957	2	2.5	2	2	9±4.2	4.4	18	6-12	2±0.89	11	12	1-3	-	-	-	-
Subuluridae																
Subulura lacertilia Vicente, Van-Sluys, Fontes and Kiefer, 2000	-	-	-	-	-	-	-	-	2±1.29	13	14	1-4	-	-	-	-
Onchocercidae	1	2.5	1	1	-	-	-	-	-	-	-	-	-	-	-	-
PENTASTOMIDA																
Raillietiellidae																
Raillietiella mottae Almeida, Freire and Lopes, 2008	-	-	-	-	-	-	-	-	2.5±2.12	3.9	5	1-4	-	-	-	-

Table 2- Generalized Linear Model (GLM) results showing the influence of sex, collection season, and their interaction (sex/season) on the parasite load of *Enyalius bibronii* collected in Chapada do Araripe and PNHR Fazenda Almas (FA); DF = Degrees of freedom.

	Chapada do Araripe		**PNHR Fazenda Almas**	
Coeficient	**Z, DF**	**P**	**Z, DF**	**P**
Sex	4.326, 31	P<0,005	-0.008, 41	P= 0.994
Season	3.413, 31	P<0.001	0.175, 41	P= 0.861
Sex/Season	-2.896, 31	P<0.01	0.008, 41	P= 0.994

Parasites from the genus *Physaloptera* Rudolphi, 1819 infect various lizard species (Lacerda et al. 2023), typically colonizing the stomach and intestines (Ávila & Silva, 2010) and following a heteroxenous life cycle (Anderson, 2000). Our study recorded low prevalence rates for *P. retusa* (P = 10%) and *P. lutzi* (P = 5%, 31%, 10%). Vrcibradic *et al.* (2007) found *P. retusa* and *P. lutzi* in *E. bilineatus* with similarly low prevalence (P = 3%, 2%, respectively) in an Atlantic Forest area. Likewise, Dorigo *et al.* (2014) reported *Physaloptera* sp. in *E. brasiliensis* with infection rates below 15%, suggesting that *Enyalius* spp. are not preferred hosts for *Physaloptera* spp. However, our study detected *Physaloptera* infections in three geographically distinct *E. bibronii* populations. Along with the record from Teixeira *et al.* (2020), these findings suggest that, despite low prevalence, *Physaloptera* species commonly infect *Enyalius* lizards.

Parapharyngodon alvarengai has been recorded in anurans and lizards, including *Trachylepis atlantica* Schmidt, 1945 and *Ameiva ameiva* Linnaeus, 1758 (Ávila & Silva, 2010). In the Caatinga region, it has been documented in *Tropidurus hispidus* (Spix, 1825) and *T. semitaeniatus* (Spix, 1825) (Brito *et al.*, 2014a, b; Araújo-Filho *et al.*, 2017). Our study found *P. alvarengai* in three of the four sampled areas, following a distribution pattern similar to *P. lutzi*. The wide geographical range of these species in the Caatinga suggests high generalist host selection.

Parasites of the genus *Subulura* Molin, 1860 have been described by Vicente *et al.* (1997) infecting various birds and mammals. For reptiles, *S. lacertilia* was described by Vicente *et al.* (2000) parasitizing the lizard *Eurolophosaurus nanuzae* Rodrigues, 1981. Our study reports a low-prevalence infection (P = 13%) compared to Fontes *et al.* (2003), which recorded infection in *E. nanuzae* with a prevalence of 63.7% in males and 47.8% in females. This parasite has a heteroxenous life cycle, which Vicente *et al.* (2000) identified as the cause of reptile infection, describing its occurrence as accidental. In our study, this parasite was found only in PNHR Fazenda Almas. However, compared to the other parasite species found in this area, it exhibited greater abundance, making it the most common parasite in this population. Differences in parasite species composition in the same host across different populations may be explained, among other factors, by the fact that each population exists in unique structural and environmental conditions. These intrinsic processes influence host-parasite interactions at a local scale; for example, variations in the availability of intermediate hosts in the diet may occur in different locations (Klaion *et al.*, 2011).

Parasites from the family Onchocercidae exhibited low prevalence (P = 1%). These parasites have been widely recorded infecting many Neotropical lizards (Ávila & Silva, 2010). Since we found only a larva, we could not identify the parasite at the species level. This finding may indicate a recent infection by this parasite.

In this study, we report the first occurrence of Pentastomida in *Enyalius* spp. lizards. *Raillietiella mottae* has been documented by several authors infecting lizards in the Caatinga and Restinga domains. Most records come from Tropiduridae (Almeida *et al.*, 2008a, 2008b, 2009; Brito *et al.*, 2014b; Araújo-Filho *et al.*, 2017) and Gekkonidae (Almeida *et al.*, 2008b; Brito *et al.*, 2014b; Gonçalves-Sousa *et al.*, 2010, 2014), with the latter showing the highest infection rates: *Phyllopezus periosus* Rodrigues, 1986 (P = 66.7%), *P. pollicaris* (Spix, 1825) (P = 18.2%), and *Hemidactylus agrius* Vanzolini, 1978 (P = 28.6%) (Almeida *et al.*, 2008b; Gonçalves-Sousa *et al.*, 2010; Lima *et al.*, 2018). *Raillietiella mottae* was recorded infecting the lizard *Micrablepharus maximiliani* (Reinhardt & Luetken, 1861) (P = 4%, Almeida *et al.*, 2009), *Copeoglossum arajara* (Rebouças-Spieker, 1981) (P = 1.6%, Ribeiro *et al.*, 2012a), and *Ameiva ameiva* Linnaeus, 1758 (P = 2.22%, Silva *et al.*, 2019). In all these cases, the low prevalence is similar to the infection found in *E. bibronii* (P = 3.9%), likely related to the evolutionary history of these parasites with Gekkonidae (Lima *et al.*, 2018), as well as nocturnal habits, which may provide greater access to intermediate hosts.

Host size can influence parasite abundance by providing more space and nutritional resources (Poulin, 1997). This factor is well-documented (Sousa *et al.*, 2007; Anjos *et al.*, 2008; Galdino *et al.*, 2014; Brito *et al.*, 2014a; Araújo-Filho *et al.*, 2017). Our study identified a significant correlation between snout-vent length (SVL) and parasite abundance only in the population from PNHR Fazenda Almas. Similarly, Sousa *et al.* (2007) found a positive correlation between parasite load and larger males in *E. perditus*. However, the factors influencing this relationship remain unclear, as the other studied populations did not show this correlation, and aggregation indices were similar across all populations, indicating an aggregated parasite distribution in all cases. In the Caatinga domain, studies have reported a positive correlation between lizard size and parasite abundance in Restinga and Atlantic Forest environments (Araújo-Filho *et al.*, 2017; Brito *et al.*, 2014a). However, other studies have found no such correlation in lizards (Anjos *et al.*, 2008; Galdino *et al.*, 2014).

With our results, we highlight the importance of long-term studies, as opposed to one-off samples, in order to properly study the ecology of communities, not only of the adult hosts but also of the associated parasitic fauna, since the samples collected at PNHR Fazenda Almas were taken punctually over three different years, possibly collecting different generations of hosts, unlike the other sampling areas, where collections take place over the course of a year and/or subsequent years. This may be an important factor, as the larger the lizard, the older it is, and, therefore, the more likely it is to have eaten a contaminated intermediate at some point in its life or to have had contact with infective larvae (Campião *et al.*, 2009). Therefore, the reason may not just be ecological, but probabilistic. Thus, other factors such as diet, habitat availability and use, environmental conditions, locomotion patterns, longevity, and phylogenetic factors also play essential roles in the dynamics of the parasite in lizard populations (Aho, 1990; Brito *et al.*, 2014a).

For seasonal variations, we analyzed only the populations for which data were available, specifically those from Chapada do Araripe and PNHR Fazenda Almas. Our results showed that males were more parasitized than females during the wet season in Chapada do Araripe, whereas no significant differences were observed in PNHR Fazenda Almas. Several factors can influence parasite infections, ranging from host physiology to hormonal changes that may increase susceptibility to parasites and even alter behavior (Moller *et al.*, 2003). Environmental variation can significantly impact both parasite and host biology (Hamilton & Zuk, 1982; Schall & Dearing, 1987; Zuk & McKean, 1996; Salvador *et al.*, 1996). Seasonality, in turn, can influence lizard foraging frequency, as resource availability is greater in the rainy season than in the dry season. These findings align with Sousa *et al.* (2007), who reported that *E. perditus* males had higher parasite loads than females. Brito *et al.* (2014a) found a significant correlation between male infection rates and endoparasite prevalence in *Ameivula ocellifera* (Spix, 1825) and *Tropidurus semitaeniatus*. In the same study, the author observed a correlation between *T. hispidus* infection and the rainy season, linking parasite infection to humidity, which alters the ingestion of parasite eggs by intermediate hosts (Anderson, 2000).

Enyalius bibronii exhibited a moderate parasite richness (7 spp.) compared to studies on other species within the genus. Composition and infection rates varied across different populations, but without a clear pattern. The relation between body size and infection observed only in PNHR Fazenda Almas, as suggested by Oliveira *et al.* (2022), may reflect a greater variation in the average size of the analyzed individuals. Therefore, we conclude that host size does not appear to be a predictive factor for parasite composition in *E. bibronii*. The analysis of sex, seasonality, and their interaction was significant only in the Chapada do Araripe. Although this result was statistically significant, it may be linked to local environmental dynamics, as the slopes of Chapada do Araripe is a mesic region with higher humidity and precipitation than the Caatinga *stricto sensu* areas.

In this study, we present new parasite records for *Enyalius bibronii* in four conservation areas in northeastern Brazil, expanding knowledge of host-parasite biology. We highlight the unique parasite composition in each area, emphasizing the need for future studies to evaluate parasite distribution comprehensively. Such research is crucial for understanding the true diversity of species within these communities and the ecological relationships they maintain throughout their range, potentially revealing parasite dispersal mechanisms alongside their hosts.

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