



Revista Brasileira de Parasitologia
Veterinária

ISSN: 0103-846X

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Colégio Brasileiro de Parasitologia
Veterinária
Brasil

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Revista Brasileira de Parasitologia Veterinária, vol. 18, núm. 3, julio-septiembre, 2009, pp.
22-28

Colégio Brasileiro de Parasitologia Veterinária
Jaboticabal, Brasil

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Ticks on domestic animals in Pernambuco, Northeastern Brazil

Carrapatos em animais domésticos em Pernambuco, Nordeste do Brasil

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Received June 23, 2008

Accepted August 18, 2009

Abstract

The objective of this article was to discuss some aspects of ticks associated with domestic animals in the State of Pernambuco, northeastern Brazil, based on a literature review and present new data obtained from recent tick collections carried out in this northeastern Brazilian state. From August 2007 to June 2008, 1,405 ticks were collected and five species were identified: *Amblyomma cajennense* (Fabricius, 1787), *Amblyomma ovale* Koch, 1844, *Dermacentor nitens* Neumann, 1897, *Rhipicephalus (Boophilus) microplus* (Canestrini, 1887), and *Rhipicephalus sanguineus* (Latreille, 1806). Dogs from urban areas were found exclusively infested by *R. sanguineus*, whereas dogs from rural areas were found infested by *A. cajennense*, *A. ovale*, *R. (B.) microplus*, and *R. sanguineus*. The only tick species found on cattle and goats was *R. (B.) microplus*. Horses were found infested by *D. nitens* and at a lesser extent by *A. cajennense* and *R. (B.) microplus*. The only tick species found on donkeys was *D. nitens*. This study confirms the presence of *A. cajennense* in Pernambuco and describes for the first time the presence of *A. ovale* in this state. The medical and veterinary relevance and control of ticks associated with domestic animals in Pernambuco are also briefly discussed.

Keywords: Ixodidae, Brazil, taxonomy, domestic animals.

Resumo

O objetivo desse artigo é discutir alguns aspectos relacionados aos carrapatos que parasitam animais domésticos no Estado de Pernambuco com base numa revisão da literatura e apresentar novos dados obtidos a partir de recentes coletas de carrapatos realizadas nesse estado do nordeste brasileiro. De agosto de 2007 a junho de 2008, 1.405 carrapatos foram coletados e cinco espécies foram identificadas: *Amblyomma cajennense* (Fabricius, 1787), *Amblyomma ovale* Koch, 1844, *Dermacentor nitens* Neumann, 1897, *Rhipicephalus (Boophilus) microplus* (Canestrini, 1887) e *Rhipicephalus sanguineus* (Latreille, 1806). Cães de áreas urbanas foram encontrados infestados exclusivamente por *R. sanguineus* ao passo que cães de áreas rurais foram encontrados parasitados por *A. cajennense*, *A. ovale*, *R. (B.) microplus* e *R. sanguineus*. A única espécie identificada sobre bovinos e caprinos foi *R. (B.) microplus*. Equinos foram encontrados infestados por *D. nitens* e menos frequentemente por *A. cajennense* e *R. (B.) microplus*. A única espécie de carrapato encontrada sobre asininos foi *D. nitens*. Esse estudo confirma a presença de *A. cajennense* em Pernambuco e registra pela primeira vez a presença de *A. ovale* nesse estado. A importância médica e veterinária e a situação do controle de carrapatos de animais domésticos em Pernambuco são brevemente discutidas.

Palavras-chave: Ixodidae, Brasil, taxonomia, animais domésticos.

Introduction

Ticks are known vectors of disease agents to humans and domestic animals (DANTAS-TORRES, 2007, 2008). With respect to pathogen transmission, ticks are among the most important vectors, being comparable only to mosquitoes. It is also noteworthy that ticks still cause significant economic losses to the livestock industry worldwide. These losses, which were estimated

to be around USD 2 billion per year only in Brazil (GRISI et al., 2002), are mainly a result of blood depletion, transmission of pathogens, and costs of control programs.

Among tick-borne diseases that may affect humans in the Americas, Rocky Mountain spotted fever is probably the most important. This disease is caused by the bacterium *Rickettsia rickettsii* (Wolbach, 1919) (DANTAS-TORRES, 2007) and tick vectors involved in each disease foci may vary. In Brazil, *Amblyomma cajennense* (Fabricius, 1787) is a major vector, although other tick species have also been implicated in the transmission cycle

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of *R. rickettsii* (DANTAS-TORRES, 2007). While typically found on horses, *A. cajennense* ticks have a broad host range and can be found on other domestic animals, such as cattle and dogs (ARAGÃO, 1936; GUIMARÃES et al., 2001).

Ticks infesting domestic animals (cat, cattle, chicken, dog, donkey, goat, horse, mule, pig, rabbit, and sheep) have long been studied in Brazil. Domestic animals have been found naturally infested by a number of argasid (Argasidae family) and ixodid (Ixodidae family) tick species. Despite that, there are few reliable records of ticks infesting domestic animals in northeastern Brazilian states, as is the case of Pernambuco. In fact, the literature about ticks infesting domestic animals in Pernambuco is poor (DANTAS-TORRES et al., 2004b) and only few voucher tick specimens have been deposited in reference tick collections. Thus, the aim of the present study was to discuss tick species infesting domestic animals in Pernambuco based on a literature review and present new data obtained from recent tick collections carried out in this northeastern Brazilian state.

Material and Methods

From August 2007 to June 2008, ticks were collected from domestic animals from different municipalities in Pernambuco (Table 1). Ticks were collected in all geographical areas of Pernambuco; i.e., metropolitan area of Recife (coastal area), Zona da Mata (Atlantic rainforest area), Agreste (middle scrub zone), and Sertão (semi-arid inland area).

Most ticks were casually collected by the author during different field missions carried out at irregular intervals. Ticks sent to the author for identification – most of which collected by veterinarians working in different municipalities of Pernambuco – were also included in this study. As a rule, ticks were collected manually and kept in 70% ethanol until taxonomic identification using appropriate taxonomic keys (COOLEY, 1946; ARTHUR, 1960; ARAGÃO; FONSECA, 1961; KEIRANS; DURDEN, 1998). Nomenclature of ticks follows Horak et al. (2002).

Voucher tick specimens have been deposited in the following tick collections (accession numbers within brackets): Instituto Butantã, São Paulo, SP, Brazil (IBSP) (9982-9987); Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo, São Paulo, SP, Brazil (CNC) (1313-1316, 1319-1327); Instituto Oswaldo Cruz, Rio de Janeiro, RJ, Brazil (IOC) (0963-0974).

Results

A total of 1,405 ticks (including males, females, nymphs, and larvae) collected from 85 domestic animals (i.e., cattle, dogs, donkeys, goats, and horses) in Pernambuco were taxonomically studied. Five species were identified: *Amblyomma cajennense*, *Amblyomma ovale* Koch, 1844, *Dermacentor nitens* Neumann, 1897 (formerly *Anocentor nitens*), *Rhipicephalus (Boophilus) microplus* (Canestrini, 1887) (formerly *Boophilus microplus*), and *Rhipicephalus sanguineus* (Latreille, 1806). Co-infestation by more than one tick species was observed in 14 (16.7%) animals. For convenience' sake, detailed information regarding examined material is presented in Table 2.

Discussion

The tick species found on domestic animals in Pernambuco are those commonly found in other Brazilian states (ARAGÃO, 1936; LABRUNA et al., 2000; GUIMARÃES et al., 2001; GUERRA; BRITO, 2004).

1. Ticks infesting cats and dogs

There is no record of tick infestation on cats in Pernambuco. Cats are rarely found infested by ticks (ARAGÃO, 1936; GUIMARÃES et al., 2001; SILVA et al., 2007) and this is in part due to their hygiene habits that favor the removal of ectoparasites. Sometimes ticks can attach in areas of difficult access (e.g., head) for cats to remove them (SILVA et al., 2007), thus favoring parasitism.

In urban areas of Pernambuco, dogs have typically been found infested by *R. sanguineus* ticks (DANTAS-TORRES et al., 2004b). In highly infested environments, *R. sanguineus* ticks can be found on carpets, walls, and furniture and they can incidentally parasitize other hosts, including humans (DANTAS-TORRES et al., 2006).

In rural areas of Pernambuco, dogs have been found infested by *R. sanguineus* and occasionally by other tick species, including *A. cajennense*, *A. ovale*, and *R. (B.) microplus*, as shown in Table 2. Among these, *A. ovale* and *R. sanguineus* appear to be the most common ticks infesting dogs in some rural areas of Pernambuco (F.D.-T., unpublished data). The parasitism by ticks other than *R. sanguineus* in dogs is particularly usual in farms where dogs live in close contact with livestock and also in dogs living near forested areas. However, previous reports of *D. nitens* and *Amblyomma fuscum* (Neumann, 1907) on dogs in Pernambuco (ROCHA, 1985; see DANTAS-TORRES et al., 2004) could not be confirmed. To date, the only reliable records of *A. fuscum* in Pernambuco were adults collected from red-tailed boas (*Boa constrictor* Linnaeus, 1758) (DANTAS-TORRES et al., 2008) and nymphs collected from small mammals and reared to the adult stage (MARTINS et al., in press).

2. Ticks infesting cattle, goats, and sheep

In the present study, the only tick species found on cattle and goats was *R. (B.) microplus* and no tick was found on sheep. Aragão (1936) reported the presence of *R. (B.) microplus* in Recife, Água Preta, and Tapera (Moreno?), although without further data about tick developmental stages or hosts. Working in the municipality of Garanhuns, Rocha (1985) identified *A. cajennense*, *D. nitens*, and *R. (B.) microplus* on cattle and *D. nitens* and *R. (B.) microplus* on goats. Unfortunately, no voucher tick specimens from Rocha study are available in reference collections. Thus, further collections of ticks on cattle from Garanhuns should be carried out to confirm these findings. In our hands, *R. (B.) microplus* was the only species found on cattle in Garanhuns.

It is well known that *R. (B.) microplus* ticks can occasionally be found on hosts other than cattle (ARAGÃO, 1936; GUIMARÃES et al., 2001). But although relatively common in certain areas, the infestation by *R. (B.) microplus* ticks on certain hosts (e.g., cats, dogs, chickens, and rabbits) is usually accidental.

Table 1. Study area.

Geographical region	Municipality	Latitude	Longitude	Altitude (m)	Territory (km ²)
Agreste (middle scrub zone)	Agrestina	08° 27' 29"	35° 56' 41"	427	201
	Bezerros	08° 14' 00"	35° 47' 49"	470	493
	Feira Nova	07° 57' 03"	35° 23' 21"	154	108
	Garanhuns	08° 53' 25"	36° 29' 34"	842	472
	Gravatá	08° 12' 04"	35° 33' 53"	447	513
	Limoeiro	07° 52' 29"	35° 27' 01"	138	270
	Passira	07° 59' 42"	35° 34' 50"	176	330
	Sairé	08° 19' 39"	35° 42' 20"	663	195
	São Vicente Férrer	07° 35' 28"	35° 29' 29"	419	110
Metropolitan area of Recife (coastal area)	Camaragibe	08° 01' 18"	34° 58' 52"	55	55
	Ipojuca	08° 23' 56"	35° 03' 50"	10	527
	Olinda	08° 00' 32"	34° 51' 19"	16	44
	Paulista	07° 56' 27"	34° 52' 23"	13	94
	Recife	08° 03' 14"	34° 52' 52"	4	217
Zona da Mata (Atlantic rainforest area)	Amaraji	08° 22' 59"	35° 27' 09"	289	235
	Glória do Goitá	08° 00' 06"	35° 17' 34"	158	231
	Paudalho	07° 53' 48"	35° 10' 47"	69	278
	Vicência	07° 39' 25"	35° 19' 36"	119	231
Sertão (semi-arid inland area)	Petrolina	09° 23' 55"	40° 30' 03"	376	4,559

3. Ticks infesting donkeys and horses

Horses were found infested by *D. nitens* and occasionally by *A. cajennense* and *R. (B.) microplus*. The horses found infested by *A. cajennense* were co-infested by *D. nitens*. Overall, these results are in agreement with Rocha's early findings (1985) in Garanhuns. Additionally, Silva (1989) found *R. sanguineus* on horses in Garanhuns. However, as no voucher specimens were deposited in reference collections, the infestation by *R. sanguineus* on horses in Pernambuco needs confirmation.

Donkeys were infested exclusively by *D. nitens*. Rocha (1895) reported the presence of *D. nitens* and *R. (B.) microplus* ticks infesting donkeys and mules in Garanhuns.

4. Ticks infesting chickens, pigs, and rabbits

In the present study, no ticks were found on chickens, pigs, and rabbits. During the 1930s, Aragão (1936) reported the presence of *Argas miniatus* Koch, 1844 and *Haemaphysalis leporispalustris* (Packard, 1869) in Pernambuco. Except for Aragão report, there is no record of the presence of these tick species in this state. Considering that *A. miniatus* and *H. leporispalustris* have been found in most Brazilian states (ARAGÃO, 1936; GUIMARÃES et al., 2001), it should be expected that both species are present in Pernambuco. However, further research to confirm the presence of *A. miniatus* and *H. leporispalustris* in Pernambuco are needed.

To the author's knowledge, there is no record of tick infestations on pigs in Pernambuco. In other Brazilian states, pigs have occasionally been found infested by *Amblyomma aureolatum* (Pallas, 1772), *A. cajennense*, *Amblyomma naponense* Packard, 1869, *Amblyomma oblongoguttatum* Koch, 1844, *A. ovale*, *Amblyomma*

scalpturatum Neumann, 1906, and *R. (B.) microplus* (ARAGÃO, 1936; GUIMARÃES et al., 2001; LABRUNA et al., 2002). Of note, in a rural property where *A. ovale* ticks were found on two dogs, there were some pigs but they were free of ticks.

5. Notes on the ecology of ticks of domestic animals in Pernambuco

The present study revealed that *A. cajennense* ticks occur in all areas of Pernambuco, except in the semi-arid inland area. This area is typically hot and dry, which might be unsuitable for *A. cajennense* ticks (CHACÓN et al., 2003). However, the climate of some municipalities (e.g., Triunfo) seems to favor the development of *A. cajennense*. Therefore, further studies are expected to reveal the presence of *A. cajennense* in this area. This tick is known to have low host-specificity and high affinity for humans (DANTAS-TORRES, 2007). The person in charge of the horse found infested by *A. cajennense* in Amaraji (Atlantic rainforest area) informed that her children are usually bitten by ticks, particularly when they are undertaking activities in a remnant of the Atlantic rainforest located near her property.

Amblyomma ovale ticks are currently known to occur only in the middle scrub zone of Pernambuco. This tick is a common ectoparasite of dogs from the municipality of São Vicente Férrer (F.D.-T., unpublished data). Considering the physical geography of this municipality, *A. ovale* ticks are likely to be present also in the Atlantic rainforest area and possibly in the coastal area.

Dermacentor nitens ticks are common in all geographical areas of Pernambuco (ROCHA, 1985; SILVA, 1989; FAUSTINO et al., 2005). An exception is the municipality of Petrolina where infestation by *D. nitens* on horses occurs but is apparently less

Table 2. Detailed data on ticks (n = 1,405) collected from domestic animals (n = 85) in Pernambuco, from August 2007 to June 2008.

Nº	Specimens	Host	Municipality	Date
1	1 M of <i>R. sanguineus</i>	<i>C. familiaris</i>	Olinda	August 2007
2	5 M, 2 F and 1 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Recife	August 2007
3	1 M and 1 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Agrestina	October 2007
4	7 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Agrestina	October 2007
5	1 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Agrestina	October 2007
6	8 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Agrestina	October 2007
7	5 M and 10 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Amaraji	November 2007
8	3 N of <i>A. cajennense</i> ; 1 M of <i>R. sanguineus</i>	<i>C. familiaris</i>	Amaraji	November 2007
9	1 M and 2 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Passira	November 2007
10	2 M, 2 F and 1 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Passira	November 2007
11	5 M, 2 F, 5 N and 5 L of <i>R. sanguineus</i>	<i>C. familiaris</i>	Petrolina	November 2007
12	3 M, 2 F and 7 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Recife	November 2007
13	6 M and 8 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Vicência	November 2007
14	1 F of <i>R. (B.) microplus</i>	<i>C. hircus</i>	Passira	November 2007
15	1 M and 5 F of <i>R. (B.) microplus</i>	<i>C. hircus</i>	Passira	November 2007
16	13 M, 5 F and 6 N of <i>A. cajennense</i> ; 1 F, 10 N and 1 L of <i>D. nitens</i>	<i>E. caballus</i>	Amaraji	November 2007
17	2 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Petrolina	December 2007
18	1 M and 5 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Petrolina	December 2007
19	10 M and 2 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Petrolina	December 2007
20	1 M of <i>R. sanguineus</i>	<i>C. familiaris</i>	Glória de Goitá	December 2007
21	4 F and 1 N of <i>R. (B.) microplus</i>	<i>B. indicus</i>	Vicência	December 2007
22	1 M, 6 F and 1 N of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Vicência	December 2007
23	20 M, 30 F, 23 N and 3 L of <i>D. nitens</i>	<i>E. caballus</i>	Vicência	December 2007
24	17 M, 9 F, 11 N and 2 L of <i>D. nitens</i>	<i>E. asinus</i>	Vicência	December 2007
25	3 M, 2 F, 2 N and 1 L of <i>D. nitens</i>	<i>E. asinus</i>	Vicência	December 2007
26	4 F and 1 N of <i>D. nitens</i>	<i>E. caballus</i>	Camaragibe	December 2007
27	1 M, 18 N and 2 L of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	December 2007
28	3 M, 13 N and 1 L of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	December 2007
29	1 M, 1 F, 54 N and 12 L of <i>D. nitens</i> ; 3 N of <i>R. (B.) microplus</i>	<i>E. caballus</i>	Gravatá	December 2007
30	2 M, 5 F, 2 N and 1 L of <i>D. nitens</i> ; 1 M of <i>A. cajennense</i>	<i>E. caballus</i>	Gravatá	December 2007
31	2 M and 2 F of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	December 2007
32	6 F of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	December 2007
33	3 F of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	December 2007
34	3 F of <i>D. nitens</i> ; 2 F of <i>R. (B.) microplus</i>	<i>E. caballus</i>	Glória do Goitá	December 2007
35	14 M, 28 F, 21 N and 6 L of <i>D. nitens</i>	<i>E. caballus</i>	Glória do Goitá	December 2007
36	4 M and 5 F of <i>D. nitens</i>	<i>E. caballus</i>	Glória do Goitá	December 2007
37	2 M and 12 F of <i>D. nitens</i>	<i>E. caballus</i>	Glória do Goitá	December 2007
38	5 M, 5 F, 5 N and 1 L of <i>D. nitens</i> ; 2 M of <i>R. (B.) microplus</i>	<i>E. caballus</i>	Glória do Goitá	December 2007
39	1 M of <i>R. sanguineus</i> ; 1 M and 3 F of <i>R. (B.) microplus</i>	<i>C. familiaris</i>	Feira Nova	January 2008
40	7 M and 5 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Paudalho	January 2008
41	31 M and 31 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Paudalho	January 2008
42	34 M, 30 F, and 2 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Paudalho	January 2008
43	2 M of <i>R. sanguineus</i>	<i>C. familiaris</i>	São Vicente Férrer	January 2008
44	3 M and 6 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Passira	January 2008
45	9 M and 21 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Limoeiro	January 2008
46	1 M, 3 F and 2 N of <i>R. (B.) microplus</i>	<i>B. indicus</i>	Garanhuns	January 2008
47	2 M and 6 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Garanhuns	January 2008
48	9 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Garanhuns	January 2008
49	9 F of <i>R. (B.) microplus</i>	<i>B. indicus</i>	Garanhuns	January 2008
50	4 M and 7 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Garanhuns	January 2008
51	1 M and 7 F of <i>R. (B.) microplus</i>	<i>B. indicus</i>	Garanhuns	January 2008
52	3 F of <i>R. (B.) microplus</i>	<i>B. taurus</i>	Garanhuns	January 2008
53	10 N and 5 L of <i>D. nitens</i>	<i>E. caballus</i>	Ipojuca	January 2008

Abbreviations: M, males; F, females; N, nymphs; L, larvae.

Table 2. Continued...

Nº	Specimens	Host	Municipality	Date
54	1 M, 5 F, 5 N and 1 L of <i>D. nitens</i>	<i>E. caballus</i>	Feira Nova	January 2008
55	18 N and 3 L of <i>D. nitens</i>	<i>E. caballus</i>	Feira Nova	January 2008
56	1 N of <i>D. nitens</i>	<i>E. caballus</i>	Petrolina	January 2008
57	2 M, 1 F and 2 N of <i>D. nitens</i> ; 1 M of <i>A. cajennense</i>	<i>E. caballus</i>	Gravatá	January 2008
58	5 M, 9 F and 2 N of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	January 2008
59	6 M and 5 F of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	January 2008
60	8 M, 7 F, 5 N and 4 L of <i>D. nitens</i> ; 1 N of <i>R. (B.) microplus</i>	<i>E. caballus</i>	Gravatá	January 2008
61	1 F, 8 N and 52 L of <i>D. nitens</i>	<i>E. caballus</i>	Gravatá	January 2008
62	5 M and 4 F of <i>D. nitens</i> ; 1 M of <i>R. (B.) microplus</i>	<i>E. caballus</i>	Sairé	January 2008
63	3 M, 3 F, 35 N and 35 L of <i>D. nitens</i> ; 1 M of <i>A. cajennense</i> ; 8 N of <i>R. (B.) microplus</i>	<i>E. caballus</i>	Sairé	January 2008
64	2 M, 5 F, 9 N and 4 L of <i>D. nitens</i>	<i>E. caballus</i>	Sairé	January 2008
65	1 M and 3 F of <i>D. nitens</i>	<i>E. caballus</i>	Sairé	January 2008
66	4 M and 11 F of <i>D. nitens</i>	<i>E. caballus</i>	Limoeiro	January 2008
67	1 M, 5 F and 2 N of <i>D. nitens</i>	<i>E. caballus</i>	Limoeiro	January 2008
68	3 M and 17 F of <i>D. nitens</i>	<i>E. caballus</i>	Limoeiro	January 2008
69	2 M and 2 F of <i>D. nitens</i>	<i>E. asinus</i>	Limoeiro	January 2008
70	1 M and 1 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Feira Nova	February 2008
71	72 M and 65 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Olinda	February 2008
72	12 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Olinda	February 2008
73	5 M and 15 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Passira	February 2008
74	10 M and 6 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Paulista	February 2008
75	2 M and 1 F of <i>D. nitens</i>	<i>E. caballus</i>	Bezerros	February 2008
76	5 F of <i>D. nitens</i>	<i>E. caballus</i>	Bezerros	February 2008
77	2 M and 5 F of <i>D. nitens</i>	<i>E. caballus</i>	Feira Nova	February 2008
78	4 M, 5 F and 1 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Recife	March 2008
79	6 M, 6 F and 1 N of <i>R. sanguineus</i>	<i>C. familiaris</i>	Recife	March 2008
80	1 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	Recife	April 2008
81	2 M and 1 F of <i>A. ovale</i> ; 2 M and 1 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	São Vicente Férrer	May 2008
82	1 M of <i>A. ovale</i>	<i>C. familiaris</i>	São Vicente Férrer	May 2008
83	1 F of <i>A. ovale</i>	<i>C. familiaris</i>	São Vicente Férrer	June 2008
84	5 M and 14 F of <i>A. ovale</i> ; 10 M and 5 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	São Vicente Férrer	June 2008
85	1 M and 7 F of <i>A. ovale</i> ; 4 M and 1 F of <i>R. sanguineus</i>	<i>C. familiaris</i>	São Vicente Férrer	June 2008

Abbreviations: M, males; F, females; N, nymphs; L, larvae.

common (F.D.-T, personal observations). The climate of Petrolina is probably unsuitable for the development and survival of *D. nitens*. Its climate is characterized by high temperatures associated with low relative humidity and low precipitation. The mean annual relative humidity is about 65%, but during the dry season it may be as low as 50% and the mean annual rainfall is less than 800 mm (SILVA, 2004). It is known that low relative humidity (<50%) greatly affects both egg hatching and larval survival rates of *D. nitens* ticks (GUIMARÃES DA SILVA et al., 1997; SUZUKI et al., 1999; FAUSTINO et al., 2005).

Rhipicephalus (Boophilus) microplus ticks are found infesting cattle in all geographical areas of Pernambuco. This is expected because *R. (B.) microplus* is historically well established in the Brazilian territory (ARAGÃO, 1936) and because the climate of Pernambuco is suitable for its development and survival. In the present study, *R. (B.) microplus* was found not only on cattle but also on a dog, goats, and horses.

Rhipicephalus sanguineus ticks have been found in virtually all geographical areas of Pernambuco. They are common anywhere,

from Recife (far east) to Petrolina (far west). This is expected due to the fact that *R. sanguineus* is differentially adapted to live in both humid and dry environments (YODER et al., 2006). Interestingly, the intensity of parasitism by *R. sanguineus* on dogs living in rural areas is lower than in urban areas (F.D.-T, personal observations). The explanation for this is not yet clear, but it is likely to be due to a combination of factors, including host density and climate (temperature and relative humidity).

Co-infestations by more than one tick species were commonly observed in the present study. Dogs were found infested simultaneously by *A. ovale* plus *R. sanguineus*, *A. cajennense* plus *R. sanguineus*, and *R. (B.) microplus* plus *R. sanguineus*. Horses were found co-infested by *A. cajennense* plus *D. nitens* and *D. nitens* plus *R. (B.) microplus*. Additionally, a horse was found infested by three tick species (i.e., *A. cajennense*, *D. nitens* and *R. (B.) microplus*). In rural properties where domestic animals (e.g., dogs, cattle and horses) live in close contact the occurrence of co-infestation might be common.

6. Medical and veterinary significance of ticks of domestic animals in Pernambuco

All four tick species found on domestic animals in Pernambuco are known vectors of pathogens of veterinary significance. Incidentally, they can parasitize human beings and act as vectors of major human disease agents (GUGLIELMONE et al., 2006). For instance, *A. cajennense* is the main vector of *R. rickettsii* in Brazil (DANTAS-TORRES, 2007) and *R. sanguineus* has been implicated in the transmission of a large list of pathogens, including *R. rickettsii*, *Babesia canis vogeli* Reichenow, 1937 and *Babesia gibsoni* (Patton, 1910) (DANTAS-TORRES; FIGUEREDO, 2006; DANTAS-TORRES, 2007, 2008). Additionally, there has been speculation on the role of *R. sanguineus* as a potential vector of *Leishmania infantum* Nicolle, 1908 (= *Leishmania chagasi* Cunha & Chagas, 1937) in Brazil (COUTINHO et al., 2005), including in Pernambuco (SILVA et al., 2007), but it requires further investigation.

Tick-borne pathogens have long been recognized in Pernambuco (ALECRIM et al., 1983; DANTAS-TORRES et al., 2004a; ARAÚJO et al., 2005; DANTAS-TORRES; FIGUEREDO, 2006), although little information is currently available about tick-borne diseases, their distribution, risk factors, and impact on livestock industry in this state. For example, a suspected case of human babesiosis was documented in Pernambuco during the early 1980s (ALECRIM et al., 1983) and, so far, no further data on human babesiosis in Pernambuco has been obtained and little is known of tick species infesting humans in this state. Cases of human parasitism by *R. sanguineus* ticks have been recorded in Pernambuco (DANTAS-TORRES et al., 2006) and human parasitism by *Amblyomma* larvae is not rare, particularly in people entering into remnants of Atlantic rainforest (F.D.-T, unpublished data).

7. Tick control in Pernambuco and research needs

The status of tick control in Pernambuco is largely unknown. The control of *R. (B.) microplus* has been studied in properties located in the Atlantic rainforest area and the middle scrub zone of Pernambuco (SANTANA et al., 2001b). It was found that 85.7% of cattle managers did not know “what acaricide resistance means”. The active compounds most commonly used in the surveyed properties were cypermethrin, amitraz, and ivermectin. Acaricide spraying is the most commonly used method in both areas.

The control of *R. sanguineus* is commonly carried out using fipronil, selamectine, pyrethroids (e.g., cypermethrin and deltamethrin), and amitraz. Spray, spot-on or pour-on formulations and impregnated-collars are often used by dog owners in the metropolitan area of Recife, but not in rural areas. Under certain circumstances (e.g., in highly infested domiciles), the use of acaricides on the environment has been recommended (F.D.-T, personal observations).

Acaricide resistance in ticks has been described in Pernambuco (SANTANA et al., 2001a, 2001b), although the burden of acaricide resistance on the livestock industry in this state has not been systematically evaluated. Resistance is in part a result

of the uncontrolled use of acaricides, as discussed elsewhere (SANTANA et al., 2001b). Alternatives for tick control, such as use of medicinal plants, have been studied in Pernambuco and the results are promising (FARIAS et al., 2007).

During the 1930s, Aragão (1936) reported the presence of *A. aureolatum* and *Amblyomma parvum* Aragão, 1908 in Pernambuco, but without further data on ticks or hosts. During recent decades, there were no records of *A. aureolatum* and *A. parvum* in Pernambuco. Thus, the presence of both species in this state needs confirmation. Also, further studies about ticks and tick-borne diseases in Pernambuco are urgently needed. The present study definitely confirms the presence of *A. cajennense* in Pernambuco and raises some questions about the local risk of transmission of tick-borne diseases, such as Rocky Mountain spotted fever. Further studies to assess the current distribution and ecology of *A. cajennense* ticks in Pernambuco are recommended. Additionally, it is crucial to determine whether these ticks are infected by pathogens of medical and veterinary significance, particularly by *R. rickettsii*. This could provide new insights about the ecology of ticks and the pathogens they transmit.

Acknowledgments

Thanks to my colleagues (Andresa C. B. de Oliveira, Anne G. S. S. Campos, Assis B. Nunes, Danniele de G. Barboza, Fernando J. da Silva, Ana K. de A. Soares, Karla P. de O. Luna, Maria I. A. Cavalcanti, Mineo Nakazawa, Raquel Vasconcelos, and Vitor N. Maia) for kindly sending me tick specimens for identification. Thanks also to the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for a PhD scholarship.

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