

# Pentastomids infecting an invader lizard, *Hemidactylus mabouia* (Gekkonidae) in northeastern Brazil

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(With 1 figure)

## Abstract

From January to April 2006, 37 specimens of *Hemidactylus mabouia* were collected in houses, in the municipality of Barbalha (7° 20' S and 39° 18' W), Ceará State, Northeast Brazil. Among the individuals captured, 17 were infected with pentastomids, totalling a prevalence of 45.9%, which did not differ between sexes. Host size did not influence the infection intensity. Two species of pentastomids were found: *Raillietiella frenatus* and *R. mottae*. The prevalence of *R. frenatus* (43.2%) was higher than *R. mottae* (2.7%), whereas the infection intensity of *R. frenatus* was comparatively lower ( $1.8 \pm 1.4$ ) than *R. mottae* (36 parasites in a single host). Overall mean intensity of infection was  $3.8 \pm 8.4$  pentastomids. We found no pentastomid infecting juvenile geckos. The parameters of infection in this host population are in accordance to the findings of other studies, in which the high parasitism rate was associated to the feeding habits of geckos living in houses and buildings. *Hemidactylus mabouia* is a new host to *R. mottae* and the infection by *R. frenatus* is the first record of the occurrence this pentastomid species in Brazil.

**Keywords:** *Raillietiella*, Pentastomida, house geckos, neotropical region.

## Pentastomídeos infectando um lagarto invasor, *Hemidactylus mabouia* (Gekkonidae), na região nordeste do Brasil

### Resumo

De janeiro a abril de 2006 foram coletados 37 espécimes de *Hemidactylus mabouia* em domicílios no município de Barbalha (7° 20' S e 39° 18' W), Estado do Ceará, Nordeste do Brasil. Entre os indivíduos capturados, 17 estavam infectados com pentastomídeos, totalizando uma prevalência de 45,9%, sem diferenças significantes entre os sexos. O tamanho dos hospedeiros também não influenciou na intensidade de infecção. Duas espécies de pentastomídeos foram encontradas: *Raillietiella frenatus* e *R. mottae*. A prevalência de *R. frenatus* (43,2%) foi mais alta do que a de *R. mottae* (2,7%), enquanto que a intensidade média de infecção de *R. frenatus* foi comparativamente mais baixa ( $1.8 \pm 1.4$ ) do que a de *R. mottae* (36 parasitas em um único indivíduo). A intensidade geral de infecção foi de  $3.8 \pm 8.4$  pentastomídeos. Não foi encontrado nenhum gecko juvenil infectado por pentastomídeo. Os parâmetros de infecção nesta população de hospedeiros estão de acordo com outros estudos, que indicam altas taxas de parasitismo associadas com os hábitos alimentares de geckos vivendo em domicílios e edificações. *Hemidactylus mabouia* representa um novo hospedeiro para *R. mottae* e a infecção por *R. frenatus* constitui o primeiro registro de ocorrência desta espécie de pentastomídeo no Brasil.

**Palavras-chave:** *Raillietiella*, Pentastomida, geckos domiciliares, região neotropical.

### 1. Introduction

Some invader lizards of the genus *Hemidactylus* (Gekkonidae) have contributed to the decrease and extinction of native lizard fauna in different regions of the planet (Selcer, 1986; Dixon, 1987; Riley et al., 1988; Criscione and Font, 2001). The gecko *Hemidactylus mabouia* is a broadly distributed species in the tropics

which invaded the New World after accidental introductions, becoming a successful colonizer widely represented in southern North America and in Central and South America (Federico and Cacivio, 2000).

Throughout its range, *H. mabouia* has harboured an extensive parasitic fauna composed of protozoans, platy-

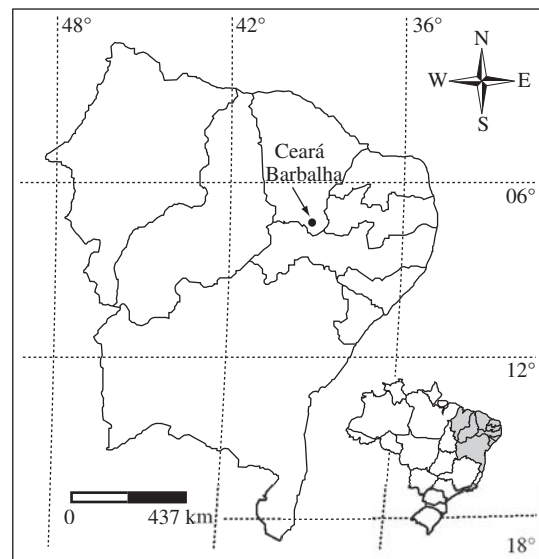
helminthes, acanthocephalans, nematodes, pentastomids, and mites (Ali et al., 1985; Simonsen and Sarda, 1985; Lainson and Paperna, 1999; Martínez-Rivera et al., 2003). However, few studies have been performed to evaluate to what extent this parasitic fauna was 'left behind' during the colonization process or if a subset of it was carried with their invader hosts. Recent studies have shown that *Hemidactylus turcicus* and *H. mabouia* have played a minor role in the introduction of their exotic parasites, indeed that exotic hosts have been colonized by native fauna of parasites, as reported by Vicente et al. (1993); Hanley et al. (1995); Criscione and Font (2001); Anjos et al. (2005). However, one parasite mite, *Geckobia hemidactyli*, seems to have accompanied *H. mabouia* throughout its dispersion towards the western (Martínez-Rivera et al., 2003).

Pentastomids are common parasites of the respiratory tract of vertebrates, with more than 130 species described (Almeida and Christoffersen, 1999; 2002; Rego, 1983; 1984). Knowledge on infection by the pentastomid *Raillietiella* on geckos in the Americas is scarce, although the African pentastomids *Raillietiella frenatus* and *R. teagueselfi* were reported in the lungs of the exotic gecko *Hemidactylus turcicus* in Texas and Florida (USA) (Pence and Selcer, 1988; Riley et al., 1988; 1991). In Central America there has been only one report of pentastomid in the lungs of *H. mabouia* (formerly identified as *R. frenatus*) in Puerto Rico (Self and Diaz, 1961). In Brazil, few works concerning raillietielids as lizard parasites have been reported: *Raillietiella freitasi* in the lungs of *Thracylepis atlanticus* (formerly *Mabuya punctata*), from Fernando de Noronha Island (situated on the northeastern coast) (Motta, 1963; Motta and Gomes, 1968; Rego, 1983; 1984); larvae of *Raillietiella* sp. in skink *Mabuya agilis* reported by Vrcibradic et al. (2002); Dias et al. (2005) reported a likely new species of *Raillietiella* aff. *furcocerca* infecting *Cnemidophorus abaetensis* and *Cnemidophorus ocellifer*; and Almeida et al. (2008) described *R. mottae* living in the lungs of *Tropidurus hispidus*, a dweller of Cariri (a microregion of Ceará State).

In this study we evaluate pentastomid infection in a population of the exotic gecko *H. mabouia* living in an urban area in northeastern Brazil, specifically addressing: i) what is the composition of pentastomid fauna; and ii) to what extent do the host sex and size affect the parameters of infection (prevalence and intensity) by pentastomids.

## 2. Material and Methods

We collected 37 specimens of *Hemidactylus mabouia* from January through April 2006 in human buildings (houses) in the municipality of Barbalha (7° 18' S and 39° 18' W, Figure 1), southern Ceará state, in Northeastern Brazil. The climate of the area is predominantly mild hot semi-arid, with a mean annual temperature varying from 24 to 26 °C and an annual rainfall of 1153 mm, with



**Figure 1.** Location of the study area in Northeastern Brazil. The municipality of Barbalha (Ceará) is indicated by the black dot.

a marked rainy period from January to April and a dry season from May to December. The vegetation in the area is composed of plant species common to Caatinga, Cerrado, wet forest, and transitional zones between these adjacent biomes (IPECE, 2005).

Lizards were collected by hand, being promptly euthanized with ether and fixed with formalin 10% and posteriorly preserved in ethanol 70%. Lizard snout-vent length (SVL) was measured with a ruler (to the nearest 1 mm). Voucher specimens were housed in the Zoological Collection of the Universidade Regional do Cariri (LZ-URCA): 323-332, 334, 336, 338, 339, 341-355, 368-375.

We removed the lungs of the geckos which were carefully checked under a stereomicroscope to search for pentastomids. The pentastomids found were either preserved in ethanol 70% or mounted on slides and treated with a Hoyer medium. Their identification was based on the dimension of hooks and the copulatory spicules of males (Rego, 1983; 1984; Ali et al., 1981; 1984a, b, 1985). The specimens found were compared with representative material from two collections: the Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC) and the Zoological Collection of the Laboratory of the Universidade Regional do Cariri (LZ-URCA) in order to confirm parasite identity: *Raillietiella freitasi* (CHIOC 20420, 20421, 20429, 20431, 20432, 20434, 20439, 30325a-c, 30326, 30327, 30328, 30329a-c, 30330a-b) and *R. mottae* (LZ-URCA 0201-212).

The ecological terms in parasitology used in the present study follow Bush et al. (1997). A *t*-test was performed to evaluate if there was a significant difference between size (SVL) of hosts and to test for sexual differ-

ences in adult lizards in terms of intensity of infection. Sexual differences in overall prevalence were tested using the Z-test for proportions (Zar, 1999). The effect of lizard host size (SVL in mm) on pentastomid lung infection rate was analysed using the Spearman rank correlation (Zar, 1999). For the estimates of the relationship between host size (SVL in mm) and intensity of infection, only the hosts parasitized by *R. frenatus* were included, because of the greater prevalence of this parasite and also due to the possibility of misunderstanding the interpretation of results due to the occurrence of an ‘outlier’ (a highly infected female – see below).

### 3. Results

We sampled a total of 37 geckos, being 10 juveniles (mean SVL = 30.2 ± 7.5 mm; range = 17.0-38.0 mm), 11 adult females (mean SVL = 58.5 ± 4.3 mm; range = 52.0-65.0 mm), and 16 adult males (mean SVL = 55.6 ± 6.0 mm; range = 48.0-65.0 mm) (Table 1). The sexes of the lizard did not differ significantly in terms of SVL (*t*-test: *t* = 1.395; *df* = 25; *p* = 0.175). However, adult and juvenile geckos differed significantly in SVL (*t* = 11.918; *df* = 35; *p* < 0.001).

We found only two species of Pentastomida infecting *H. mabouia*: *Raillietiella frenatus* and *R. mottae*, which were infecting the lungs of lizards. These are the first records of occurrence of the pentastomids *R. frenatus* in Brazil, and *H. mabouia* is a new host to *R. mottae*. Of the 37 geckos analyzed, 17 individuals were parasitized by at least one species of pentastomid (overall prevalence of 45.9%, Table 1). The overall prevalence in adult females was 54.5% (6/11; Table 1) whereas within adult males, it was 68.8% (11/16; Table 1), but the differences among adults of the sexes was not significant (Z-test:  $Z_c = 0.34$ ; *p* = 0.730). We found no pentastomid infecting juvenile geckos.

The mean intensity of infection of *R. frenatus* was 1.8 ± 1.4 pentastomids (Table 1), whereas the infection rate of a single female infected by *R. mottae* was 36 parasites (Table 1). Overall mean intensity of infection was 3.8 ± 8.4 pentastomids (Table 1). Mean intensity of infection by *R. frenatus* did not differ significantly (*t*-test: *t* = 1.164; *df* = 14; *p* = 0.264) between adult females (2.4 ± 1.9; Table 1) and adult males (1.5 ± 1.0; Table 1).

The size of adult host lizards (SVL) did not influence the intensity of infection ( $r_s = 0.489$ ; *p* = 0.055; *n* = 16), but this result could be due to the low number of female hosts ( $r_s = 0.229$ ; *p* = 0.710; *n* = 5).

### 4. Discussion

From a historical perspective, *R. frenatus* probably followed the colonization movements of *Hemidactylus* spp. (Self and Diaz, 1961; Riley et al., 1991) whereas *R. mottae* seems to have been acquired in the New World, from a native lizard species, *T. hispidus* (Almeida et al., 2008).

The overall prevalence (45.9%) of pentastomids infecting the studied population of *H. mabouia* was markedly lower than those reported for *H. mabouia* from Puerto Rico (89%; Simonsen and Sarda, 1985) and for *H. haitianus* from the Caribbean Hispaniola Island (62%; Powell et al., 1993), but they were higher than *H. turcicus* from the United States (19.8%; Riley et al., 1988) and *H. frenatus* from Indonesia (25-33%; Matsuo and Oku, 2002). In Brazil, the studies have shown unequal prevalence in native lizards species *Mabuya agilis* (3.6-9.0%; Vrcibradic et al., 2002); *Cnemidophorus abaetensis* (6.0%; Dias et al., 2005), and *C. ocellifer* (2.5%; Dias et al., 2005); and *Tropidurus hispidus* (11.1%; Almeida et al., 2008).

Juvenile *H. mabouia* lizards were not infected by pentastomids. This may result from the fact that larger and probably older geckos tend to present a greater diversity of parasites, prevalence, and mean intensity of infection due to the comparatively longer time of exposition and contact with infection sources (Vogel and Bundy, 1987; Cunha-Barros et al., 2003). The diet composition of hosts also could influence these infection parameters (Rocha, 1989; Vitt, 2000; Anjos et al., 2005). The diet of host *H. mabouia* juveniles usually includes only ants and termites; whereas the stomachs of adult individuals contain various types of arthropods, including larger items such as spiders, cockroaches, and moths (Almeida, present data; Rocha and Anjos, 2007). We do not know to what extent such ontogenetic differences in diet composition may favour the absence of pentastomid parasites in juvenile geckos of the population studied here.

**Table 1.** Snout-vent length (mm) ± standard Deviation, Overall Prevalence (%) and Intensity of infection by *Raillietiella frenatus* and *R. mottae* in *Hemidactylus mabouia* from Barbalha municipality, Brazil.

Host	SVL (mm)	N	Parasite species				Overall	
			<i>Raillietiella frenatus</i>		<i>Raillietiella mottae</i>		Prevalence (%)	Intensity of Infection
			Prevalence (%)	Intensity of Infection	Prevalence (%)	Intensity of Infection		
Males	55.6 ± 6.0	16	68.80	1.5 ± 1.0	0.0	-	68.8	1.5 ± 1.0
Females	58.5 ± 4.3	11	45.4	2.4 ± 1.9	9.1	36	54.5	8.0 ± 13.8
Juveniles	30.2 ± 7.5	10	0.0	-	0.0	-	0.0	-
Total	-	37	43.2	1.8 ± 1.4	2.7	36	45.9	3.8 ± 8.4

*Raillietiella mottae* was found in just one individual lizard host (low prevalence, 2.7%) with high infection intensity (36 pentastomids). The mean intensity of infection by *Raillietiella frenatus* ( $1.8 \pm 1.4$ ) was similar to other mean intensity values reported for other pentastomids species in Brazil and some other lizard hosts in natural infections:  $1.0 \pm 0.0$  in *Mabuya agilis* (Vrcibradic et al., 2002);  $4.5 \pm 0.0$  in *Cnemidophorus abbaetensis* (Dias et al., 2005);  $1.0 \pm 0.0$  in *C. ocellifer* (Dias et al., 2005); and  $6.0 \pm 1.4$  in *Tropidurus hispidus* (Almeida et al., 2008). However, a single host female parasitized by *R. mottae* presented a high intensity of infection (36 parasites) as compared with all the above-mentioned other host data. We are fully aware that our small sampling does not enable us to make generalizations about the high degree of infection and consequent damage caused by *R. mottae* in *H. mabouia* in Brazil.

Although the prevalence between males (68.8%) and females (54.5%) did not differ, the infection intensity was higher in females ( $2.4 \pm 1.9$ ) than in males ( $1.5 \pm 1.0$ ). Since males and females did not differ in size, diet and habitat use, as we observed in situ, this could explain the similar prevalence between males and females. However, the difference in infection rates between males and females could be explained by inherent factors.

In Gekkonidae, particularly in house dweller species, their egg-contaminated faeces and prey items (such as cockroaches) usually result in very high prevalence and intensity of pentastomid infection (Ali and Riley, 1983; Riley et al., 1991). Thus, such trophic relationship of house geckos may explain in part the relative difference between the infection rates of *H. mabouia* and other sympatric lizards in northeast Brazil and very likely in other regions of this country.

It has been demonstrated experimentally that *R. frenatus* may utilize cockroaches as intermediate hosts (Ali and Riley, 1983; Jeffery et al., 1985; Bosch, 1986). The success in associating to new intermediate hosts might have been the keystone for *R. frenatus* to maintain itself in exotic hosts and would be favored due to widely distributed intermediate hosts like cockroaches (Criscione and Font, 2001).

Pentastomids have shown to be regulator parasites of lizard populations (Riley et al., 1991). The way exotic pentastomids act on native lizards and their potential host regulatory capacity upon exotic gecko populations deserves further studies. Our understanding of these questions may contribute to the adaptive success and establishment of this exotic lizard and consequently its regulatory process.

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