Exp Appl Acarol (2006) 40:83–100
DOI 10.1007/s10493-006-9027-0

Ticks (Ixodidae) on humans in South America

A. A. Guglielmone · L. Beati · D. M. Barros-Battesti · M. B. Labruna · S. Nava · J. M. Venzal · A. J. Mangold · M. P. J. Szabó · J. R. Martins · D. González-Acuña · A. Estrada-Peña

Received: 1 July 2006 / Accepted: 8 August 2006 /
Published online: 14 November 2006

Abstract Twenty eight species of Ixodidae have been found on man in South America (21 *Amblyomma*, 1 *Boophilus*, 2 *Dermacentor*, 2 *Haemaphysalis*, 1 *Ixodes* and 1 *Rhipicephalus* species). Most of them are rarely found on man. However, three

A. A. Guglielmone (✉) · S. Nava · A. J. Mangold
Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Rafaela, CC 22, CP 2300 Rafaela, Santa Fe, Argentina
e-mail: aguglielmone@rafaela.inta.gov.ar

L. Beati
United States National Tick Collection, Institute of Arthropodology and Parasitology and Department of Biology, Georgia Southern University, Statesboro, GA 30460-8056, USA

D. M. Barros-Battesti
Instituto Butantan, Laboratório de Parasitologia, Av. Vital Brasil 1500, 05503-900 São Paulo, Brazil

M. B. Labruna
Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, Av. Prof. Orlando M. de Paiva 87, 05508-900 São Paulo, Brazil

J. M. Venzal
Departamento de Parasitología Veterinaria, Facultad de Veterinaria, Alberto Lasplaces, 1550, CP 11600 Montevideo, Uruguay

M. P. J. Szabó
Faculdade de Medicina Veterinária, Universidade Federal de Uberlandia, Av. Pará 1720, Campus Umuarama-Bloco 2T, 38400-902 Uberlandia, Minas Gerais, Brazil

J. R. Martins
Fundação Estadual de Pesquisa Agropecuária, Instituto de Pesquisas Veterinárias Desiderio Finamor, Estrada do Conde 6000, 92990-000 Eldorado do Sul, Rio Grande do Sul, Brazil

D. González-Acuña
Facultad de Medicina Veterinaria, Universidad de Concepción, Casilla 537, Chillán, Chile

A. Estrada-Peña
Facultad de Veterinaria, Unidad de Parasitología, Miguel Servet 177, 50013 Zaragoza, Spain

species frequently parasitize humans in restricted areas of Argentina (*A. neumanni* reported from 46 localities), Uruguay (*A. triste* from 21 sites) and Argentina–Brazil (*A. parvum* from 27 localities). The most widespread ticks are *A. cajennense* (134 localities in Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Suriname and Venezuela), *A. ovale* (37 localities in Argentina, Brazil, Ecuador, French Guiana, Guyana, Paraguay, Suriname and Venezuela) and *A. oblongoguttatum* (28 sites in Brazil, Colombia, French Guiana, Guyana, Suriname and Venezuela). *Amblyomma aureolatum* (18 localities in Argentina, Brazil, French Guiana and Paraguay), *A. cajennense*, and *A. triste* are vectors of rickettsioses to man in South America. A better understanding of the respective roles of these and other tick species in transmitting pathogens to humans will require further local investigations. *Amblyomma* ticks should be the main subjects of these studies followed by species of *Boophilus*, *Dermacentor*, *Haemaphysalis* and *Rhipicephalus* species. In contrast with North America, Europe and Asia, ticks of the genus *Ixodes* do not appear to be major players in transmitting diseases to human. Indeed, there is only one record of an *Ixodes* collected while feeding on man for all South America.

Keywords Ticks · Ixodidae · Humans · South America

Introduction

Recent outbreaks of tick-transmitted human rickettsioses in Argentina (Ripoll et al. 1999), Uruguay (Venzal et al. 2004) and especially in Brazil (Silva and Galvão 2004) have generated renewed interest in ticks as vectors of human disease agents in South America. Simultaneously, studies on Neotropical ticks are also increasing (Estrada-Peña et al. 2005; Labruna et al. 2005a; Guglielmone et al. 2006) and they include research on ticks infesting humans (Venzal et al. 2003; Marques et al. 2006; Nava et al. 2006; Labruna et al. in press; Szabó et al. 2006). Nevertheless, the information on ticks of the family Ixodidae as parasite of man in South America is not exhaustive. Therefore, a collaborative effort has been made to summarize this information by gathering records from the literature and unpublished data from several tick collections in Argentina, Brazil, Chile, Uruguay and the United States of America. This compilation of data should prove useful to those interested in ticks and human tick-borne diseases.

Materials and methods

Our review is based on a thorough appraisal of the scientific literature, and unpublished records of ticks from man deposited in the following tick collections: Argentina, Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Rafaela, Santa Fe; Brazil, Instituto de Pesquisas Veterinárias Desiderio Finamor, Eldorado do Sul, Rio Grande do Sul; Laboratório de Parasitologia, Instituto Butantan, São Paulo; Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo, Faculdade de Medicina Veterinária, Universidade Federal de Uberlandia, Uberlandia; Chile, Laboratorio de Zoología, Departamento de Ciencias Pecuarias, Universidad de Concepción, Chillán;

Uruguay, Departamento de Parasitología, Facultad de Veterinaria, Montevideo. Additionally, unpublished information from South America contained in the most important tick collection worldwide, the United States National Tick Collection, Georgia Southern University, Statesboro, Georgia (USNTC) was included; ticks specimens from this collection are identified with the acronym RML.

Tick specimens were identified morphologically and sometimes molecularly by comparing their 16S rDNA sequences to homologous sequences deposited in GenBank. A few diagnoses of engorged nymphs were done after they moulted into adults.

Results

A total of 28 species of Ixodidae were detected on humans. New localities were determined for 20 species in many political divisions of several countries and they are listed in Table 1 according to collection accession number, tick stages, date, country, political division, locality and coordinates. The information from the literature is presented below. This information is complemented with quotations from Table 1 for first finding of a tick species in a major political division of a given country.

(1) *Amblyomma aureolatum* (Pallas): ARGENTINA – undetermined locality of the Alto Paraná region, probably in the Province of Misiones (Boero 1957 as *A. striatum*). BRAZIL – State of Paraná: Almirante Tamandaré (25°19′S 49°19′W), Curitiba (25°25′S 49°17′W), São José dos Pinhais (25°32′S 49°12′W) (Arzua et al. 2005); State of São Paulo: Guarulhos (23°29′S 46°32′W), Taiaçupeba (23°38′S 46°11′W) (Figueiredo et al. 1999; Pinter et al. 2004). FRENCH GUIANA – Cayenne region: Crique-Anguille (04°50′N 52°31′W), Oyapock (03°54′N 51°47′W), Régina (04°18′N 52°08′W), Saut Tigre (05°01′N 53°02′W) and Souvenir (undetermined) (Floch and Abbonnenc 1940; Floch and Fauran 1958, as *A. striatum*). PARAGUAY – Department of San Pedro: San Pedro (24°07′S 56°59′W) (Nava et al. in press). The confirmed localities for *A. aureolatum* are 18 but its parasitism on man may include Bolivia (Squire 1972) and Uruguay (Neumann 1911 as *A. striatum*). This needs confirmation since the Bolivian findings are of a larval infestation, and the larva of *A. aureolatum* is still undescribed. The Uruguayan finding may actually refer to a Brazilian collection, because Neumann (1911) mentioned its presence on man followed by the words ''Brésil, Uruguay''.

(2) *Amblyomma brasiliense* Aragão: ARGENTINA – Province of Jujuy: San Pedro (24°13′ 64°52′W) (Dios and Knopoff 1930); Province of Salta: undetermined locality (Boero 1945). BRAZIL – State of Paraná: Adrianópolis ''Parque Estadual das Lauráceas'' (24°44′S 48°33′W) (Arzua et al. 2005); State of São Paulo: Intervales State Park (24°17′S 48°25′W) (Szabó et al. 2006); State of Rio de Janeiro: the first locality is shown in Table 1. PARAGUAY – Department of San Pedro: San Pedro (*op. cit.*) (Nava et al. in press). According to Keirans (1985) it is not clear if this tick species was found on a human or a cow. However, the USNTC has a tick from man for this locality (RML 11078: 1M, Feb. 1913). The total confirmed sites for this species is 11. Squire (1972) allegedly found this species on man in Bolivia but this is a doubtful record for the same reasons given for *A. aureolatum*.

(3) *Amblyomma cajennense* (Fabricius): ARGENTINA – Provinces of Chaco, Formosa, Jujuy, Salta and Tucumán (Mazza and Cores 1931; Aragão 1938; Boero

Table 1 New localities for tick species (Ixodidae) found on man in South American countries deposited in Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina; Instituto de Pesquisas Veterinárias Desiderio Finamor (IPVDF); Instituto Butantan (IBSP); Universidade de São Paulo (CNC), Universidade Federal de Uberlandia (UFU), Brazil; Universidad de Concepción (DCP), Chile; Facultad de Veterinaria (DP), Uruguay and Georgia Southern University (RML), U.S.A. M = male, F = female, N = nymph, L = larva

Accesion number	Tick stages	Date	Country	Political division	Locality	Coordinates
Amblyomma aureolatum						
IBSP9635	1F	Nov 28, 2005	Brazil	São Paulo	Embu	23°39′S 46°51′W
IBSP6948	1M 1F	Sep 12, 1996	*Ib.*	*Ib.*	Itapecerica da Serra	23°43′S 46°51′W
IBSP9641	1F	Nov 28, 2005	*Ib.*	*Ib.*	Mariporá	23°19′S 46°35′W
CNC583	1M	Jan 5, 2002	*Ib.*	*Ib.*	Mogi das Cruzes	23°31′S 46°11′W
IBSP9576	1F	Nov 3, 2005	*Ib.*	*Ib.*	São Lourenço da Serra	23°51′S 46°57′W
CNC800	1F	Sep 28, 2003	*Ib.*	*Ib.*	São Paulo	23°32′S 46°38′W
A. brasiliense						
IBSP9125	1M 1F	Sep 2, 2004	Brazil	Paraná	Parque Estadual Mata dos Godoy	23°27′S 51°15′W
IBSP7317	1F	Jun 14, 2001	*Ib.*	Rio de Janeiro	Parque Nacional de Itatiaia	22°30′S 44°34′W
IBSP4438	1F	Sep 23, 1944	*Ib.*	Sao Paulo	Itanhaém	24°11′S 46°47′W
UFU153	1N	Dec 4, 2003	*Ib.*	*Ib.*	Ribeirão Grande	24°16′S 48°24′W
IBSP1152	1M	Sep 4, 1937	*Ib.*	*Ib.*	Serra da Cantareira	23°25′S 46°37′W
A. cajennense						
INTA1873	1N	Sep 10, 2004	Argentina	Salta	Campo Durán	22°14′S 63°12′W
INTA1704	1F	Feb 1, 1989	*Ib.*	*Ib.*	Saladillo	24°50′S 64°55′W
RML38757	1M 1F	Jan 19, 1963	Bolivia	Beni	San Joaquín	14°06′S 66°44′W
CNC195	1M	Jan 1999	Brazil	Distrito Federal	Brasilia	15°47′S 47°56′W
RML120556	1F	Mar 4, 1984	*Ib.*	*Ib.*	Brasilia 25 km S	16°00′S 47°52′W
RML13653	2M	Jun 5, 1935	*Ib.*	Goiás	Anápolis	16°18′S 48°57′W
UFU21	1M 1F	Mar 25, 2005	*Ib.*	*Ib.*	Araguapaz	13°44′S 50°47′W
UFU9	1N	Oct 11, 2004	*Ib.*	*Ib.*	Nova Crixás	13°43′S 50°47′W
CNC649	8M 12F	Apr 9, 2002	*Ib.*	Mato Grosso	Barão de Melgaço	16°16′S 55°57′W
RML13657	1M	Jun 13, 1935	*Ib.*	*Ib.*	Capão Grande	15°42′S 56°09′W
CNC433	1M 1F	Mar 17, 2001	*Ib.*	*Ib.*	Jauru	15°20′S 58°52′W
IBSP7647	6M 6F	Mar 3, 2002	*Ib.*	*Ib.*	Reserva do Cabaçal	15°05′S 58°28′W
CNC215	1M 1F	Nov 16, 1999	*Ib.*	Mato MS**	Trés Lagoas	20°45′S 51°40′W
UFU157	1F	May 28, 2001	*Ib.*	Minas Gerais	Barra Longa	27°17′S 43°03′W
RML120558	1M	Oct 18, 1983	*Ib.*	*Ib.*	Estação Ecológica de Piripatinga	18°48′S 45°29′W

Table 1 continued

Accesion number	Tick stages	Date	Country	Political division	Locality	Coordinates
RML13661	1M 1F	Jan 25, 1936	Brazil	Minas Gerais.	Itambucury	18°00′S 41°42′W
IBSP7649	1M	Apr 22, 2002	*Ib.*	*Ib.*	Serra Azul	20°09′S 44°27′W
IBSP5179a	30M 14F 3N	Sep 1955	*Ib.*	Pará	Rio Maicurú	02°05′S 54°04′W
IBSP4439	1M 3F	Sep 2, 1950	*Ib.*	Rio de Janeiro	Parque Nacional de Itatiaia	22°30′S 44°34′W
RML116819	2M 3F	Sep 1982	*Ib.*	Roraima	Estacão Ecológica de Maraça	03°22′N 61°40′W
IBSP9062	1F	Jul 10, 2004	*Ib.*	Sao Paulo	Agua da Prata	21°56′S 46°30′W
IBSP7451	1F	Oct 13, 2001	*Ib.*	*Ib.*	Atibada	23°07′S 46°33′W
IBSP9572	1M	Nov 21, 2005	*Ib.*	*Ib.*	Bragança Paulista	22°57′S 46°33′W
IBSP1992	1M	Jun 3, 1940	*Ib.*	*Ib.*	Butantan	23°35′S 46°44′W
IBSP9588	1M	Nov 25, 2005	*Ib.*	*Ib.*	Caieiras	23°22′S 46°44′W
CNC748	1N	Sep 17, 2002	*Ib.*	*Ib.*	Campinas	22°54′S 57°04′W
IBSP9596	3M 10F 2N	Dec 1, 2005	*Ib.*	*Ib.*	Caraguatatuba	23°37′S 45°25′W
IBSP9551	1M	Nov 16, 2005	*Ib.*	*Ib.*	Carapicuiba	23°31′S 46°50′W
IBSP9611	1F	Jan 3, 2006	*Ib.*	*Ib.*	Catanduva	21°08′S 48°58′W
IBSP9549	1F	Nov 10, 2005	*Ib.*	*Ib.*	Francisco Morato	23°17′S 46°45′W
IBSP9606	4F	Dec 8, 2005	*Ib.*	*Ib.*	Ibiúna	23°39′S 47°13′W
IBSP9625	1F	Feb 14, 2006	*Ib.*	*Ib.*	Itapetinga	23°35′S 48°03′W
IBSP9624	6M 20F	Feb 13, 2006	*Ib.*	*Ib.*	Jundiaí	23°11′S 46°52′W
IBSP7302	1F	Sep 23, 1999	*Ib.*	*Ib.*	Osasco	23°31′S 46°46′W
CNC452	1F	Apr 2001	*Ib.*	*Ib.*	Paulicea	21°19′S 51°50′W
CNC425	7N	Dec 19, 2000	*Ib.*	*Ib.*	Pedreira	22°44′S 46°54′W
IBSP1990	2N	Jun 26, 1940	*Ib.*	*Ib.*	Pilar	23°49′S 47°43′W
IBSP9577	3F 1N	Nov 3, 2005	*Ib.*	*Ib.*	Sao Lourenço da Serra	23°51′S 46°57′W
IBSP9555	1F	Nov 16, 2005	*Ib.*	*Ib.*	Sao Paulo	23°33′S 46°38′W
IBSP4463	1M 1F 1N	Mar 23, 1951	*Ib.*	*Ib.*	Serra do Diablo	22°24′S 52°35′W
CNC611	1N	Dec 2000	*Ib.*	*Ib.*	Teodoro Sampaio	22°32′S 52°12′W
IBSP9564	16M 29F	Nov 17, 2005	*Ib.*	*Ib.*	Ubatuba	23°26′S 45°04′W
IBSP9592	1M	Nov 26, 2005	*Ib.*	*Ib.*	Vargem Grande Paulista	23°36′S 47°01′W
RML12503	6F	Mar 16, 1935	*Ib.*	Unknown	Roca do Cedro	Unknown
RML66693	1M 1F 1N	Nov 21, 1975	Colombia	Casanare	Carimagua	05°23′N 71°01′W
RML64722	1F 10N	Nov 21, 1974	Ecuador	Los Ríos	Vinces	01°33′S 79°44′W
RML46156	1M 1F	Jan 31, 1965	F Guiana*	Cayenne	Montagne Togre	Unknown
IBSP4479	1F	Jul 8, 1951	*Ib.*	Unknown	Santa Clara	*Ib.*

Table 1 continued

Accesion number	Tick stages	Date	Country	Political division	Locality	Coordinates
RML146858	1M	Aug 14, 1982	Suriname	Brokopondo	Browns Berg Nature Park	04°51′N 55°12′W
A. coelebs						
CNC906	1N	Apr 8, 2005	Brazil	MS	Bonito	21°07′S 56°29′W
IBSP8733	1F	Feb 2000	*Ib.*	Roraima	Caroebe	00°53′S 59°42′W
CNC356	1F	Sep 20, 2000	*Ib.*	Sao Paulo	Teodoro Sampaio	22°32′S 52°12′W
A. dissimile						
IBSP5179b	1F	Sep 1955	Brazil.	Pará	Rio Maicurú	02°05′S 54°04′W
A. incisum						
CNC863	1N	Sep 3, 2004	Brazil	Sao Paulo	Ribeirão Grande	24°05′S 48°22′W
A. longirostre						
IBSP1278	1F	Unknown	Brazil	Sao Paulo	Butantan	23°35′S 46°44′W
A. naponense						
IBSP5194	4M	Sep 1955	Brazil	Pará	Rio Maicurú	02°05′S 54°04′W
CNC875	1N	Nov 12, 2004	*Ib.*	Rondonia	Guajará Mirim	10°47′S 65°20′W
RML123721	1N	May 19, 2006	F. Guiana	Cayenne	Floramazone Camp	04°32′N 52°09′W
A. neumanni						
INTA1943	1F 1N 1L	May 12, 2005	Argentina	Córdoba	La Luisiana	30°22′S 64°23′W
INTA983	1N	Jul 5, 1980	*Ib.*	Salta	Arenal	25°56′S 65°07′W
INTA1115	1N	Oct 16, 1980	*Ib.*	*Ib.*	El Encón	24°51′S 65°33′W
INTA1011	1M	Jul 14, 1980	*Ib.*	*Ib.*	El Tala	26°07′S 65°16′W
INTA1041	2N	Aug 29, 1980	*Ib.*	*Ib.*	El Tunal	25°15′S 64°25′W
INTA695	1M 1F	May 29, 1979	*Ib.*	*Ib.*	Finca San Martín	26°06′S 65°01′W
INTA1073	1N	Sep 7, 1980	*Ib.*	*Ib.*	Juramento	25°10′S 64°58′W
INTA186	2N	Oct 21, 1977	*Ib.*	*Ib.*	La Estrella	23°49′S 64°05′W
INTA1710	1N	Apr 18, 1989	*Ib.*	*Ib.*	Las Juntas	25°43′S 65°35′W
INTA1239	1M	May 5, 1982	*Ib.*	*Ib.*	Las Lagunillas	24°47′S 65°24′W
INTA454	1N	Oct 12, 1978	*Ib.*	*Ib.*	Palomitas	24°54′S 64°57′W
INTA1082	1N	Sep 15, 1980	*Ib.*	*Ib.*	San Luis	25°35′S 64°42′W
INTA1767	1F	Aug 19, 1980	*Ib.*	*Ib.*	Vaqueros	24°43′S 65°25′W
INTA1025	1F	Jul 23, 1980	*Ib.*	Tucumán	El Cadillal	26°42′S 65°16′W

Table 1 continued

Accesion number	Tick stages	Date	Country	Political division	Locality	Coordinates
INTA1019	1F	Jul 18, 1980	Argentina	Tucumán	Rodeo Grande	26°29′S 65°33′W
INTA991	1M	Jul 10, 1980	*Ib.*	*Ib.*	Tapia	26°36′S 65°17′W
A. oblongoguttatum						
IBSP5746	1M 1N	Apr 3, 1957	Brazil	Amazonas	Manacapurú	03°18′S 60°37′W
IBSP5195	2F	Sep 1955	*Ib.*	Pará	Rio Maicurú	02°05′S 54°04′W
CNC876	1N	Nov 17, 2004	*Ib.*	Rondonia	Monte Negro	10°17′S 63°19′W
IBSP8734	1F	Feb 2000	*Ib.*	Roraima	Caroebe	00°53′S 59°42′W
RML116160	1M 2F	Jun 1982	*Ib.*	*Ib.*	Estacão Ecológica de Maracá	03°22′N 61°40′W
RML13658	2F	Jun 2, 1936	*Ib.*	Unknown	Praia do Areaio	Unknown
RML83336	1M 4F	Aug 1959	F Guiana	Cayenne	Regina	04°18′N 52°08′W
RML116856	1F	Unknown	Guyana		Takutu Lumber Camp	06°25′N 59°00′W
RML28436	1M	Apr 14, 1950	Venezuela	Amazonas	Culebra (N slope Mount Duida)	03°40′N 65°50′W
A. ovale						
UFU000	1M	Dec 9, 2005	Brazil	São Paulo	Ribeirão Grande	24°16′S 48°24′W
IBSP9582	3F	Nov 17, 2005	*Ib.*	*Ib.*	Ubatuba	23°26′S 45°04′W
A. parvum						
INTA1942	1M	Nov 11, 2004	Argentina	Córdoba	San José de las Salinas	30°00′S 64°37′W
INTA909	1M	Oct 27, 1979	*Ib.*	*Ib.*	Sebastián Elcano	30°08′S 63°36′W
INTA1791	1M	Jan 29, 1990	*Ib.*	Salta	Cruz Quemada	25°02′S 64°58′W
INTA1170	1M	Nov 12, 1980	*Ib.*	*Ib.*	El Galpón	25°24′S 64°39′W
INTA1938	1F	Jan 2005	*Ib.*	S Estero***	Cejolao	27°28′S 62°17′W
UFU 213	1F	May 26, 2006	Brazil	Goiás	Araguapaz	13°44′S 50°47′W
IBSP4931	2M	Oct 10, 1948	*Ib.*	*Ib.*	Santa Isabel	15°18′S 49°26′W
IBSP3588	1M 1F	Feb 2005	*Ib.*	Maranhão	Aldeia do Porto	Unknown
IBSP4911	1F	Mar 29, 1953	*Ib.*	MS	Trés Lagoas	20°45′S 45°20′W
CNC889	2M 2F	Jan 2005	*Ib.*	Piauí	Gilbués	09°50′S 45°20′W
A. scalpturatum						
IBSP5181	3M 3F	Sep 1955	Brazil	Pará	Rio Maicurú	02°05′S 54°04′W
A. tigrinum						
INTA1939	2F	Nov 2005	Argentina	Córdoba	Campo La Esperanza	30°12′S 64°29′W
INTA1797	3F	Nov 1998	*Ib.*	*Ib.*	Córdoba	31°25′S 64°12′W

Table 1 continued

Accesion number	Tick stages	Date	Country	Political division	Locality	Coordinates
INTA1944	1M 1F	Feb 10, 2005	Argentina	Córdoba	Dean Funes	30°25′S 64°20′W
IBSP1666	1F 1N	May 22, 1935	Brazil	Unknown	Rio Araguaia	Unknown
A. triste						
DP0000	1M	Aug 15, 2004	Uruguay	Canelones	Balnaerio Santa Ana	34°48′S 55°28′W
DP0000	2M	Oct 6, 2000	*Ib.*	*Ib.*	Canelones	34°32′S 56°17′W
DP0000	3M 4F	Sep 15, 2003	*Ib.*	*Ib.*	Empalme Olmos	34°41′S 56°53′W
DP0000	3M	Nov 20, 2003	*Ib.*	*Ib.*	Escuela Militar de Aeronaútica	34°44′S 55°58′W
DP0000	2M	Aug 17, 2003	*Ib.*	*Ib.*	INIA Las Brujas	34°40′S 56°20′W
DP0000	1M	Dec 11, 2004	*Ib.*	*Ib.*	Pando	34°43′S 55°57′W
DP0000	1F	Oct 17, 2004	*Ib.*	*Ib.*	San Antonio	34°27′S 56°05′W
DP0000	2M 2F	Nov 30, 2004	*Ib.*	*Ib.*	Toledo Chico	34°44′S 56°06′W
DP0000	2M	Dec 2, 2000	*Ib.*	Maldonado	Piriápolis	34°48′S 55°17′W
DP0000	9M 3F	Oct 26, 2002	*Ib.*	Montevideo	Camino Maldonado	34°46′S 56°02′W
DP0000	1M	Aug 4, 2004	*Ib.*	*Ib.*	Cerro	34°46′S 56°02′W
DP0000	2M 1F	Oct 7, 2003	*Ib.*	*Ib.*	Villa García	34°46′S 56°02′W
Boophilus microplus						
RML39142	2M	Jun 10, 1963	Bolivia	Beni	San Joaquín	14°06′S 66°44′W
RML66850	1M	Oct 22, 1975	Colombia	Casanare	Carimagua	05°23′N 71°01′W
Dermacentor imitans						
RML48959	1F	May 4, 1967	Colombia	Chocó	Curiche	07°00′N 77°38′W
D. nitens						
RML39130	5L	Jun 15, 1963	Bolivia	Beni	San Joaquín	14°06′S 66°44′W
RML18051	1M 1F	1941	Colombia	Distrito Capital	Bogotá	04°37′N 74°05′W
Haemaphysalis juxtakochi						
IBSP7237	1N	Sep 23, 1999	Brazil	Sao Paulo	Itapeví	23°33′S 43°56′W
Rhipicephalus sanguineus						
IPVDF247	1M	Nov 3, 2005	Brazil	RS****	Cachoeira do Sul	30°02′S 52°53′W
IBSP8041	1F	Nov 27, 2002	*Ib.*	Sao Paulo	Parque do Ibirapuera	23°33′S 46°38′W
DCP0000	1F	Dec 2005	Chile	Región V	Valparaíso	33°02′S 71°38′W

*F Guiana = French Guiana, **MS = Mato Grosso do Sul, ***S Estero = Santiago del Estero, ****RS = Rio Grande do Sul

1954; Ivancovich 1973; Ivancovich and Luciani 1992; Mangold et al. 1990; Beldoménico et al. 2003). BOLIVIA: Department of Beni: the first locality in Table 1. BRAZIL – states of Amazonas, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná and São Paulo (Aragão 1912; Bequaert 1926; Aragão and Fonseca 1961; Lemos et al. 1997; Arzua et al. 2005; Sangioni et al. 2005); Distrito Federal, States of Goiás, Pará, Rio de Janeiro and Roraima: the first localities are shown in Table 1. COLOMBIA – Departments of Cundinamarca, Meta and Valle del Cauca (Patiño Camargo 1941; Osorno Mesa 1942); Department of Casanare: the first locality is listed in Table 1. ECUADOR – Province of Los Ríos: the first locality is listed in Table 1. FRENCH GUIANA – Cayenne region: Floch and Fauran (1958) stated that *A. cajennense* is widespread but only Floch and Abonnenc (1940) recorded one locality. GUYANA – two localities (Tonnelli-Rondelli 1937; Keirans 1985). PARAGUAY – Departments of Guairá and San Pedro (Keirans, 1985; Nava et al. in press). SURINAME – Brokopondo and Paramaribo (Santos Dias 1986). VENEZUELA – State of Amazonas: Río Ugheto (undetermined) (Guerrero 1996); State of Apure: undetermined locality (Fiasson 1949); State of Yaracuy (Jones et al. 1972). The localities for *A. cajennense* on man are 134. Its geographical distribution is shown in Fig. 1.

(4) *Amblyomma coelebs* Neumann: ARGENTINA – Province of Salta: Parque Nacional El Rey (24°15′S 64°40′W) (Beldoménico et al., 2003). BRAZIL – State of Rondonia: Headwaters of Jamari River (10°17′S 63°14′W), Line C5 (10°26′S 63°31′W), Line C25 (10°15′S 63°18′W), Parque Nacional dos Pacaás Novos (10°39′S 63°48′W) and Uru-Eu-Wau-Wau Indian Reserve (10°42′S 63°27′W) (Labruna et al. 2005b); States of Mato Grosso do Sul, Roraima and São Paulo: first localities are listed in Table 1. PARAGUAY – Department of Guairá: Villarica (25°46′S 56°27′W) (Nava et al. in press). It is unclear whether a record for San Pedro (*op. cit.*) was from a man or from another host (Keirans 1985). The confirmed localities for this species are 11.

(5) *Amblyomma dissimile* Koch: BRAZIL – State of Pará: undetermined locality (Koch 1844 as *Ixodes humanus*). COLOMBIA – unknown site (Galli Valerio 1909).

(6) *Amblyomma dubitatum* Neumann: BRAZIL – State of São Paulo: Itu (23°15′S 47°22′W), Pedreira (22°44′S 46°45′W), Ribeirão Grande (24°16′S 48°25′W) (Famadas et al. 1997, as *A. cooperi*; Labruna et al. in press). URUGUAY – Department of Tacuarembó: Rincón da Vassoura (31°15′S 56°03′W). The Uruguayan specimens were previously undetermined nymphs (Venzal et al. 2005) but posterior comparison of 16S rDNA sequences showed that they belong to *A. dubitatum*. The sequence is depicted in Venzal et al. (2005). Currently deposited in Gen Bank (DQ858955).

(7) *Amblyomma fuscum* Neumann: BRAZIL – State of Santa Catarina: Florianópolis (27°35′S 48°32′W); State of São Paulo: Guarujá (23°59′S 46°16′W) (Marques et al. 2006). The record for Santa Catarina is not confirmed because the tick was found on man in São Paulo but after visiting Florianópolis.

(8) *Amblyomma incisum* Neumann: BRAZIL – State of São Paulo: Intervales State Park (*op. cit.*) (Szabó et al. 2006). FRENCH GUIANA-Cayenne region: Bonne-Entente (05°00′N 53°51′W) and Oyapock (*op. cit.*) (Floch and Abonnenc 1941; Floch and Fauran 1958); Saint Laurent du Maroni region: Mana (05°39′N 53°46′W) (Floch and Abonnenc 1941). Labruna et al. (2005a) stated that these records are doubtful. PARAGUAY – Department of Guairá: Villarica (*op. cit.*) (Nava et al. in press). There are six confirmed localities for this species.

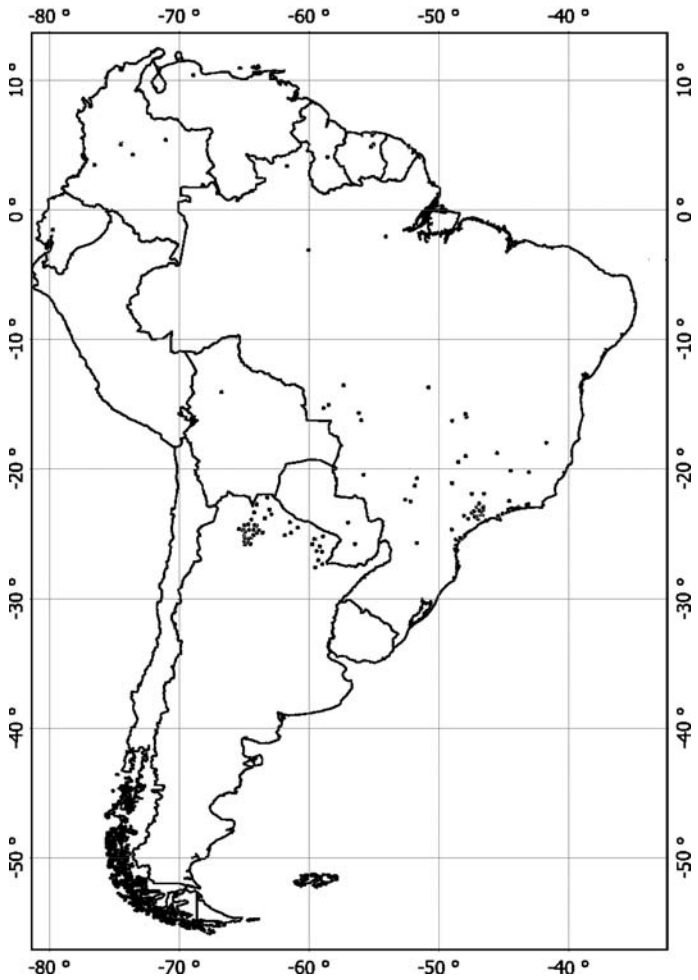

Fig. 1 Localities for *Amblyomma cajennense* on man in South America

(9) *Amblyomma longirostre* (Koch): BRAZIL – State of Paraná: Fénix-Parque Estadual Vila Rica (23°55′S 51°59′W); State of São Paulo: São Paulo (23°31′S 46°35′W) (Arzua et al. 2005). FRENCH GUIANA – Cayenne region: Cabassou (04°53′N 52°18′W), Cayenne (04°56′N 52°19′W) (Floch and Fauran 1958).

(10) *Amblyomma naponense* (Packard): BRAZIL – State of Pará: the first locality is shown in Table 1. State of Rondonia: Headwaters of Jamari River (*op. cit.*) (Labruna et al. 2005b). FRENCH GUIANA – Cayenne region: Alicoto (03°07′S 52°21′W) (Floch and Fauran 1958). There are five confirmed sites for this species.

(11) *Amblyomma neumanni* Ribaga: ARGENTINA – Provinces of Córdoba, Jujuy, Salta and Tucumán (Boero 1954; Guglielmone and Hadani 1981; Nava et al. 2006). The confirmed localities for *A. neumanni* are 46, concentrated in a narrow area from 23°49′S to 30°22′S and from 64°05′W to 65°36′W.

(12) *Amblyomma oblongoguttatum* Koch: BRAZIL – States of Pará, Paraná and Rondonia (Aragão and Fonseca 1961; Arzua et al. 2005; Labruna et al. 2005b);

States of Amazonas and Roraima: the first localities are listed in Table 1. COLOMBIA – Department of Santander (Luque Forero 1949). FRENCH GUIANA – Cayenne region (Floch and Abonnenc 1940). GUYANA – Keirans (1985) mentionated its presence along the Sipurani River. SURINAME – Brokopondo (Santos Dias 1986). VENEZUELA – States of Amazonas and Apure (Jones et al. 1972; Guerrero 1996). The confirmed localities for this species are 38. The distribution of records of *A. oblongoguttatum* on man is presented in Fig. 2.

(13) *Amblyomma ovale* Koch: ARGENTINA – Provinces of Chaco and Formosa: (Boero 1954, as *A. fossum*; Ivancovich and Luciani 1992). BRAZIL – States of Paraná, Rondonia and São Paulo (Arzua et al. 2005; Labruna et al. 2005b; Szabó et al. 2006). ECUADOR – Provinces of Napo and Sucumbíos (Zerpa et al. 2003). FRENCH GUIANA – Cayenne region (Floch and Abonnenc 1940, as *A. fossum*). GUYANA – one locality (Keirans 1985). PARAGUAY – Departments of Guairá

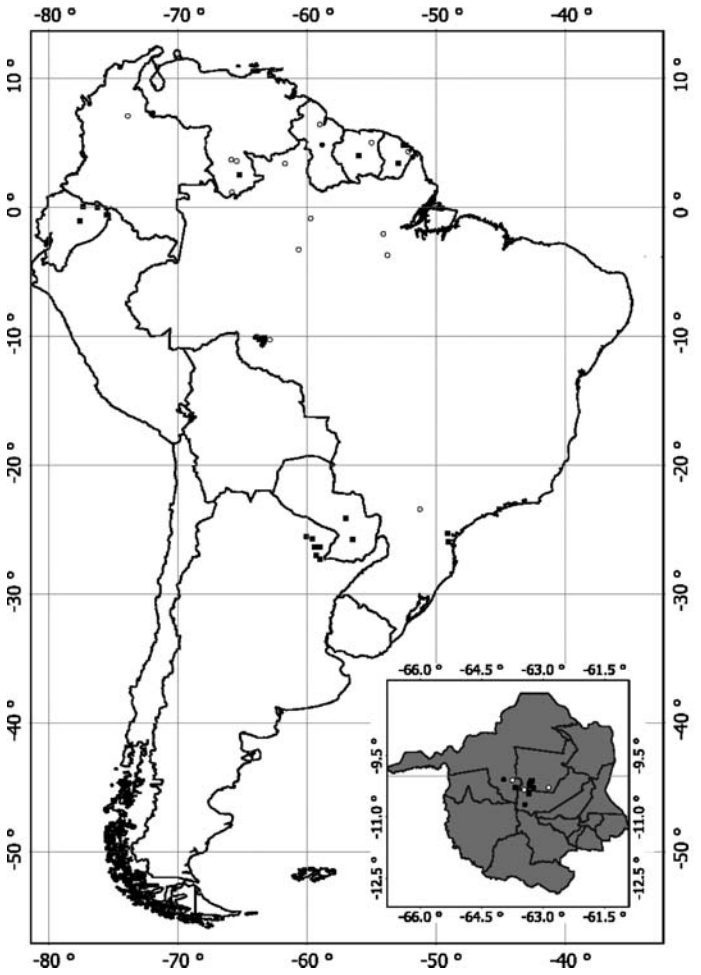

Fig. 2 Localities for *Amblyomma oblongoguttatum* (○), *Amblyomma ovale* (■), and *A. oblongoguttatum* and *A. ovale* (•) on man in South America. Enlarged map corresponds to the State of Rondonia in Central-Eastern Brazil

and San Pedro (Nava et al. in press). SURINAME – unknown locality (Keirans 1985). VENEZUELA – Amazonas and Apure States (Jones et al. 1972); Díaz Ungría (1957) reported *A. ovale* from an unknown locality in ''Delta del Orinoco''. There are 38 localities for this species. See Fig. 2 for the distribution of *A. ovale* on humans.

(14) *Amblyomma pacae* Aragão: SURINAM – Paolemu airstrip (03°21′N 55°25′W) (Jones et al. 1972).

(15) *Amblyomma parvum* Aragão: ARGENTINA – Provinces of Catamarca, Chaco, Córdoba and Salta (Boero 1954; Ivancovich 1973; Guglielmone and Hadani 1980; Ivancovich and Luciani 1992); Province of Santiago del Estero: the first locality is listed in Table 1. Most records for *A. parvum* in Argentina are concentrated in an area from 23°28′S to 30°48′S and from 61°55′W to 65°23′W. BOLIVIA – Department of Santa Cruz: locality unknown (Guglielmone et al. 1990). BRAZIL – State of Bahia: locality unknown (Guimarães et al. 2001); States of Goiás, Maranhão, Mato Grosso do Sul and Piauí: first localities in Table 1. The confirmed localites for *A. parvum* are 27.

(16) *Amblyomma pseudoparvum* Guglielmone, Mangold and Keirans: ARGENTINA – Provinces of Chaco: Colonia Benítez (27°19′S 58°57′W); Picada 8 km 157 (25°25′S 62°43′W); Formosa: Estancia El Tas Tas (24°42′S 58°57′W); and Salta: Morillo (23°26′S 62°53′W) (Ivancovich and Luciani 1992).

(17) *Amblyomma romitii* Tonelli-Rondelli: BRAZIL – State of Pará: undetermined northern locality (Aragão and Fonseca 1961 as *A. tasquei* Floch and Abonnenc). This species was synonymyzed with *Amblyomma extraoculatum* Neumann by Santos Dias (1955). However, Barros-Battesti et al. (submitted) examined the types of the two species and concluded that they are both valid.

(18) *Amblyomma rotundatum* Koch: BRAZIL – State of Rio de Janeiro: Itaboraí (22°45′S 42°52′W) (Serra Freire et al. 1995).

(19) *Amblyomma scalpturatum* Neumann: BRAZIL – State of Mato Grosso: Jaurú (15°20′S 58°52′W) (Labruna et al. 2005a). State of Pará: unknown northern locality (Aragão and Fonseca 1961); State of Rondonia: Line C10 (10°22′S 63°25′W), Line C25 (*op. cit.*) and Uru-Eu-Wau-Wau Indian Reserve (*op. cit.*) (Labruna et al. 2005b). The total localities for this species are six.

(20) *Amblyomma tigrinum* Koch: ARGENTINA – Province of Buenos Aires: Nicolás Levalle (38°52′S 62°53′W); Province of Chaco: Estancia La Aurora (26°22′S 58°59′W) (Guglielmone et al. 1982; Ivancovich and Luciani 1992); Province of Córdoba: northwestern area (Nava et al. 2006). BRAZIL – State of Rio Grande do Sul: Guaíba (30°04′S 51°44′W) (Evans et al. 2000). FRENCH GUIANA – Cayenne region: Cayenne (*op. cit.*), Crique-Anguille (*op. cit.*) (Floch and Fauran 1958). PARAGUAY – locality unknown (Nava et al. in press). URUGUAY – Department of Soriano: Cardona (33°52′S 57°21′W) (Venzal et al. 2003). The records of *A. maculatum* for Argentina (Boero 1954) and Chile (Donoso 1953) probably refer to *A. tigrinum*. Confirmed localities for *A. tigrinum* on man are 11.

(21) *Amblyomma triste* Koch: ARGENTINA – Province of Buenos Aires: INTA Delta del Paraná (38°25′S 58°35′W) (Ivancovich 1980). URUGUAY – Departments of Canelones, Maldonado, Montevideo and San José (Venzal et al. 2003, 2004). Most Uruguayan records are from a small area located between 34°27′S to 34°53′S and 55°13′W to 57°00′W. VENEZUELA – State of Amazonas: Cerro La Neblina (01°09′N 65°47′W) (Guerrero 1996). The confirmed localities for this species are 21.

(22) *Boophilus microplus* (Canestrini): ARGENTINA – unnamed localities in northwestern Argentina: 25°41′S 65°32′W, 25°02′S 64°58′W, 25°18′S 64°55′W, 25°56′S 65°07′W, 26°05′S 65°05′W, 26°22′S 65°17′W (Guglielmone et al. 1991); Province of Corrientes: Paso de la Patria (27°19′S 58°35′W); Province of Entre Ríos: unknown locality; Province of Formosa: El Bellaco Puesto 51 (25°47′S 59°44′W) and INTA El Colorado (26°24′S 59°22′W) (Ivancovich and Luciani 1992; Boero 1954). BOLIVIA – Department of Beni: the first locality is listed in Table 1. BRAZIL – State of Rondonia: unknown locality (Labruna et al. 2002). COLOMBIA – Department of Casanare: first locality in Table 1. PERU – Department of Lima: Rimac Valley (12°01′S 77°01′W) (Need et al. 1991). VENEZUELA – State of Cojedes: El Baúl (08°57′N 68°18′W) (Díaz Ungría 1957). The confirmed localities for this tick species are 18.

(23) *Dermacentor imitans* Warburton: COLOMBIA – Department of Chocó: first locality in Table 1. This is the first record for this tick species in Colombia.

(24) *Dermacentor nitens* (Neumann): BOLIVIA – Department of Beni: first locality in Table 1. BRAZIL – State of Rondonia: locality unknown (Labruna et al. 2002). COLOMBIA – Department of Boyacá: Maní (04°49′N 72°17′W), Trinidad (05°23′N 71°39′W) (Osorno Mesa 1942); Distrito Capital: first locality in Table 1. The total confirmed localities are six.

(25) *Haemaphysalis juxtakochi* Cooley: ARGENTINA – Province of Salta: Parque Nacional El Rey (*op cit*.) (Beldoménico et al. 2003). BRAZIL – State of Paraná: Curitiba (25°26′S 49°16′W); State of Rondonia: Uru-Eu-Wau-Wau Indian Reserve (*op. cit*) (Arzua et al. 2005; Labruna et al. 2005b); State of São Paulo: the first locality is listed in Table 1. FRENCH GUIANA – Cayenne region: Oyapock (*op. cit*.) (Floch and Fauran 1958). URUGUAY – Department of Tacuarembó: Rincón da Vassoura (*op. cit*.) (Venzal et al. 2005). VENEZUELA – State of Bolívar: Pauji (04°31′N 61°17′W) (Jones et al. 1972). There are eight confirmed localities for this species.

(26) *Haemaphysalis leporispalustris* (Packard): ARGENTINA – Province of Santa Fe: Mocoví (28°25′S 59°42′W) (Lahille 1905). COLOMBIA – Department of Boyacá: Muzo (05°32′N 74°06′W) (Osorno Mesa 1942 as *H. proxima*).

(27) *Ixodes luciae* Sénevet: ARGENTINA – Province of Buenos Aires: INTA Delta del Paraná (*op. cit*.) (Ivancovich and Luciani 1992).

(28) *Rhipicephalus sanguineus* (Latreille) complex: ARGENTINA – Province of Salta: Salta (24°47′S 65°24′W); Province of Santa Fe: Esperanza (31°26′S 60°55′W), Santa Fe (31°36′S 60°41′W) (Guglielmone et al. 1991; Gervasoni et al. 2003). BRAZIL – State of Goiás: Goiania (16°41′S 49°15′W); State of Pernambuco: Recife (08°05′S 34°55′W); State of São Paulo: Pedreira (22°44′S 46°57′W) (Lima et al. 1995; Danta-Torres 2005; Louly et al. 2006); State of Rio Grande do Sul: the first locality is included in Table 1. CHILE – Region Metropolitana: Santiago (33°27′S 70°38′W) (Schenone 1996); Region V: the first locality is listed in Table 1. GUYANA – locality unknown (Keirans 1985). PERU – ''Central Coast'' (Need et al. 1991). The total confirmed localities for this tick species are 15.

There are records of Ecuadorian (Galapagos Islands) ticks, which might have either been feeding or just walking on man. They are as follows: *Amblyomma macfarlandi* Keirans, Hoogstraal and Clifford: RML 59264: 1N, Mar. 3, 1970, locality unknown; *Amblyomma usingeri* Keirans, Hoogstraal and Clifford: RML 59269: 1M, Mar. 20, 1970, Volcán Acedo (00°24′S 91°07′W); RML 108234: 2M 1F, Apr. 1978,

locality as above. The same is true for *Amblyomma latepunctatum* Tonnelli-Rondelli, in French Guiana, Gallion (04°47′N 52°56′W) (Labruna et al. 2005a).

Discussion

Amblyomma and *Ixodes* ticks are well represented in South America with over 50 and 40 species, respectively (Guglielmone et al. 2003). However, while a total of 21 species of *Amblyomma* have been collected from humans, a single *Ixodes* species has been reported to feed on man, and this only once. Therefore, the medical relevance of *Ixodes* in South America appears to be low in comparison with that reported in North America, Europe and Asia (Estrada-Peña and Jongejan 1999). Indeed, ticks from the genus *Amblyomma* must become the major targets for future studies, in order to evaluate the medical importance of ticks in South America.

Amblyomma neumanni, *A. parvum* and *A. triste* were frequently found on humans in restricted regions of Argentina (*A. neumanni*), Argentina and Brazil (*A. parvum*) and Uruguay (*A. triste*). The distribution and frequency of human infestation by *A. neumanni*, does not come as a surprise, because this ticks, which occurs in a small area in northwestern Argentina (Guglielmone and Hadani 1981), has been known to feed on man for a long time (Guglielmone et al. 1991). This is, however, not the situation for the other two species. Both, *A. parvum* and *A. triste*, are established from Argentina to Mexico (Guglielmone et al. 2003; Guzmán et al. 2006) but they appear to parasitize humans only in small regions within their large distribution areas. This can be explained by the fact that interest in such species has been stirred in countries where these ticks have been found to transmit pathogens to humans, as is the situation for *A. triste*, the vector of *Rickettsia parkeri* in Uruguay (Venzal et al. 2004), or considered potential vectors as *A. parvum* in Argentina and Brazil. Additional efforts are needed to obtain basic information for a better understanding of the transmission mechanisms of tick-borne diseases in South America.

Three species of *Amblyomma* (*A. cajennense*, *A. oblongoguttatum* and *A. ovale*) appear to be commonly feeding on man in large areas of South America, in particular *A. cajennense*. This emphasizes the medical importance of *A. cajennense*, which is known to have caused a number of fatal cases of spotted fever due to *Rickettsia ricketsii* in Brazil, Colombia and Panama (Labruna 2004), and most probably also in Argentina (Ripoll et al. 1999). The relative frequency of human infestation by *A. oblongogutattum* was unexpected. Almost nothing is known about the ecology of this widely distributed Neotropical tick (Guglielmone et al. 2003). Indeed, the possible vectorial roles of *A. oblonguttatum* and *A. ovale* need to be investigated. In Brazil, these two tick species have been found infected with *Rickettsia belli* (Labruna 2004), an organism so far not known to cause any human disease.

Amblyomma aureolatum, has also been found infected with *R. rickettsii* (Labruna 2004), whereas *A. coelebs*, *A. dubitatum*, *A. longirostre*, *A. neumanni*, *A. parvum*, *A. rotundatum*, *A. scalpturatum* and *A. tigrinum*, have been found infected with rickettsial species of unknown pathogenicity to humans in Brazil and Argentina (Labruna 2004; unpublished). It has been suggsted, however, that *Rickettsia amblyommii*, detected in *A. cajennense*, *A. coelebs*, *A. longirostre* and *A. neumanni* may be responsible of human disease (Parola et al. 2005).

Additional cases of human infestation by ticks are reported for species belonging to genera *Boophilus*, *Dermacentor*, *Haemaphysalis* and *Rhipicephalus*. The finding of *D. imitans* in Colombia is the first for the country; however this record was not totally unexpected because it is established in Colombian neighboring countries Venezuela and Panama with antecedents to bite humans (Guglielmone et al. 2003). *Haemaphysalis juxtakochi* and ticks from the *R. sanguineus* complex have been found infected with *Rickettsia rhipicephali* and *Rickettsia massiliae* in Brazil and Argentina, respectively (Cicuttin et al. 2004; Labruna 2004). *Rickettsia massiliae* has been recently associated to human illness in southern Italy (Vitale et al. 2006).

Most South American tick species feed only occasionally on man. However, six species of *Amblyomma* have been found in more than 20 localities throughout the region (see above) and their vectorial capacity deserve further investigations. Five species (*A. aureolatum*, *A. coelebs*, *A. tigrinum*, *B. microplus* and *R. sanguineus* complex) were found in more than 10 localities. Ticks of the *R. sanguineus* complex are tied to diseases of worldwide medical importance. Therefore, research on tick-borne diseases in South America should not ignore them. Finally, there are many records (not included in this review) of unidentified larvae and nymphs found on humans in the Neotropics. However, the lack of adequate taxonomic keys of immature stages make difficult their identification.

Acknowledgements We acknowledge the support of Instituto Nacional de Tecnología Agropecuaria, Asociación Cooperadora de la Estación Experimental Rafaela del Instituto Nacional de Tecnología Agropecuaria and Consejo Nacional de Investigaciones Científicas y Técnicas (PIP 5721), Argentina, to AAG, SN and AJM. Financial support to DMBB, MBL, MJPS and JRM was given by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP 99/05446-8), Conselho Nacional de Desenvolvimento Científico e Tecnológico, Universidade Federal de Uberlândia and Fundação Estadual de Pesquisa Agropecuária.

References

Aragão HB (1912) Nota sobre os Ixodidas collecionados durante a expedição do Sr Coronel Rondon nos estados de Goyaz e Matto Grosso pelo Snr Dr Murillo de Campos, medico da expedição. Nova especie de *Amblyomma*: *A conspicuum*. Braz Med 26:429–430

Aragão HB (1938) Notas sobre os ixodideos da Republica Argentina. Mem Inst Oswaldo Cruz 33:319–327

Aragão HB, Fonseca F (1961) Nota de ixodologia. VIII. Lista e chave para os representantes da fauna ixodológica brasileira. Mem Inst Oswaldo Cruz 59:115–129

Arzua M, Onofrio VC, Barros-Battesti DM (2005) Catalogue of the tick collection (Acari: Ixodida) of the Museu de História Natural Capao da Imbuia, Curitiba, Paraná, Brazil. Rev Bras Zool 22:623–632

Beldoménico PM, Baldi JC, Antoniazzi LR, Orduna GM, Mastropaolo M, Macedo AC, Ruiz MF, Orcellet V, Peralta JL, Venzal JM, Mangold AJ, Guglielmone AA (2003) Ixodid ticks (Acari: Ixodidae) present at Parque Nacional El Rey, Argentina. Neotr Entomol 32:273–277

Bequaert J (1926) Medical report of the Hamilton Rice seventh expedition to the Amazon in conjunction with the department of tropical medicine of Harvard University, 1924–1925. Contr Harvard Inst Trop Biol Med 4:155–257

Boero JJ (1945) Los ixodideos de la República Argentina. Rev Med Vet (Buenos Aires) 26:1–10

Boero JJ (1954) Los ixodoideos de la República Argentina y sus huéspedes. Rev Fac Agron Vet 13:505–514

Boero JJ (1957) Las garrapatas de la República Argentina (Acarina: Ixodoidea). Depto. Edit. Univ. Buenos Aires, Buenos Aires, 113 pp

Cicuttin GL,Rodríguez Vargas M, Jado I, Anda P (2004) Primera detección de *Rickettsia massiliae* en la ciudad de Buenos Aires Resultado preliminares. Rev Arg Zoon 1:8–10
Danta-Torres F (2005) Parasitismo humano por *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae). Res. XIX Congr. Parasitol., novembre 2005, Porto Alegre, Rio Grande do Sul, Brasil, 1p. CD version.
Díaz Ungría C (1957) Nota sobre las especies de Acarina de Venezuela. Rev San Asist Soc 22: 457–467
Dios RL, Knopoff R (1930) Sobre Ixodoidea de la República Argentina. Rev Soc Arg Biol 6:593–627
Donoso R (1953) Ixodoidea de Chile. Rev Chil Entomol 3:132–134
Estrada-Peña A, Jongejan F (1999) Ticks feeding on humans: a review of records on human-biting Ixodoidea with special reference to pathogen transmission. Exp Appl Acarol 23:685–715
Estrada-Peña A, Venzal JM, Mangold AJ, Cafrune MM, Guglielmone AA (2005) The *Amblyomma maculatum* Koch, 1844 (Acari: Ixodidae: Amblyomminae) tick group: diagnostic characters, description of the larva of *A. parvitarsum* Neumann, 1901, 16S rDNA sequences, distribution and hosts. Syst Parasitol 60:99–112
Evans DE, Martins JR, Guglielmone AA (2000) A review of the ticks (Acari, Ixodida) of Brazil, their hosts and geographical distribution-1. The state of Rio Grande do Sul, southern Brazil. Mem Inst Oswaldo Cruz 95:453–470
Famadas K, Lemos ERS, Coura JR, Machado RD, Serra Freire NM (1997) *Amblyomma cooperi* (Acari: Ixodidae) parasitando humano em área de foco de febre maculosa, São Paulo–Brasil. Acta Parasitol Port 4:154
Fiasson R (1949) Contribución al estudio de los ácaros de Venezuela. Rev Grancolombina Zoot Hig Med Vet 3:567–588
Figueiredo LTM, Badra SJ, Pereira LE, Szabó MPJ (1999) Report on ticks collected in the southeast and mid-west regions of Brazil: analyzing the potential transmission of tick-borne pathogens to man. Rev Soc Bras Med Trop 32:613–619
Floch H, Abonnenc E (1940) Ixodidés de la Guyane Française. Publ Inst Pasteur Guyane Territ. Inini (3) 46 pp
Floch H, Abonnenc E (1941) Ixodidés de la Guyane Française. II. Publ Inst Pasteur Guyane (3) 31 pp
Floch H, Fauran P (1958) Ixodidés de la Guyane et des Antilles Françaises. Arch Inst Pasteur Guyane (446) 94 pp
Galli Valerio B (1909) Notes de parasitologie et de technique parasitologique. Zbl Bakteriol 51:538–545
Gervasoni SH, Guglielmone AA, Tarabla HD, Ruiz MF (2003) Factors associated with *Rhipicephalus sanguineus* (Latreille, 1806) household infestation. 10th Symp Int Vet Epidemiol Econ, Santiago, Chile, November 2003. CD version, 4 pp
Guerrero R (1996) Las garrapatas de Venezuela (Acarina: Ixodoidea). Listado de especies y claves para su identificación. Bol Dir Malariol Saneamiento Amb 36:1–24
Guglielmone AA, Hadani H (1980) Hallazgos de *Amblyomma parvum* Aragao, (1908), en Catamarca y Salta. Rev Med Vet (Buenos Aires) 61:121–129
Guglielmone AA, Hadani H (1981) La distribución geográfica de *Amblyomma neumanni* Ribaga, 1902, en la Argentina. Gac Vet 42:754–760
Guglielmone AA, Mangold AJ, Hadani A (1982) *Amblyomma tigrinum* Koch, 1844 en la Argentina. Su diagnóstico erróneo como *Amblyomma maculatum* y su distribución geográfica. Gac Vet 44:57–63
Guglielmone AA, Mangold AJ, Keirans JE (1990) Redescription of the male and female of *Amblyomma parvum* Aragao, 1908, and description of the nymph and larva, and description of all stages of *Amblyomma pseudoparvum* spn (Acari: Ixodida: Ixodidae). Acarologia 31:144–159
Guglielmone AA, Mangold AJ, Viñabal AE (1991) Ticks (Ixodidae) parasitizing humans in four provinces of northwestern Argentina. Ann Trop Med Parasitol 85:539–542
Guglielmone AA, Estrada-Peña A, Keirans JE, Robbins RG (2003) Ticks (Acari: Ixodida) of the Neotropical Zoogeographic Region. Special Publication of the International Consortium on Ticks and Tick-Borne Diseases-2, Atalanta, Hauten
Guglielmone AA, Venzal JM, González-Acuña D, Nava S, Hinojosa A, Mangold AJ (2006) The phylogenetic position of *Ixodes stilesi* Neumann, 1911 (Acari: Ixodidae): morphological and preliminary evidences from 16S rDNA sequences. Syst Parasitol 65:1–11
Guimarães JH, Tucci ED, Barros-Battesti DM (2001) Ectoparasitos de importancia veterinaria. Pleiade-FAPESP, Sao Paulo, 218 p

Guzmán-Cornejo C, Pérez TM, Nava S, Guglielmone AA (2006) Confirmation of the presence of *Amblyomma triste* Koch, 1844 (Acari: Ixodidae) in Mexico. Syst Appl Acarol 11:47–50
Ivancovich JC (1973) Las garrapatas del Chaco y Formosa. Primera comunicación. Rev Inv Agropec Ser 4, Patol Anim 10:9–24
Ivancovich JC (1980) Reclasificación de algunas especies de garrapatas del género *Amblyomma* (Ixodoidea) en la Argentina. Rev Inv Agropec 15:673–682
Ivancovich JC, Luciani CA (1992) Las garrapatas de Argentina. Monogr Asoc Arg Parasitol Vet 95 pp
Jones EK, Clifford CM, Keirans JE, Kohls GM (1972) The ticks of Venezuela (Acarina: Ixodoidea) with a key to the species of*Amblyomma* in the Western Hemisphere. Brigham Young Univ Sci Bull Biol Ser 17:1–40
Keirans JE (1985) George Henry Falkiner Nuttall and the Nuttall tick catalogue. Un St Dep Agric, Agric Res Ser Misc Pub (1438) 1785 pp
Koch CL (1844) Systematische Ubersicht uber die Ordnung der Zecken. Arch Naturg 10:217–239
Labruna MB (2004) Carta acarológica. Rev Bras Parasitol Vet 13(Supl.1):199–202
Labruna MB, Schumaker TTS, Basano SA, Camargo LMA, Camargo EP (2002) Ticks (Ixodidae) of the State of Rondonia, western Amazon, Brazil. Abst 11th Int Cong Acarol, Mérida, Yucatán, Mexico, September 2002, p 216
Labruna MB, Keirans JE, Camargo LMA, Ribeiro AF, Martins RS, Camargo EP (2005a) *Amblyomma latepunctatum*, a valid tick species (Acari. Ixodidae) long misidentified with *Amblyomma incisum* and *Amblyomma scalpturatum*. J Parasitol 91:527–541
Labruna MB, Camargo LM, Terrassini FA, Ferreira F, Schumaker TTS, Camargo EP (2005b) Ticks (Acari: Ixodidae) from the state of Rondonia, western Amazon, Brazil. Syst Appl Acarol 10: 17–32
Labruna MB, Pacheco RC, Ataliba AC, Szabó MPJ Human parasitism by the capybara tick, *Amblyomma dubitatum*. Entomol News (in press)
Lahille F (1905) Contribution a l'etude des ixodides de la Republique Argentine. An Minist Agric 2:7–166
Lemos ERS, Machado RD, Avila Pires FD, Machado SL, Costa LMC, Coura JR (1997) Rickettsiae-infected ticks in an endemic area of spotted fever in the state of Minas Gerais, Brazil. Mem Inst Oswaldo Cruz 92:477–481
Lima VLC, Figueiredo AC, Pignatti MG, Modolo M (1995) Febre maculosa no município de Pedreira-estado de São Paulo-Brasil Relação entre ocorrência de casos e parasitismo humano por ixodídeos. Rev Soc Bras Med Trop 28:135–137
Louly CCB, Fonseca IN, Oliveira VF de, Borges, LMF (2006) Ocurrencia de *Rhipicephalus sanguineus* em trabalhadores de clínicas veterinárias e canis, no município de Goiania, GO. Cienc Anim Bras 7:103–106
Luque Forero G (1949) *Amblyomma oblongoguttatum* sobre la piel de un campesino en la región selvática de Barrancabermeja. Rev Fac Med Vet Zoot 19:213–214
Mangold AJ, Gualberto A, Guglielmone AA (1990) La distribución geográfica de *Amblyomma cajennense* Fabricius, (1787) (Acari: Ixodoidea: Ixodidae) en Argentina. Vet Arg 7:306–315
Marques S, Dal Col R, Matos MO, Gonçalves EFB, Pinter A, Labruna MB (2006) Parasitismo de *Amblyomma fuscum* (Acari: Ixodidae) on humans. Cienc Rural 36:1328–1330
Mazza S, Cores LC de (1931) Acerca de ulceraciones genitales y otras lesiones producidas por garrapatas en el hombre. 6ª Reun Soc Arg Patol Reg Norte Setiembre–octubre 1930, Salta, Argentina, pp 482–484
Nava S, Caparrós A, Mangold AJ, Guglielmone AA (2006) Ticks (Acari: Ixodida: Argasidae and Ixodidae) infesting humans in northwestern of Córdoba province. Medicina (Buenos Aires) 66:225–228
Nava S, Lareschi M, Rebollo C, Benítez-Usher C, Beati L, Robbins RG, Mangold AJ, Guglielmone AA, The ticks (Acari: Ixodoidea: Argasidae, Ixodidae) of Paraguay. Ann Trop Med Parasitol (in press)
Need JT, Dale WE, Keirans JM, Dasch GA (1991) Annotated list of ticks (Acari: Ixodidae: Argasidae) reported in Peru: distribution, hosts, and bibliography. J Med Entomol 28:590–597
Neumann LG (1911) Ixodidae. Das Tierreich (26), 169 pp
Osorno Mesa E (1942) Las garrapatas de la República de Colombia. Rev Fac Nac Agr Medellín 5:57–103
Parola P, Paddock CD, Raoult D (2005) Tick-borne rickettsiosis around the world: emerging diseases challenging old concepts. Clin Microbiol Rev 18:719–756

Patiño Camargo L (1941) Nuevas observaciones sobre un tercer foco de fiebre petequial (maculosa) en el hemisferio americano. Bol of Sanit Panam 20:1112–1114

Pinter A, Dias RA, Gennari SM, Labruna MB (2004) Study of the seasonal dynamics, life cycle, and host specificity of *Amblyomma aureolatum* (Acari: Ixodidae). J Med Entomol 41:324–332

Ripoll CM, Remondegui CE, Ordoñez G, Arazamendi R, Fusaro H, Hyman MJ, Paddock CD, Zaki SR, Olson JG, Santos Buch CA (1999) Evidence of rickettsial spotted fever and ehrlichial infections in a subtropical territory of Jujuy, Argentina. Am J Trop Med Hyg 61:350–354

Sangioni LA, Horta MC, Vianna MCB, Gennari SM, Soares RM, Galvao MAM, Schumaker TTS, Ferreira F, Vidotto O, Labruna MB (2005) Rickettsial infection in animals and Brazilian spotted fever endemicity. Emerg Inf Dis 11:265–270

Santos Dias JAT (1955) Identidade e sinonímia da éspecie *Amblyomma extraoculatum* Neumann, 1899 (Acarina, Ixodoidea). Mem Est Mus Zool Univ Coimbra (229) 6 pp

Santos Dias JAT (1986) Ixodídeos (Acarina–Ixodoidea) em coleção no Museu Zoológico de Amsterdão. García de Orta Ser Zool 13:75–87

Schenone H (1996) Diagnósticos hechos a (1384) pacientes que consultaron por probable mordedura de arañas o picaduras de insectos. Bol Chileno Parasitol 51:20–27

Serra Freire NM, Peralta ASL, Teixeira RHF, Gazeta GS, Amorim M (1995) *Amblyomma rotundatum* parasitando *Homo sapiens* no parque zoobotánico do MPEG e em Itaboraí. Arq Soc Zool Bras 16:20

Silva LJ, Galvão MAM (2004) Epidemiologia das riquetsioses do género *Rickettsia* no Brasil. Rev Bras Parasitol Vet 13(Supl. 1):197–198

Squire FA (1972) Entomological problems in Bolivia. PANS 18:249–268

Szabó MPJ, Labruna MB, Castagnolli KC, Garcia MV, Pinter A, Veronez VA, Magalhães GM, Castro MB, Vogliotti A, (2006) Ticks (Acari: Ixodidae) parasitizing humans in an Atlantic rainforest reserve of southeastern Brazil with notes on host suitability. Exp Appl Acarol 39:339–346

Tonnelli-Rondelli M (1937) Ixodoidea Parte I *Amblyomma ovale* Koch, *Amblyomma cajennense* Fabricius (sic) e le specie a lor affini nuove o poco note. Riv Parassitol 1:273–298

Venzal JM, Guglielmone AA, Estrada Peña A, Cabrera PA, Castro O (2003) Ticks (Ixodida: Ixodidae) parasitising humans in Uruguay. Ann Trop Med Parasitol 97:769–772

Venzal JM, Portillo A, Estrada-Peña A, Castro O, Cabrera PA, Oteo JA (2004) *Rickettsia parkeri* in *Amblyomma triste* from Uruguay. Emerg Infec Dis 10:1493–1495

Venzal JM, Félix ML, Olmos A, Mangold AJ, Guglielmone AA (2005) A collection of ticks (Ixodidae) from wild birds in Uruguay. Exp Appl Acarol 36:325–331

Vitale G, Mansueto S, Rolan J-M, Raoult D (2006) *Rickettsia massiliae* human isolation. Emerg Inf Dis 12:174–175

Zerpa C, Keirans JE, Mangold AJ, Guglielmone AA (2003) Confirmation of the presence of *Amblyomma ovale* Koch 1844 and first records of *Amblyomma scalpturatum* Neumann 1906 (Acari: Ixodida: Ixodidae) in the Amazonian region of Ecuador. Proc Entomol Soc Wash 105:783–785