Ticks (Acari: Ixodidae) on Wild Animals from the Porto-Primavera Hydroelectric Power Station Area, Brazil

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From June 2000 to June 2001, a total of 741 ticks were collected from 51 free-living wild animals captured at the Porto-Primavera Hydroelectric power station area, located alongside an approximately 180 km course of the Paraná river, between the states of São Paulo and Mato Grosso do Sul, comprising 9 species of 3 genera: Amblyomma *(7 species),* Boophilus *(1) and* Anocentor *(1). A total of 421 immature* Amblyomma *ticks were reared in laboratory until the adult stage, allowing identification of the species.* A. cajennense *was the most frequent tick species (mostly immature stages) collected on 9 host species*: Myrmecophaga tridactyla, Tamandua tetradactyla, Cerdocyon thous, Puma concolor, Tayassu tajacu, Mazama gouazoubira, Hydrochaeris hydrochaeris, Alouatta caraya, Cebus apella. *Other tick species were less common, generally restricted to certain host taxa.*

Key words: ticks - wildlife - *Amblyomma* - *Boophilus* - *Anocentor* - Brazil

Ticks are obligate blood feeders that parasitize a wide variety of terrestrial and flying vertebrates and a few marine snakes and lizards (Hoostraal 1985). More than 800 tick species have been described in the world (Keirans 1992, Camicas et al. 1998). Ticks are vectors of more kinds of microorganisms than any other arthropod taxon, including mosquitoes (Hoogstraal 1985, Oliver 1989). The vast literature regarding ticks has centered mostly around 10% of the world tick fauna, which have been well recognized for their medical and veterinary significance. However, a comprehensive knowledge of the ecology of "important" ticks and tick borne-diseases are best achieved by knowing the biological and physiological similarities and differences between all species, in relation to their hosts and to the environment. Knowledge of biological models of tick parasitism of wildlife is very useful to clarify factors that have permitted a few tick species to become economically important pests and vectors of disease agents to man and animals (Hoogstraal 1985).

There are 54 valid tick species in Brazil, of which 32 belong to the genus *Amblyomma* (Guimarães et al. 2001). Although more than half of the 102 known *Amblyomma* species in the World are endemic to the New World (Keirans 1992), they have been poorly studied. For many Brazilian species, geographic and host records are scarce and new tick species have recently been discovered (Barros Battesti et al. 1999, Labruna et al. 2002a). Although all tick species reported in Brazil have been properly described in the adult stage, immature stages (larvae and nymphs) of most of them are still unknown. Thus, host records for immature stages of the majority of the *Amblyomma* species from Brazil are even more scarce. This situation is linked to the lack of a taxonomic keys for identification of *Amblyomma* immature stages in Latin America. Currently, the only conclusive means of identifying species of *Amblyomma* immature stages from Brazil are by rearing these ticks until the adult stage, or by the use of specific molecular markers (Marrelli et al. 2001).

The present study reports ticks infesting several wildlife species captured alongside the Paraná river, Brazil. Several *Amblyomma* immature stages were collected and reared until the adult stage in the laboratory, allowing conclusive identification of the species.

MATERIALS AND METHODS

Porto-Primavera Hydroelectric power station is located in Brazil between the southwest of the state of São Paulo and the east of the state of Mato Grosso do Sul. Its water reservoir, filled up by the Paraná river, flooded an area of 2,200 km^2 at the São Paulo and Mato-Grosso do Sul border (Szabó et al. 2002). During the flooding, some free-living wild animals were rescued for an extensive research program with the financial support of the São Paulo State Energy Company (Cesp). The flooded area was composed of an extensive flat swamp, interposed by areas of dense forest above high-water level. Altitude ranged from 276 to 328 m above sea level.

For the present study, a total of 51 animals was sampled, comprising 15 different species (Table) from the following municipalities: Anaurilândia, Bataguassu, Bataiporã, Brasilândia, Santa Rita Pardo in Mato Grosso do Sul; Presidente Epitácio, Primavera and Rosana in São Paulo. All these municipalities are contiguously located alongside an approximately 180 km course of the Paraná river, between Brasilândia (21º15'S, 52º01'W) and Rosana (22º33'S, 53º01'W). Captures were carried out at irregular intervals from June 2000 to June 2001, a period when flooding procedures were divided into stages.

Captured animals were restrained with or without anesthesia (depending on animal species), and given a thor-

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ough physical examination. As other biological samples were taken for other research projects, tick sampling was performed on a limited period of 3 min/host. After this procedure, animals were taken to several Brazilian zoos, authorized breeders, or experimental reintroduction areas.

Ticks collected on the animals were immediately placed in dry plastic vials containing few fresh grass leaves, and covered by a cork containing several minute holes. Vials were properly identified and conditioned under room temperatures for few days or weeks, and then they were sent to the laboratory. The purpose of this procedure was to try to maintain ticks alive inside the vials until arriving at the laboratory for taxonomic identification.

Engorged larvae or nymphs that arrived alive at the laboratory were immediately placed in an incubator at 25ºC and RH 85%, to allow them to molt to nymphs and adults, respectively. Nymphs obtained from the engorged larvae were infested on naive rabbits according to Pinter et al. (2002). Adults obtained from the engorged nymphs were used for identification of the species of the former immature ticks collected on the animals.

RESULTS

A total of 741 ticks were collected from the 51 animals (Table). Nine tick species were identified, comprising 3 genera: *Amblyomma* (7 species), *Boophilus* (1) and *Anocentor* (1). From 495 nymphs and 77 larvae of the genus *Amblyomma* collected from the animals, a total of 413 and 8, respectively, were successfully reared until the adult stage in the laboratory, allowing identification of the species. The remaining 82 nymphs and 69 larvae died before reaching the adult stage, and were identified only to their generic level (*Amblyomma* sp.).

A. cajennense was the most frequent tick species, collected on 9 host species of different mammal taxa (Edentata, Carnivora, Artiodactyla, Rodentia and Primates). All these hosts harbored only immature stages of *A. cajennense,* except for one Edentata species (*Myrmecophaga tridactyla*) and one Artiodactyla (*Tayassu tajacu*), on which adults of *A. cajennense* were additionally found. Other *Amvblyomma* species were generally found in the adult stage, restricted to certain host taxa: *A. rotundatum* on snakes (*Bothrops moojeni* and *Boa constrictor*), *A. nodosum* on anteaters (*M. tridactyla* and *Tamandua tetractyla*), *A. cooperi* on capybara (*Hydrochaeris hydrochaeris*) and *A. longirostre* on porcupine (*Coendou prehensilis*). Representative specimens of all ticks species of the present study have been deposited in the National Tick Collection of Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo (nos: 302, 326, 327, 329, 332-349, 351, 352, 447, 448, 462, 463, 475-477, 488, 489, 575).

DISCUSSION

Our results showed that *A. cajennense* was the most common tick species in the studied area. This species is endemic to the Neotropical region, where it seems to be primarily a parasite of large wild mammals, especially tapirs (*Tapirus terrestris*), capybaras (*H. hydrochaeris*), peccaries (*Tayassu* spp.) (Aragão 1911, 1936). Horses, which were introduced into New World during colonization, have been showed to act as primary hosts for all parasitic stages of *A. cajennense* (Oliveira 1998, Labruna et al. 2002b). Cattle, another introduced host, was also showed to be a suitable host for *A. cajennense* (Fairchild et al. 1966, Serra-Freire 1982). During the present study, many farms alongside the Paraná river were visited and those provided shared areas by horses, cattle and wild animals. In addition, tapirs were also present in these areas (unpublished data). We believe that our results of *A. cajennense* on a great variety of wild animals (Table) can be linked to the availability of several primary hosts for *A. cajennense* (horse, cattle, tapir, capybara, peccary). Although a variety of animal species and also humans can be infested by *A. cajennense* (Aragão 1936, Lopes et al. 1998, Pereira et al. 2000, present study), the abundance of the infestations will depend on the availability of the primary hosts for the tick. In addition, environmental conditions of the area must have been favorable for the free-living stages of *A. cajennense* in the present study. It has been shown that this tick is very sensitive to vegetation cover (Labruna et al. 2001a).

The cattle tick, *B. microplus*, was collected from marsh deer (*Blastocerus dichotomus*) and jaguar (*Panthera onca*). This tick is highly prevalent on cattle in almost all of Brazil (Horn 1983). It is an Old World tick that was probably introduced in Brazil with cattle (Aragão 1911). Several studies have reported infestations by *B. microplus* on wild and domestic hosts other than cattle, but in all cases these hosts have a history of sharing the same area with cattle (Labruna et al. 2001a,b). Another study, conducted simultaneously on the same area of the present study, showed that *B. microplus* was the main tick species infesting four populations of marsh deers (Szabó et al. 2002). So far, cattle is the only known primary host for *B. microplus* in Brazil and should be viewed as the main source of *B. microplus* for any other host species. Similarly, horses are primary hosts for *A. nitens* over Northern, Central and Southeastern Brazil (Aragão & Fonseca 1953, Labruna et al. 2001a) and the finding of this tick on marsh deer in the present study should be linked to the presence of infested horses in the studied area.

A. nodosum was the most common adult tick on both anteaters species, *M. tridactyla* and *T. tetractyla*. To our knowledge, adults of this species have been reported exclusively on anteaters (Aragão 1936, Fairchild et al. 1966, Jones et al. 1972, Guimarães et al. 2001). In the present study, all 304 adult ticks that molted from engorged nymphs collected on anteaters were identified as *A. cajennense*. Thus, information about hosts for *A. nodosum* immature stages remains lacking.

The present record of *A. triste* on *M. tridactyla* (Table) is the first of this tick on an Edentata. It should not be considered unusual as the adult stage of *A. triste* has shown a broad host range in Uruguay (Sampaio et al. 1992). However, marsh deer seem to be the primary hosts for the adult stage of *A. triste* in Brazil (Szabó et al. 2002). The taxonomic position of *A. triste* was formerly confused with *A. tigrinum* and *A. maculatum* in South America (Kohls 1956). It is probable that *A. maculatum* does not exist in Brazil and adults of *A. tigrinum* parasitize almost exclusively Carnivora hosts (Guglielmone et al. 2000). As this last species is morphologically very similar to *A. triste,* previous reports of *A. tigrinum* on marsh deer in Brazil

TABLE

Ticks collected from wild animals in the Primavera hydroelectric power station area, Brazil

Host		Tick	Number of ticks					Mean no. of ticks
Name (n)	No. infested/No. non-infested host	species	Males	Females	Nymphs	Larvae	Total	± SE (range)
REPTILA								
Bothrops moojeni (1)	1/0	*Amblyomma rotundatum*	-	1	-	-	1	1 ± 0.0 (1)
Boa constrictor (1)	1/0	*A. rotundatum*	-	1	-	-	1	1 ± 0.0 (1)
	1/0	*Amblyomma* sp.	-	-	7	2	9	9 ± 0.0 (9)
EDENTATA								
Myrmecophaga tridactyla (20)	18/2	*A. cajennense*	24	12	270 [a]	-	306	15.3 ± 14.2 (0-54)
	12/8	*A. nodosum*	45	7	-	-	52	2.6 ± 4.4 (0-18)
	1/19	*A. triste*	-	1	-	-	1	0.05± 0.2 (0-1)
	11/9	*Amblyomma* sp.	-	-	30	-	30	1.5 ± 2.2 (0-6)
Tamandua tetradactyla (5)	4/1	*A. cajennense*	-	-	34 [a]	-	34	6.8 ± 7.6 (0-18)
	4/1	*A. nodosum*	21	7	-	-	28	5.6 ± 9.2 (0-22)
	1/4	*Amblyomma* sp.	-	-	1	-	1	0.2 ± 0.4 (0-1)
CARNIVORA								
Cerdocyon thous (1)	1/0	*A. cajennense*	-	-	3 [a]	-	3	3 ± 0.0 (3)
Puma concolor (2)	1/1	*A. cajennense*	-	-	-	8 [b]	8	4 ± 5.6 (0-8)
	1/1	*A. coelebs*	-	-	1 [a]	-	1	0.5 ± 0.7 (0-1)
	2/0	*Amblyomma* sp.	-	-	-	63	63	31.5 ± 19.0 (18-45)
Panthera onca (2)	2/0	*Boophilus microplus*	-	-	8	-	8	4 ± 4.2 (1-7)
	2/0	*Amblyomma* sp.	-	-	1	2	3	1.5 ± 0.7 (1-2)
ARTIODACTYLA								
Tayassu tajacu (5)	5/0	*A. cajennense*	6	1	23 [a]	-	30	6 ± 5.7 (1-15)
	3/2	*Amblyomma* sp.	-	-	10	-	10	2 ± 2.5 (0-6)
Mazama gouazoubira (1)	1/0	*A. cajennense*	-	-	5 [a]	-	5	5 ± 0.0 (5)
	1/0	*Amblyomma* sp.	-	-	3	-	3	3 ± 0.0 (3)
Blastocerus dichotomus (1)	1/0	*B. microplus*	-	4	-	-	4	4 ± 0.0 (4)
	1/0	*Anocentor nitens*	1	1	-	-	2	2 ± 0.0 (2)
RODENTIA								
Coendou prehensilis (3)	3/0	*A. longirostre*	5	-	-	-	5	1.6 ± 0.5 (1-2)
Hydrochaeris hydrochoeris (3)	3/0	*A. cooperi*	14	10	39 [a]	-	63	21 ± 13.1 (7-33)
	1/2	*A. cajennense*	-	-	1 [a]	-	1	0.3 ± 0.6 (0-1)
	3/0	*Amblyomma* sp.	-	-	3	1	4	1.3 ± 0.5 (1-2)
PRIMATES								
Alouatta caraya (3)	3/0	*A. cajennense*	-	-	18 [a]	-	18	6 ± 5.6 (1-12)
	2/1	*Amblyomma* sp.	-	-	20	1	21	7 ± 10.4 (0-19)
Cebus apella (3)	3/0	*A. cajennense*	-	-	19 [a]	-	19	6.3 ± 7.6 (1-15)
	3/0	*Amblyomma* sp.	-	-	7	-	7	2.3 ± 1.1 (1-3)

a: species identification was carried out after nymphs had molted to the adult stage in the laboratory; *b*: species identification was carried out after larvae had molted to nymphs that engorged on rabbits and molted to the adult stage in the laboratory.

(Serra-Freire et al. 1996, Sinkoc et al. 1998, Pereira et al. 2000) should be re-evaluated.

The present records of adults of *A. longirostre* on porcupine, *A. rotundatum* on cold blooded hosts (snakes), and *A. cooperi* on capybaras are in agreement with the literature that reports these ticks, almost exclusively on these hosts (Aragão 1936, Jones et al. 1972, Evans et al. 2000, Guimarães et al. 2001). The finding of an *A. coelebs* nymph on puma (*P. concolor*) is the first host record concerning an immature stage of this species. Adults of *A. coelebs* have been found on a variety of medium and large mammals, but tapirs seem to be its primary hosts (Fairchild et al. 1966, Jones et al. 1972, Guimarães et al. 2001).

Our findings reinforce previous studies, which showed the genus *Amblyomma* comprising the largest number of species parasitizing wildlife in Brazil (Aragão 1936, Sinkoc et al. 1998, Evans et al. 2000, Pereira et al. 2000, Guimarães et al. 2001, Labruna et al. 2002a). In addition, we found a variety of host records for immature stages of *A. cajennense*, much broader than for the adult stage. Further studies should emphasize host usage by *Amblyomma* immature stages, contributing to a better knowledge of life history of the New World *Amblyomma* fauna.

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