


## Ticks (Acari: Ixodidae) of the state of Amazonas, Brazil

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**Abstract** The tick fauna of Brazil is currently composed by 72 species. The state of Amazonas is the largest of Brazil, with an area of  $\approx 19\%$  of the Brazilian land. Besides its vast geographic area, only 19 tick species have been reported for Amazonas. Herein, lots containing ticks from the state of Amazonas were examined in three major tick collections

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from Brazil. A total of 5933 tick specimens were examined and recorded, comprising 2693 males, 1247 females, 1509 nymphs, and 484 larvae. These ticks were identified into the following 22 species: *Amblyomma cajennense* sensu lato, *Amblyomma calcaratum*, *Amblyomma coelebs*, *Amblyomma dissimile*, *Amblyomma dubitatum*, *Amblyomma geayi*, *Amblyomma goeldii*, *Amblyomma humerale*, *Amblyomma latepunctatum*, *Amblyomma longirostre*, *Amblyomma naponense*, *Amblyomma oblongoguttatum*, *Amblyomma ovale*, *Amblyomma rotundatum*, *Amblyomma scalpturatum*, *Amblyomma varium*, *Dermacentor nitens*, *Haemaphysalis juxtakochi*, *Ixodes* cf. *Ixodes fuscipes*, *Ixodes luciae*, *Rhipicephalus microplus*, *Rhipicephalus sanguineus* sensu lato. Ticks were collected from 17 (27.4%) out of the 62 municipalities that currently compose the state of Amazonas. The following four species are reported for the first time in the state of Amazonas: *A. coelebs*, *A. dubitatum*, *H. juxtakochi*, and *Ixodes* cf. *I. fuscipes*. The only tick species previously reported for Amazonas and not found in the present study is *Amblyomma parvum*. This study provides a great expansion of geographical and host records of ticks for the state of Amazonas, which is now considered to have a tick fauna composed by 23 species. It is noteworthy that we report 1391 *Amblyomma* nymphs that were identified to 13 different species.

**Keywords** Tick fauna · Amazon · *Amblyomma*

## Introduction

The tick fauna of Brazil is currently composed by 72 species, 47 in the Ixodidae family, and 25 in the Argasidae family (Labruna et al. 2016; Dall'Agnol et al. 2017; Muñoz-Leal et al. 2017). The state of Amazonas is the largest of Brazil, with an area of 1,567,954 km<sup>2</sup>, ≈ 19% of the Brazilian land, and at the same time larger than the area of Colombia or Venezuela. Amazonas is entirely located in the Amazon biome, which is still well preserved. In fact, because Amazonas preserves > 95% of its Amazon forest, it bears the second lowest population density of Brazil (2.57 inhabitants/km<sup>2</sup>); its population in the year 2016 (4,001,667 inhabitants, with ≈ 54% living in the capital Manaus) represented less than 2% of the Brazilian population (official data available at [www.ibge.gov.br](http://www.ibge.gov.br)).

Besides its vast geographic area, the Amazon tick fauna is currently known only from isolated studies, usually related to a single species of tick or to specific groups of hosts. Based on these studies, only the following 19 tick species (26.4% of the Brazilian tick fauna) have been reported for the Amazonas state: *Ixodes luciae* Sénevet (Onofrio et al. 2010), *Amblyomma cajennense* (Fabricius) sensu stricto (Rosas et al. 2016), *Amblyomma calcaratum* Neumann (Guimarães et al. 2001; Martins et al. 2014), *Amblyomma dissimile* Koch (Adis 1981), *Amblyomma geayi* Neumann (Voltzit 2007; Labruna et al. 2009), *Amblyomma goeldii* Neumann (Martins et al. 2015), *Amblyomma humerale* Koch (Aragão 1936; Labruna et al. 2002), *Amblyomma latepunctatum* Tonelli-Rondelli (Labruna et al. 2005a), *Amblyomma longirostre* (Koch) (Martins et al. 2014), *Amblyomma naponense* (Packard) (Soares et al. 2014), *Amblyomma oblongoguttatum* Koch (Guglielmone et al. 2006; Soares et al. 2014), *Amblyomma ovale* Koch (Guglielmone et al. 2003; Soares et al. 2014), *Amblyomma parvum* Aragão

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(Mullins 2004), *Amblyomma rotundatum* Koch (Aragão, 1936), *Amblyomma sculpturatum* Neumann (Labruna et al. 2005a; Soares et al. 2014), *Amblyomma varium* Koch (Marques et al. 2002), *Dermacentor nitens* Neumann (Labruna et al. 2005b), *Rhipicephalus microplus* (Canestrini) (Aragão 1936), and *Rhipicephalus sanguineus* (Latreille) sensu lato (s.l.) (Castro and Rafael 2006).

In order to expand our knowledge of the poorly known tick fauna of Amazonas state, the present study compiled all tick records of the Amazonas state that have been deposited in three major tick collections of Brazil.

## Materials and methods

Lots containing ticks from the state of Amazonas were examined in the following three tick collections from Brazil: “Coleção Zoológica Paulo Bürrnheim da Universidade Federal do Amazonas, seção Ixodidae” (CZPB-UFAM-IX; curator: S.G.), Manaus, State of Amazonas; “Coleção Nacional de Carrapatos Danilo Gonçalves Saraiva” (CNC; curators: M.B.L. and T.F.M.) of the University of São Paulo, São Paulo City, state of São Paulo; and “Coleção de Ácaros do Instituto Butantan” (IBSP; curator: V.C.O.), São Paulo City. Tick taxonomical identifications followed Barros-Battesti et al. (2006), Onofrio et al. (2009; 2010), and Martins et al. (2010; 2013; 2015). From each tick lot, we considered the information regarding host, locality (municipality), and date. All lots from the CZPB comprise unpublished reports, while only a minority of the data from CNC and IBSP has been previously reported, as stated in our results.

## Results and discussion

Grouping the three tick collections, a total of 5933 tick specimens were examined and recorded, comprising 2693 males, 1247 females, 1509 nymphs, and 484 larvae (Table S1). These ticks were identified into 22 species, as shown in Table 1. Other ticks could not be identified to species level due to lack of literature support (larvae of the genera *Amblyomma*, *Haemaphysalis* and *Ixodes*, and a few nymphs of *Haemaphysalis* and *Ixodes*). Ticks were collected from 18 (29.0%) out of the 62 municipalities that currently compose the state of Amazonas (Fig. 1). The following four species are reported for the first time in the state of Amazonas: *Amblyomma coelebs* Neumann, *Amblyomma dubitatum* Neumann, *Haemaphysalis juxtakochi* Cooley, and *Ixodes* cf. *Ixodes fuscipes* Koch. The former taxon is provisionally treated with “cf.” because its external morphology presented slight differences to *I. fuscipes* (comparing to the type specimen deposited in the Zoologischen Museums Berlin (ZMB) tick collection, which will be presented in detail in another manuscript, still in progress (V.C.O., S.G., M.B.L., unpublished data).

Nava et al. (2010) reported that the distribution of *A. dubitatum* in South America was concentrated in several biomes (e.g., Pampa, Chaco, Cerrado, Brazilian Atlantic Forest) but not in the Amazon. Therefore, our unprecedented record of a *A. dubitatum* female from Sta. Isabel Rio Negro Municipality (northern part of the state) is at least atypical at this moment. In fact, the principal host of *A. dubitatum*, the capybara (*Hydrochoerus hydrochaeris*), is usually parasitized by another tick species, *Amblyomma*

**Table 1** Tick species collected in the state of Amazonas, Brazil

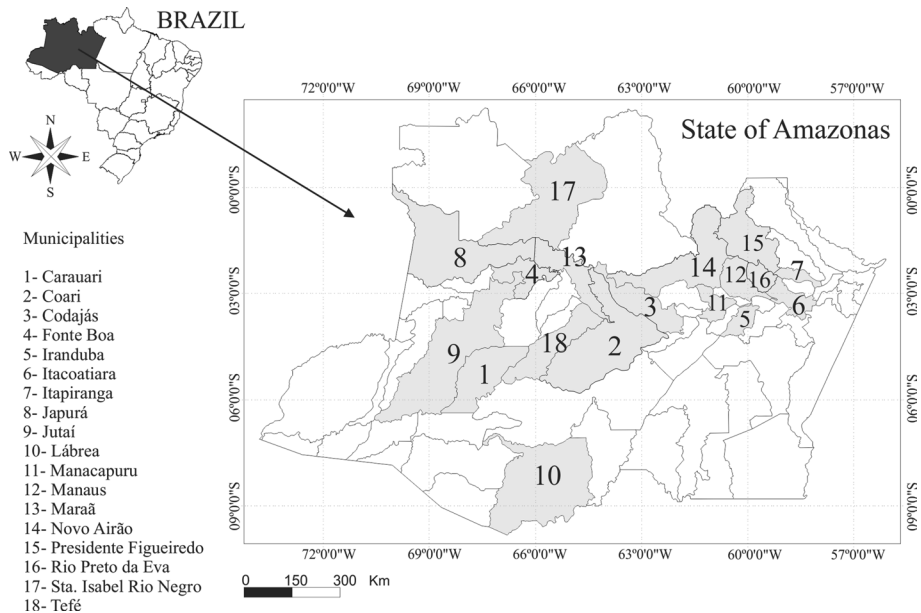
Tick species	No. specimens per tick stage				Municipalities <sup>b</sup>
	Males	Females	Nymphs	Larvae	
<i>Amblyomma cajennense</i> s.l. <sup>a</sup>	2				12,15
<i>Amblyomma calcaratum</i>	1	1			Not informed
<i>Amblyomma coelebs</i>	3	5	7		2,4,12,15,17
<i>Amblyomma dissimile</i>	337	432	882		10,12,14
<i>Amblyomma dubitatum</i>		1			17
<i>Amblyomma geayi</i>	1570	426	414		5,11,12,14,16-18
<i>Amblyomma goeldii</i>	304	109			3,7,12,15
<i>Amblyomma humerale</i>	119	28	21		4,8,10,12,15-17
<i>Amblyomma latepunctatum</i>	12	4	12		2,8,11,12,15-17
<i>Amblyomma longirostre</i>	1	1	1		1,12
<i>Amblyomma naponense</i>	30	14	11		2,7,8,10,12,15,17
<i>Amblyomma oblongoguttatum</i>	1	1	9		11,15,17
<i>Amblyomma ovale</i>	17	9	9		2,12,13,15,17
<i>Amblyomma rotundatum</i>		6	14		6,12,18
<i>Amblyomma sculpturatum</i>	2	2	8		2,4,8,12,17
<i>Amblyomma varium</i>	278	114	3		5,12
<i>Amblyomma</i> spp.				435	5,8,10,12,14,17,18
<i>Dermacentor nitens</i>	3	2			12
<i>Haemaphysalis juxtakochi</i>	8	7	3		6,12,17
<i>Haemaphysalis</i> sp.			1	2	12
<i>Ixodes</i> c.f. <i>Ixodes fuscipes</i>	1	72	96	35	12,15
<i>Ixodes luciae</i>		3	1		12,17
<i>Ixodes</i> sp.			17	12	12
<i>Rhipicephalus microplus</i>	1	1			Not informed
<i>Rhipicephalus sanguineus</i> s.l.	3	9			12,15
Total	2693	1247	1509	484	

<sup>a</sup>We consider these records as *A. cajennense* sensu lato (s.l.) because they refer to only 2 males, precluding a conclusive diagnosis of the species of the *A. cajennense* species complex, as discussed elsewhere (Martins et al. 2016)

<sup>b</sup>Municipality numbers represented in Fig. 1

*romitii* Tonelli-Rondelli in the Amazon region (Labruna et al. 2010). Since there are records of *A. romitii* in tree neighboring states of Amazonas (Mato Grosso, Pará and Rondônia) (Labruna et al. 2010; Sampaio et al. 2010; Witter et al. 2016), it is likely that this tick species is also present in Amazonas, a condition yet to be recorded.

Castro and Serra Freire (1996) reported *A. calcaratum* for the state of Amazonas; however, the location reported by these authors (Samuel Hydroelectric dam) is actually located in another state (Rondônia). Herein, we present a single record of *A. calcaratum* from unknown locality and host in the state of Amazonas, based on a lot from the IBSP tick collection. It seems that this single report was previously considered by Guimarães et al. (2001), who mentioned without details the presence *A. calcaratum* in Amazonas state. More recently, Martins et al. (2014) reported *A. calcaratum* nymphs on passerine



**Fig. 1** Municipalities where ticks were collected in the state of Amazonas, Brazil

birds in Santa Isabel do Rio Negro municipality, confirming the presence of this tick species in Amazonas.

While Aragão (1936) reported *A. incisum* for the state of Amazonas, a more recent revision of this taxon did not confirm its presence in that Brazilian state (Labruna et al. 2005a). In fact, many earlier lots of *A. incisum* from the Amazon region were recently reclassified as *A. latepunctatum* (Labruna et al. 2005a); therefore, the presence of *A. incisum* in Amazonas, albeit probable, is yet to be confirmed by bona fide records.

Aragão (1913) reported a lot of *Amblyomma pictum* Neumann (reported as *Amblyomma conspicuum* Aragão) from “Xingu River, state of Amazonas”. However, Xingu River belongs to the states of Mato Grosso and Pará, two neighboring states of Amazonas. Therefore, we are not considering valid the presence of *A. pictum* in the state of Amazonas.

The only tick species previously reported for Amazonas and not found in the present study is *A. parvum*, with a single record by Mullins (2004). A recent biogeographical study of *A. parvum* in South America demonstrated that this tick species is typically associated with dry areas; i.e., Cerrado, Caatinga, and Chaco biomes; and at the same time, absent from the Amazon biome (Nava et al. 2016). Therefore, this single record by Mullins (2004) for the state of Amazonas is at least atypical, requiring further analyses.

This study provides a great expansion of geographical and host records of ticks for the state of Amazonas, which is now considered to have a tick fauna composed by 23 species. It is noteworthy that we report 1391 *Amblyomma* nymphs that were identified to 13 different species. This procedure was impossible until few years ago, when the current taxonomic literature for *Amblyomma* nymphs was not yet available (Martins et al. 2010, 2013, 2015, 2016). Finally, our study was somewhat biased to Manaus municipality (the state Capital) because 82% of all tick records were from this municipality. Given the great

extension of the Amazonas state, associated with lack of studies in most of its municipalities, indeed more tick species are to be reported from the Amazonas state in future studies.

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## References

- Adis J (1981) Observações eco-entomológicas da Amazônia: I. Um carrapato ectoparasito da Boa constritor. *Acta Amazon* 11:407
- Aragão H (1913) Nota sobre algumas coleções de carrapatos brasileiros. *Mem Inst Oswaldo Cruz* 5:263–270
- Aragão H (1936) Ixodidas brasileiros e de alguns países limitrofes. *Mem Inst Oswaldo Cruz* 31:759–843
- Barros-Battesti DM, Arzua M, Bechara GH (2006) Carrapatos de importância médico-veterinária da Região Neotropical: Um guia ilustrado para identificação de espécies. *Vox/International Consortium on Ticks and Tick-borne Diseases (ICTTD-3)/Butantan, São Paulo, Brazil*, p 223
- Castro MCM, Rafael JA (2006) Ectoparasitos de cães e gatos da cidade de Manaus, Amazonas, Brasil. *Acta Amaz* 36:535–538
- Castro GR, Serra Freire NM (1996) Revision of the tick fauna: I. Anteaters (*Tamandua* sp.). *Entomol Vectores* 3:63–65
- Dall’Agnol B, Michel T, Weck B, Souza UA, Webster A, Leal BF, Klafke GM, Martins JR, Ott R, Venzal JM, Ferreira CAS, Reck J (2017) *Borrelia burgdorferi* sensu lato in *Ixodes longiscutatus* ticks from Brazilian Pampa. *Ticks Tick Borne Dis* 8:928–932
- Guglielmone AA, Estrada-Peña A, Mangold AJ, Barros-Battesti DM, Labruna MB, Martins JR, Venzal JM, Arzua M, Keirans JE (2003) *Amblyomma aureolatum* (Pallas, 1772) and *Amblyomma ovale* Kock, 1844: hosts, distribution and 16S rDNA sequences. *Vet Parasitol* 113:273–288
- Guglielmone AA, Beati L, Barros-Battesti DM, Labruna MB, Nava S, Venzal JM, Mangold AJ, Szabó MJP, Martins JR, Gonzalez Acuña D, Estrada-Peña A (2006) Ticks (Ixodidae) on humans in South America. *Exp Appl Acarol* 40:83–100
- Guimarães JH, Tucci EC, Barros-Battesti DM (2001) Ectoparasitos de importância veterinária. Editora Plêiade, São Paulo, Brazil, p 213
- Labruna MB, Camargo LMA, Terrasini FA, Schumaker TTS, Camargo EP (2002) Notes on parasitism by *Amblyomma humerale* (Acari: Ixodidae) in the state of Rondônia, Western Amazon, Brazil. *J Med Entomol* 39:814–817
- Labruna MB, Keirans JE, Camargo LMA, Ribeiro AF, Martins RS, Camargo EP (2005a) *Amblyomma latepunctatum*, a valid tick species (Acari: Ixodidae) long misidentified with both *Amblyomma incisum* and *Amblyomma scalpturatum*. *J Parasitol* 91:527–541
- Labruna MB, Camargo LMA, Terrasini FA, Ferreira F, Schumaker TT, Camargo EP (2005b) Ticks (Acari: Ixodidae) from the state of Rondônia, western Amazon, Brazil. *Syst Appl Acarol* 10:17–32
- Labruna MB, Onofrio VC, Beati L, Arzua M, Bertola PB, Ribeiro AF, Barros-Battesti DM (2009) Redescription of the female, description of the male, and several new records of *Amblyomma parkeri* (Acari: Ixodidae), a South American tick species. *Exp Appl Acarol* 49:243–260
- Labruna MB, Barbieri FS, Martins TF, Brito LG, Ribeiro FD (2010) New tick records in Rondônia, Western Brazilian Amazon. *Rev Bras Parasitol Vet* 19:192–194
- Labruna MB, Nava S, Marcili A, Barbieri AR, Nunes PH, Horta MC, Venzal JM (2016) A new argasid tick species (Acari: Argasidae) associated with the rock cavy, *Kerodon rupestris* Wied-Neuwied (Rodentia: Caviidae), in a semiarid region of Brazil. *Parasit Vectors* 9:511
- Marques S, Barros-Battesti DM, Faccini JL, Onofrio VC (2002) Brazilian distribution of *Amblyomma varium* Koch, 1844 (Acari: Ixodidae), a common parasite of sloths (Mammalia: Xenarthra). *Mem Inst Oswaldo Cruz* 97:1141–1146
- Martins TF, Onofrio VC, Barros-Battesti DM, Labruna MB (2010) Nymphs of the genus *Amblyomma* (Acari: Ixodidae) of Brazil: descriptions, redescriptions, and identification key. *Ticks Tick Borne Dis* 1:75–99

- Martins TF, Scofield A, Oliveira WBL, Nunes PH, Ramirez DG, Barros-Battesti DM, Sá LRM, Ampuero F, Souza JC Jr, Labruna MB (2013) Morphological description of the nymphal stage of *Amblyomma geayi*, and new nymphal records of *Amblyomma parkeri*. Ticks Tick Borne Dis 4:181–184
- Martins TF, Fecchio A, Labruna MB (2014) Ticks of the genus *Amblyomma* (Acari: Ixodidae) on wild birds in the Brazilian Amazon. Syst Appl Acarol 19:385–392
- Martins TF, Gianizella SL, Nunes PH, Faria DC, Nascimento CA, Abrahão CR, Miranda FR, Teixeira RH, Ramirez DG, Barros-Battesti DM, Labruna MB (2015) New records of *Amblyomma goeldii* (Acari: Ixodidae) and description of the nymphal stage. Zootaxa 3949:439–444
- Martins TF, Barbieri ARM, Costa FB, Terassini FA, Camargo LMA, Peterka CRL, Pacheco RC, Dias RA, Nunes PH, Marcili A, Scofield A, Campos AK, Horta MC, Guilloux AG, Benatti HR, Ramirez DG, Barros-Battesti DM, Labruna MB (2016) Geographical distribution of *Amblyomma cajennense* (sensu lato) ticks (Parasitiformes: Ixodidae) in Brazil, with description of the nymph of *A. cajennense* (sensu stricto). Parasit Vectors 9:186
- Mullins MC (2004) *Amblyomma parvum* a parasite of *Dasyypus kappleri* in the state of Amazonas, Brazil. Rev Ciênc Agrár Belém 42:287–291
- Muñoz-Leal S, Toledo LF, Venzal JM, Marcili A, Martins TF, Acosta IC, Pinter A, Labruna MB (2017) Description of a new soft tick species (Acari: Argasidae: *Ornithodoros*) associated with stream-breeding frogs (Anura: Cycloramphidae: *Cycloramphus*) in Brazil. Ticks Tick Borne Dis 8:682–692
- Nava S, Venzal JM, Labruna MB, Mastropaolo M, González EM, Mangold AJ, Guglielmo AA (2010) Hosts, distribution and genetic divergence (16S rDNA) of *Amblyomma dubitatum* (Acari: Ixodidae). Exp Appl Acarol 51:335–351
- Nava S, Gerardi M, Szabó MP, Mastropaolo M, Martins TF, Labruna MB, Beati L, Estrada-Peña A, Guglielmo AA (2016) Different lines of evidence used to delimit species in ticks: a study of the South American populations of *Amblyomma parvum* (Acari: Ixodidae). Ticks Tick Borne Dis 7:1168–1179
- Onofrio VC, Barros-Battesti DM, Labruna MB, Faccini JL (2009) Diagnoses of and illustrated key to the species of *Ixodes* Latreille, 1795 (Acari: Ixodidae) from Brazil. Syst Parasitol 72:143–157
- Onofrio VC, Labruna MB, Faccini JLH, Barros-Battesti DM (2010) Description of immature stages and redescription of adults of *Ixodes luciae* Sénevet (Acari: Ixodidae). Zootaxa 2495:53–64
- Rosas FCW, Sicsu da Cruz TM, Gianizella SL, dos Santos Ramalheira C, Martins TF (2016) A first record of ticks in free-ranging giant otter (*Pteronura brasiliensis*) in the Brazilian Amazon. IUCN Otter Spec Group Bull 33–1:3–7
- Sampaio SJ, Martins TF, Labruna MB, Onofrio VC, Faccini JLH, Barros-Battesti DM (2010) A second record of *Amblyomma romitii* Tonelli-Rondelli, 1939 (Acari: Ixodidae) from the State of Pará, Brazil. Syst Appl Acarol 15:184–186
- Soares HS, Camargo LMA, Gennari SM, Labruna MB (2014) Survey of canine tick-borne diseases in Lábrea, Brazilian Amazon: ‘accidental’ findings of *Dirofilaria immitis* infection. Rev Bras Parasitol Vet 23–4:473–480
- Voltzit OV (2007) A review of Neotropical *Amblyomma* species (Acari: Ixodidae). Acarina 15:3–134
- Witter R, Martins TF, Campos AK, Melo ALT, Corrêa SHR, Morgado TO, Wolf RW, May-Júnior JA, Sinkoc AL, Strussmann C, Aguiar DM, Rossi RV, Semedo TBF, Campos Z, Desbiez ALJ, Labruna MB, Pacheco RC (2016) Rickettsial infection in ticks (Acari: Ixodidae) of wild animals in midwestern Brazil. Ticks Tick Borne Dis 7:415–423