Exp Appl Acarol
DOI 10.1007/s10493-012-9533-1

Capybaras and ticks in the urban areas of Uberlândia, Minas Gerais, Brazil: ecological aspects for the epidemiology of tick-borne diseases

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Received: 22 October 2011 / Accepted: 5 February 2012

Abstract In Brazil capybara, the biggest existing rodent species, and associated tick species, *Amblyomma cajennense* and *Amblyomma dubitatum*, are undergoing an unplanned host and parasite population expansion in both urban and rural areas. However, scientific information about such issue, particularly in urban areas, is scanty. Such rodent and ticks are associated in some municipalities, particularly in southeastern Brazil, with the transmission of the highly lethal *Rickettsia rickettsia* caused spotted-fever. In this study ecological aspects related to the establishment and expansion of capybaras and ticks in urban areas of Uberlândia, Minas Gerais State, Brazil were evaluated. For this purpose, capybara and tick abundance in four urban areas and an ecological reserve was determined. Abundance of capybaras varied between areas and over the sampling period and these differences were related to human activities. A positive correlation was found between capybara and tick abundance, however, the tick species had an uneven distribution within the municipality and environmental factors rather than host availability were blamed for such. On the whole these observations show that capybara populations in urban areas are associated to high environmental infestation of ticks and the increased risk of bites and of pathogen transmission to humans. At the same time the uneven distribution of tick species might implicate in an unequal risk of tick-borne diseases within the same urban area.

Keywords Tick · Capybara · Urban area · *Amblyomma cajennense* · *Amblyomma dubitatum* · Brazil

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Published online: 16 February 2012

Introduction

Host–tick relationships are changing fast in anthopized areas. Meanwhile most host as well as parasite species are negatively affected; a few species are greatly favored. In urban areas domestic animal numbers do usually expand at human will whereas the increase in the population of some other hosts as well as that of parasites is accidental. Humans view such unpredicted increase with a feeling that varies from benevolence to disgust and fear. In Brazil capybaras and their tick species illustrate a relatively recent, unplanned and ongoing host and parasite expansion in urban and rural areas.

Capybara (*Hydrochoerus hydrochaeris* L. Hydrochoeridae), the largest living rodent (it can weigh more than 50 kg) and a semi aquatic species, is widely distributed in South America. The capybara is a gregarious species; a typical family group is constituted of three to four males and six females with one male leading the group (Pachaly et al. 2001). According to Ferraz et al. (2007) the increase in habitat carrying capacity, which results from rising agricultural production, and the decline in natural predators in southeastern Brazil are possibly the two main factors that are contributing to the capybara population increase in human-altered landscape habitats. The same authors mention that the hunting prohibition by Brazilian federal law and the high reproductive capacity of capybaras may also have contributed to their habitat expansion and population increase.

Whatever the cause of capybara population increase in anthropized areas, it is usually associated with high environmental tick infestation levels of either one or both of two tick species; *Amblyomma cajennense* (Fabricius) and *Amblyomma dubitatum* (= *A. cooperi*) Neumann (Souza et al. 2006; Perez et al. 2008; Szabó et al. 2009). Capybaras are quite resilient to tick infestations and may support high infestation loads. For example, Perez et al. (2008) counted a mean number of 2,860 ticks/animal (mostly *A. cajennense* and *A. dubitatum*) on three capybaras at a University campus in Piracicaba, São Paulo, Brazil. Thus human tick-bites, particularly by *A. cajennense*, are a recurrent problem in public areas with capybaras. Last but not least, there is in the country a clear association between capybaras, high environmental *A. cajennense* populations and human *Rickettsia rickettsii* caused spotted-fever (Labruna 2009).

Problems related to capybaras, ticks and spotted-fever are often reported by the media in southeastern Brazil and urban parks are in this regard of major concern. However, spotted-fever with several fatal cases is reported in some municipalities with capybaras (Angerami et al. 2006) but not in others. Indeed, although several articles aiming at the description of ecological features of spotted fever in Brazil have been conducted in the past few years (reviewed by Labruna 2009), its ecology in natural, rural or urban areas still has many unknown features. Actually information about capybaras on its own is scanty in Brazil. Such situation is rather awkward in urban areas where, on one side humans have a tender feeling towards capybaras and, on the other hand, they represent a troublesome feature for health authorities due to tick bites and the potential source for zoonotic disease. In this sense evaluation of capybara and tick populations in urban areas is a basic step to guide a possible host and parasite management in anthropized areas as well as for better understanding the epidemiology of spotted-fever.

Uberlândia municipality in Minas Gerais State, southeast Brazil is the third most populous of the State. As many other cities in the country it has several urban capybara groups, tick-bites are frequent but human spotted-fever has not been reported so far. At the same time scientific information about capybaras and their ticks is non-existent. Thus the aim of this work was to provide basic information about capybaras, their relationship with the environment and tick infestations in an urban area of southeastern Brazil.

Materials and methods

Study sites

The study was conducted in Uberlândia municipality, Minas Gerais, southeastern Brazil. The municipality has 600,285 inhabitants, an area of 1,436 km^2 and the urban area covers, approximately, 135 km^2 at an average altitude of 863 m above sea level. It is 556 km distant from the State Capital, Belo Horizonte, and is located within the Cerrado Biome, the Brazilian savannah. Climate is subtropical with two well defined seasons: a dry winter (May to September) and a rainy summer (October to April). The mean annual temperature and precipitation are of 22°C and 1,650 mm, respectively.

Four urban locations and one natural reserve (Panga) were chosen for the study. The natural reserve (Estação Ecológica do Panga) was included to allow comparison of urban areas to a fairly natural one. At each site, one transect 1,000 long and 50 m wide (5 ha) was designed for capybara survey and tick sampling. Owing to its big size and the presence of at least three distinct capybara groups, three transects were set up in one of the locations (Sabiá park). Detailed information about each location and transect is provided in Table 1.

Capybara abundance

Capybara counts were performed twice every month from March 2008 to April 2009 to provide a mean count for each month. A mean of the monthly counts of capybaras at each transect from the 13 months of survey was then considered capybara abundance. To count capybara an observer walked for an hour immediately after dawn along transects and counted animals (usually foraging in this period). The study sites were sampled always by the same observer (V.L.Q.) to avoid potential double counting. No effort was made to differentiate males, females or young. Animal density was not calculated as it was impossible to determine territories used by capybara groups by solely this visual method.

Scat counts

An attempt was made to count fresh capybara scats along transects, however, too many scats in transect Sabia 1, slowed the capybara counting too much. Thus only the presence or lack of fresh scats in each month was recorded.

Tick abundance

Ticks at each transect were sampled at capybaras trails, in locations where conspicuous host vestiges (scats and tracks) were found and also at places without clear capybara signs. For convenience only adult ticks were sampled; it is easier to identify and handle such stage. Tick sampling occurred in summer, from 3 to 5 of February 2009, and once at each transect. Summer was chosen because it is the season of predominance of adults of both *A. cajennense* and *A. dubitatum* ticks species (Labruna et al. 2002; Szabó et al. 2007). Ticks were captured with CO_2 traps and cloth dragging. CO_2 were used as described elsewhere (Szabó et al. 2009) and for dragging a white flannel 1 meter wide and two meters long was pulled over vegetation and observed every 20 m. Twenty CO_2 traps and cloth dragging for 80 min were used for sampling each transect. Rainy days that could interfere with both tick sampling methods were avoided. Tick species captured were identified according to Onófrio et al. (2006). Total number of adult ticks captured at each location was considered representative of the local tick abundance.

Table 1 Locations and transects used for capybara survey and tick sampling within Uberlândia municipality, Minas Gerais, Brazil, 2008 and 2009

Transect	Coordinates	Description of locations and transects
Sabiá park 1	S 18°54′ 39.8″ W 48°14′ 14.2″	Sabiá, the biggest urban park (185 ha) has a dam, and a forest fragment of 350,000 m^2 interspersed with swampy areas. The park is fenced and surrounded by the city. It is closed at night and has 24 h vigilance. Tick infestation of the park is high. Transect Sabiá park 1, was located by the margins of the dam, which is grassy with scattered shrubs and trees. On the 13th of August, 2008, 27 capybaras were translocated from this transect to a Cerrado reserve
Sabiá park 2	S 18°54′ 21.8″ W 48°14′ 05.2″	Within the same park described above, part of transect was dominated by shrubs with scattered mango (*Mangifera indica*) and guava (*Psidium guajava*) trees. Grass on the remaining part
Sabiá park 3	S 18°54′ 34.0″ W 48°13′ 37.5″	Within the same park described above this transect had flooded forest by the Jataí stream and tropical semi-deciduous forest
Praia club	S 18°55′ 58.6″ W 48°17′ 29.9″	Sport and leisure club at both margins of the Uberabinha river. Margins of the river within the club with a capybara group restricted by a fence to 10 m wide path at each side of the river. Path with predominance of grass with occasional exotic ornamental shrubs and canebrake (bamboo) and a degraded gallery forest patch. Employees with access to the margins do complain about ticks. Closed at night but with 24 h vigilance
Granja Planalto	S 18°54′ 82.6″ W 48°18′ 42.0″	Granja Planalto, a commercial company at the left margin of the Uberabinha river, has small dam with degraded gallery forest with a few trees (*Inga* sp., *Matayba* sp.), shrubs and grass. A group of capybaras were blamed for tick infestations. Vigilance of the area diminished at the beginning of the survey and occasional invasion by people and probably hunting occurred close to the dam and capybaras were seen less frequently from then on
Uberabinha river	S 18°54′ 88.8″ W 48°18′ 28.9″	Unfenced right margin of the river between the Praia club and Granja Planalto with 20–30 m wide path with grass and shrubs, small remnants of gallery forest (with predominance of *Inga* sp.) and delimited by a road. Left margin with urban homes with various fruit trees in backyards. No specific surveillance in this area
Panga Reserve	S 19°10′ 02.6″ W 48°23′ 7.30″	Natural cerrado reserve (404 ha) 30 km from the city center surrounded by agricultural lands. Transect at the border of the reserve in a gallery forest by the margins of the Panga stream where a group of capybaras used to live. Before the survey, landless workers camped close to the stream and it underwent a strong anthropic influence, probably hunting

Statistical analysis

Correlation between capybara abundance at the various transects and corresponding tick abundance of, either all ticks together or separately by species (*A. dubitatum* and *A. cajennense*), was evaluated using two tailed Pearson correlation test. The confidence interval was set at 95%.

Results

Capybara abundance

Host abundance (Table 2) varied from transect to transect. In transect Sabiá 1 capybara counts varied from 8 to 42. In the transect Sabiá 2 counts varied from 20 to 47 and in transect Sabiá 3 varied from zero to five. However, considering that removal of capybaras from transect Sabiá 1 in August 2008 decreased animal counts sharply, abundance was calculated for the period before animal removal (Table 2). Thus monthly counts in this transect varied initially (March 2008 to July 2008) from 28 to 42 capybaras and decreased thereafter (August 2008–March 2009) to as few as 8–12 animals. At the same time in the transect Sabiá 2, an increased incidence of fights was observed among capybaras from August 2008 on, and animal counts of March 2008 to July 2008 increased thereafter (August 2008–March 2009) from 20–31 to 30–47. In Sabiá 3 transect, capybara counts fluctuated fairly constantly over the survey period and no increase or decrease trend was observed. Capybara counts varied from 12 to 18 in Praia club transect. Capybaras were not seen in the remaining sites (Granja Planalto, Uberabinha river and Panga) throughout the study period.

Host vestiges

Conspicuous host vestiges (scats, tracks and/or host specific ticks) were observed in all transects including the locations where capybaras were not seen. On the whole fresh

Table 2 Capybara and tick abundance in the various transects within Uberlândia municipality, Minas Gerais Brazil, 2008 and 2009

Transects	Host abundance	Tick abundance (%)		
		Amblyomma cajennense	*Amblyomma dubitatum*	All species
Sabiá 1	37[a]	259 (87.8)	36 (12.2)	295 (46.2)
Sabiá 2	34.3	129 (99.2)	1 (0.8)	130 (20.3)
Sabiá 3	2.6	70 (98.6)	1 (1.4)	71 (11.1)
Praia	15	1 (1.9)	53 (98.1)	54 (8.44)
Granja Planalto	0	26 (66.7)	13 (33.3)	39 (6.1)
Uberabinha river	0	8 (16.3)	41 (83.7)	49 (7.7)
Panga	0	1 (100)	0 (0)	1 (0.16)
Correlation	–	(r = 0.83)	(r = 0.15)	(r = 0.84)

Percentage of each tick species found at each transect is shown between parentheses. Correlation between abundance of each tick species or all ticks and host abundance was evaluated by two tailed Pearson correlation test ($P < 0.05$)

[a] Abundance from the period before capybara removal

capybara scats were recorded 6, 11, 8, 13, 4, 7, 1 times out of the 13 months of survey on transects from, respectively, Sabiá 1, 2 and 3, Praia club, Granja Planalto, Uberabinha river and Panga. In the case of Sabiá 1, scats were recorded in the first 5 months (March 2008–July 2008) before animal removal and once again only in December 2008.

Tick abundance

Overall 639 adult ticks of two species were found in the survey (Table 2); 494 *A. cajennennse* (77.3% of all ticks) and 145 *A. dubitatum* (22.7% of all ticks). Almost half of these ticks were found in Sabiá 1 transect whereas only one in Panga transect. *A. cajennense* was the main tick species captured, however, *A. dubitatum* was more prevalent in Praia club (98.1% of ticks) and at the Uberabinha river transects (83.7% of ticks).

Data analysis

A positive correlation was found between host abundance and overall tick abundance ($r = 0.84$; $P < 0.05$) as well as *A. cajennense* tick abundance ($r = 0.83$; $P < 0.05$) but only if data of transect Sabiá 1 from the period before capybara withdrawal in August 2008 was used. At the same time, whatever the data used, no correlation between capybara and *A. dubitatum* tick abundance was found ($r = 0.15$; $P > 0.05$).

Discussion

Supporting previous reports (Souza et al. 2006; Perez et al. 2008; Szabó et al. 2009) two tick species were found on capybaras territories: *A. cajennense* and *A. dubitatum*. Meanwhile the former is considered the most important vector of spotted fever in South America (Labruna 2009) a role for the latter as an infectious disease vector to humans is not proven. *Amblyomma dubitatum* is less aggressive to human beings and, even though an undefined *Rickettsia* species from the spotted-fever group was found in this tick species (Labruna et al. 2004), it usually harbors *Rickettsia bellii* a non-pathogenic one (Pacheco et al. 2009). Thus differences in the spatial distribution of these tick species on capybara territories may have implications in the epidemiology of *R. rickettsia* caused spotted-fever.

Results from this work showed that capybara and tick abundance are prone to several influences and which determine an uneven distribution of ticks within the same urban area. Regarding host distribution in urban areas, our observations indicated that, capybara groups establish and display a confident behavior in locations where, apart from food (vegetation) and water source, they are protected from antagonistic human attitude by fences and vigilance such as in Sabiá park and Praia club. We are unaware if such situation interferes with host population size but it explains the aggregation of capybaras and their careless behavior in public sites with constant surveillance as well as the higher density of ticks in such locations. These sites are thus where tick, pathogen and human contact may occur more frequently. However, even though capybaras were not seen in transects without vigilance and fences, conspicuous vestiges (including capybara ticks) undeniably revealed their presence. Thus even though less abundant, ticks might be found in such places and human tick-bites may occur.

Positive correlation was found between capybara abundance and *A. cajennense* and total tick abundance only if host data of Sabiá 1 transect from the period before capybara withdrawal in August 2008 was used. An important aspect to consider in such analysis is

that tick numbers in the environment change more slowly after host number alterations. Since most of the ticks survive for several months or even more in the environment (Balashov 1972) and both tick species found seem to have a 1 year life cycle in south-eastern Brazil (Serra-Freire 1982; Labruna et al. 2002; Szabó et al. 2007), many adult ticks sampled in February 2009 were in fact fed as nymphs on capybaras taken away in August 2008. Thus environmental tick abundance was more associated to capybara abundance observed 6 months earlier, before translocation of several of these hosts.

Abundance of each tick species as well as its correlation with host abundance presented other unexpected feature. Since *A. dubitatum* is known to be a highly capybara-specific tick (Nava et al. 2010) a correlation between parasite abundance and that of capybaras was predicted, but which did not occur. Actually *A. dubitatum* prevailed in two transects where, on the other hand, only a few *A. cajennense* were found. Considering that capybara is also a primary host for *A. cajennense* (Labruna et al. 2001) environmental factors can be blamed for the uneven distribution of both tick species in the various transects. In this regard we speculate that *A. dubitatum* was privileged over *A. cajennense* in transects by river margins and where hosts were forced to remain close to the river by fences (Praia) or road and city (Uberabinha river). In such places, river margins are exposed to flooding in the rainy summer which favors the survival of *A. dubitatum*, a species more adapted to inundated environment in relation to *A. cajennense* (Szabó et al. 2007). At the same time the correlation between *A. cajennense* and of capybara abundance (before animal withdrawal from Sabia1) may be explained by the greater capybara abundance detected in locations where hosts were not restricted to a narrow and seasonally flooded territory which provided food, vegetation and protection to hosts but also drier microhabitats necessary for *A. cajennense*.

Overall our observations indicate that capybaras living on a range of microhabitats around a water source (from seasonally/occasionally flooded areas to higher and drier areas) may maintain varying tick populations. Notably, such differences in tick populations may occur within the urban area of the same municipality, with implications on the epidemiology of tick-borne diseases. Thus seasonally flooded areas are not adequate for *A. cajennense* but for *A. dubitatum* and fewer human tick-bites are expected from this less aggressive tick species. But if capybaras do have access to drier places that surround water sources, *A. cajennense* will survive increasing the risk of human spotted-fever. It must be stressed, however, that human tick bites at such places are seasonal and higher frequency is associated to prevalence of immature stages, particularly of nymphs, in the environment. *Amblyomma cajennense* nymphs, which prevail from middle winter on and in spring (Oliveira et al. 2000; Labruna et al. 2002; Veronez et al. 2010), are more numerous than adults, are more segregated than larvae increasing the likelihood of contact with humans, and are small enough to go unnoticed during parasitism.

Anyhow, if one considers capybara's resilience to withstand high tick loads and lack of predators to control host populations, such places are prone to high environmental tick infestation. Thus human beings sharing this habitat are exposed to tick-bites especially of the more human aggressive tick, *A. cajennense*. Therefore, capybaras in urban areas may be considered synanthropes and development of methods for population control is mandatory.

Acknowledgments This research was supported by Fundação de Amparo à Pesquisa do Estado de Minas Gerais—FAPEMIG, Federal University of Uberlândia, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—CAPES (masters fellowship to V.L.Q.) and Conselho Nacional de Desenvolvimento Científico e Tecnológico—CNPq (Academic Career Research Fellowship to K.D.C. and M.P.J.S.). The authors are indebted to administration and personnel from Parque do Sabiá, Praia Clube and Granja Planalto for permission and logistic support for the survey.

References

Angerami RN, Resende MA, Feltrin AFC, Katz G, Nascimento EM, Stucchi RSB, Silva LJ (2006) Brazilian spotted fever: a case series from an endemic area in southeastern. Brazil Ann NY Sci 1078:252–254

Balashov YS (1972) Bloodsucking ticks (Ixodoidea)—vectors of diseases of man and animals (Translation from Russian). Misc Publ Entomol Soc Am 8:161–362

Ferraz KMP, Ferraz SFB, Moreira JR, Couto HTZ, Verdade LM (2007) Capybara (*Hydrochoerus hydrochaeris*) distribution in agroecosystems: a cross-scale habitat analysis. J Biogeogr 34:223–230

Labruna MB (2009) Ecology of Rickettsia in South America. Ann NY Acad Sci 1166:156–166

Labruna MB, Kerber CE, Ferreira F, Faccini JLH, De Waal DT, Gennari SM (2001) Risk factors to tick infestations and their occurrence on horses in the state of São Paulo. Brazil Vet Parasitol 97:1–14

Labruna MB, Kasai N, Ferreira F, Faccini JLH, Gennari SM (2002) Seasonal dynamics of ticks (Acari: Ixodidae) on horses in the state of São Paulo, Brazil. Vet Parasitol 105:65–77

Labruna MB, Whithworth T, Horta MC, Bouyer DH, McBridge JW, Pinter A, Popov V, Gennari SM, Walker DH (2004) Rickettsia species infecting *Amblyomma cooperi* ticks from an area in the State of São Paulo Brazil, where Brazilian spotted fever is endemic. J Clin Microbiol 42:90–98

Nava S, Venzal JM, Labruna MB, Mastropaolo M, Gonzáles EM, Mangold AJ, Guglielmone AA (2010) Hosts, distribution and genetic diveregence (16S rDNA) of *Amblyomma dubitatum* (Acari: Ixodidae). Exp Appl Acarol 51:335–351

Oliveira PR, Borges LMF, Lopes CML, Leite RC (2000) Population dynamics of the free-living stages of *Amblyomma cajennense* (Fabricius, 1787) (Acari: Ixodidae) on pastures of Pedro Leopoldo, Minas Gerais State, Brazil. Vet Parasitol 92:295–301

Onófrio VC, Labruna MB, Pinter A,Giacomin FG, Barros-Battesti DM (2006) Comentários e chaves para as espécies de *Amblyomma.* In: Barros-Battesti DM, Arzua M, Bechara HG (eds) Carrapatos de importância medico-veterinária da região neotropical: um guia ilustrado para identificação de espécies. Vox/ICTTD-3/Butantan, São Paulo/BR, pp 53–71

Pachaly JR, Acco A, Lange RR, Nogueira TMR, Nogueira MF, Ciffoni EMG (2001) Order Rodentia (Rodents) biology and medicine. In: Fowler ME, Cubas ZS (eds) Biology, medicine and surgery of South American wild animals Iowa, USA. Iowa State University Press, Iowa, pp 225–237

Pacheco RC, Horta MC, Pinter A, Moraes-Filho J, Martins TF, Nardi MS, Souza SSAL, Souza CE, Szabó MPJ, Richtzenhain LJ, Labruna MB (2009) Pesquisa de *Rickettsia* spp. em carrapatos *Amblyomma cajennense* e *Amblyomma dubitatum* no Estado de São Paulo. Rev Soc Bras Med Trop 42:351–353

Perez CA, Almeida AF, Almeida A, Carvalho VHB, Balestrin DC, Guimarães MS, Costa JC, Ramos LA, Arruda-SantosA D, Máximo-Espíndola CP, Barros-Battesti DM (2008) Carrapatos do gênero Amblyomma (Acari: Ixodidae) e suas relações com hospedeiros em área endêmica para febre maculosa no Estado de São Paulo Braz J. Vet Parasitol 17:210–217

Serra-Freire NMS (1982) Epidemiologia de *Amblyomma cajennense*: ocorrência estacional e comportamento dos estádios não parasitários em pastagens do Estado do Rio de Janeiro. Arq Univ Fed Rur Rio de Janeiro 5:187–193

Souza SSAL, Souza CE, Neto EJR, Prado AP (2006) Dinâmica sazonal de carrapatos (Acari: Ixodidae) na mata ciliar de uma região endêmica para febre maculosa na região de Campinas, São Paulo, Brasil. Ciência Rural Santa Maria 36:887–891

Szabó MPJ, Castro MB, Ramos HGC, Garcia MV, Castagnolli KC, Pinter A, Veronez VA, Magalhães GM, Duarte JMB, Labruna MB (2007) Species diversity and seasonality of free-living ticks (Acari: Ixodidae) in the natural habitat of wild Marsh deer (*Blastocerus dichotomus*) in Southeastern Brazil. Vet Parasitol 143:147–154

Szabó MPJ, Labruna MB, Garcia MV, Pinter A, Castagnolli KC, Pacheco RC, Castro MB, Veronez VA, Magalhães GM, Vogliotti A, Duarte JMB (2009) Ecological aspects of free-living ticks (Acari: Ixodidae) on animal trails in an Atlantic rainforest of Southeastern Brazil. Ann Trop Med Parasitol 103:57–72

Veronez VA, Freitas BZ, Olegário MMM, Carvalho WM, Pascoli GVT, Thorga K, Garcia MV, Szabó MPJ (2010) Ticks (acari: ixodidae) within various phytophysiognomies of a cerrado reserve in Uberlândia, Minas Gerais, Brazil. Exp Appl Acarol 50:169–179