

SIGMODONTINAE RODENTS AS HOSTS FOR LARVAE AND NYMPHS OF *IXODES LORICATUS* NEUMANN, 1899 (ACARI: IXODIDAE)

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Summary:

Larvae and nymphs of *Ixodes loricatus* Neumann, 1899 ticks (confirmed by morphological characters and by comparison of 16S mitochondrial rDNA sequences) were collected from Sigmodontinae Wagner, rodents in central and northern Argentina and Uruguay. A total of 100 larvae and 38 nymphs of *I. loricatus* were collected on the genera *Akodon* Meyen ($n = 36$ individuals), *Calomys* Waterhouse ($n = 2$), *Oligoryzomys* Bang ($n = 12$), *Oxymycterus* Waterhouse ($n = 9$), and *Scapteromys* Waterhouse ($n = 13$). 72 larvae and 18 nymphs were collected on *Akodon*. Adults of *I. loricatus* were found in central Argentina and Uruguay on Didelphimorphia of the genera *Didelphis* Linnaeus and *Lutreolina* Thomas. *Ixodes loricatus* has been considered a species with strict total specificity to Didelphimorphia. Our results show that this statement may not be justified. Sigmodontinae rodents are sympatric and share habitats with the phylogenetically distant Didelphimorphia; infestation with *I. loricatus* seems to be its consequence. We tentatively consider *I. loricatus* moderately specific to Didelphimorphia.

KEY WORDS : Ixodidae, *Ixodes loricatus*, larva, nymph, hosts, Rodentia, Sigmodontinae, Didelphimorphia, Didelphinae, Argentina, Uruguay.

Résumé :

RONGEURS SIGMODONTINAE HÔTES DES LARVES ET DES NYMPHES D'*IXODES LORICATUS* NEUMANN, 1899 (ACARI : IXODIDAE)
Les larves et nymphes d'*Ixodes loricatus* Neumann, 1899 (reconnues par leurs caractères morphologiques et par comparaison avec des séquences de l'ADNr 16S mitochondrial) ont été recueillies sur les rongeurs Sigmodontinae, au centre et nord de l'Argentine et en Uruguay. Un total de 100 larves et 38 nymphes de *I. loricatus* ont été recueillies sur les genres *Akodon* Meyen ($n = 36$ individus), *Calomys* Waterhouse ($n = 2$), *Oligoryzomys* Bang ($n = 12$), *Oxymycterus* Waterhouse ($n = 9$), et *Scapteromys* Waterhouse ($n = 13$). 72 larves et 18 nymphes ont été recueillies sur *Akodon*. Des adultes de *I. loricatus* ont été trouvés au centre de l'Argentine et en Uruguay sur des Didelphimorphia du genre *Didelphis* Linnaeus et *Lutreolina* Thomas. L'espèce *I. loricatus* a été considérée comme spécifique pour les Didelphimorphia. Nos résultats montrent que cette notion n'est peut-être pas justifiée. Les rongeurs Sigmodontinae partagent leur habitat avec les Didelphimorphia, phylogénétiquement éloignés, et l'infection par *I. loricatus* semble en être la conséquence. Nous considérons que *I. loricatus* est modérément spécifique des Didelphimorphia.

MOTS CLÉS : Ixodidae, *Ixodes loricatus*, larve, nymphe, hôtes, Rodentia, Sigmodontinae, Didelphimorphia, Didelphinae, Argentine, Uruguay.

New world marsupials (Didelphimorphia) are hosts for all parasitic stages of *Ixodes loricatus* Neumann, 1899, a species found in Argentina, Brazil, Mexico, Paraguay, Uruguay, Venezuela and Guatemala (Guglielmono *et al.*, 2003). Venzal *et al.* (2003) and Beldoménico *et al.* (2003) reported that immature stages of *I. loricatus* have been found on different species of Sigmodontinae Wagner, rodents in Argentina and Uruguay. Lareschi (1996), Lareschi *et al.*

(2003) and Nava *et al.* (2003) also registered its presence on Argentinian Sigmodontinae without specifying the tick stages found. There are also several Brazilian findings of *I. loricatus* immature stages on "house rat", "wild rodent" and *Oryzomys* Baird spp. (Cooley & Kohls, 1945; Barros Battesti & Knysak, 1999).

Rodents may be of importance for the cycle of *I. loricatus*, a species considered with strict total specificity to neotropical marsupials by Hoogstraal & Aeschlimann (1982). In this article we present results of studies with Sigmodontinae rodents to sustain the hypothesis that *I. loricatus* is not strict totally dependent on Didelphimorphia.

MATERIALS AND METHODS

Ixodes loricatus ticks were collected from rodents and marsupials trapped for parasite surveys in central (Buenos Aires and Santa Fe provinces) and northern (province of Salta) Argentina, and Uruguay. Adult ticks were diagnosed following Cooley & Kohls (1945)

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and Boero (1957) to separate them from the related *Ixodes luciae* Sénevet, 1940. Nymphs of *I. loricatus* were identified following Cooley and Kohls (1945); these authors stated that the nymph of *I. loricatus* was unknown (p. 10), but provided description and figures of the nymph (pp. 188-189). No figures are available for the identification of the larva of *I. loricatus*. All tick specimens classified as larva or nymph of *I. loricatus* were compared with known material and unpublished redescrptions of *I. loricatus* kindly provided by D.M. Barros Battesti (Instituto Butantan, Sao Paulo, Brazil). DNA was extracted from specimens of Uruguay and Argentina, representing the most southern and northern localities of our collection of *I. loricatus*, to be compared with the sequence of *I. loricatus* 16S mitochondrial rDNA deposited in GenBank (accession N° U95892) and also with the related species *I. luciae* (U95894), following Mangold *et al.* (1998). A difference of 2 % in the base pairs sequences of 16S rDNA was considered the maximum for intraspecific variation (Kain *et al.*, 1999). The tick specimens used in the study are deposited in the following collections: Uruguay, Universidad de la República, Facultad de Veterinaria, Departamento de Parasitología, Montevideo; Argentina, Universidad Nacional de La Plata, Centro de Estudio Parasitológicos y Vectores, La Plata; Universidad Nacional del Litoral, Facultad de Veterinaria, Esperanza and Universidad Nacional de Rosario, Facultad de Ciencias Veterinarias, Casilda.

RESULTS

The sequence of 16S mitochondrial rDNA of *I. loricatus* tick from northern Argentina and southern Uruguay are deposited in the GenBank under the accession numbers AY510268 and AY510269, respectively. The difference between DNA sequences of Argentinean and Uruguayan tick populations differed by 0.5 % and 1.8 % with the sequence of *I. loricatus* deposited in the GenBank, respectively, and both differed 1.3 % between themselves. The difference with *I. luciae* ranged from 4.3 % to 4.8 %, further confirming the *I. loricatus* identity of the specimens studied. See figure 1 for nucleotide differences of *I. loricatus* and *I. luciae*.

A total of 100 larvae and 38 nymphs of *I. loricatus* were collected from 36 *Akodon* Meyen, two *Calomys* Waterhouse, 12 *Oligoryzomys* Bang, nine *Oxymycterus* Waterhouse and 13 *Scapteromys* Waterhouse (Table I). 72 larvae and 18 nymphs were found on *Akodon*. In our sample, *Akodon* appeared to be more parasitized than other Sigmodontinae ($P = 0.0468$, Yate's corrected chi-square). Two females of *I. loricatus* were collected from a *Lutreolina crassicaudata* (Desmarest) at La Balandra, Argentina (July 2001, collectors: S. Nava & M. Lareschi), one male from a *Didelphis albiventris* Lund at

	11111111	222222223
	7892258999	2333366775
	4427899239	3578967128
<i>I. loricatus</i> Arg	GTATAGAGGA	G TAGTAAAAAT
<i>I. loricatus</i> BraA.....G.
<i>I. loricatus</i> UruGAA.	...T...G..
<i>I. luciae</i> Peru	AAGGGAGAAG	A.TAATG.GA

Fig. 1. – Nucleotide differences found in the 16S rDNA sequence of the *I. loricatus* from Argentina, Brazil, Uruguay and *I. luciae* from Peru.

A dot indicates that the sequence at that point is identical to the top sequence. Numbers (to be read in the vertical) refer to positions in the alignment.

Funes, Argentina (Oct. 7, 2002, collector: C. Zerpa), six females ticks from two *D. albiventris* at Santa Clara de Saguier (June 14, 2003, collector: P.M. Beldoménico) and three females from a *D. albiventris* at Barra del Arroyo Maldonado, Uruguay (Nov. 7, 1999, collector: J.M. Venzal). No larva or nymph of *I. loricatus* were found on these marsupials.

DISCUSSION

The findings of *I. loricatus* on Sigmodontinae comprise a wide area of its southern distribution. The only known record of *I. loricatus* further south of Barra Arroyo Maldonado is that of an engorged female from an unknown host (Tierra del Fuego, Argentina; C. Berg's Collection), from the southern tip of America (Neumann, 1901). The findings in Argentina and Uruguay appear to indicate that rodents may be more than accidental hosts for immature stages of this tick species. In this sense, *I. loricatus* resembles the related *I. luciae*, whose larva and nymphs are frequently found on rodents according to Hoogstraal & Aeschlimann (1982).

A compilation (A.A. Guglielmo, unpublished, available upon request) of 194 literature host records of *I. loricatus*, comprising 180 localities from Mexico to Argentina, showed the preference of this tick species for Didelphimorphia (82 % of records). However, apart from some unusual records on Primates (Keirans, 1982), Xenarthra (Cooley & Kohls, 1945) or Carnivora (Aragão, 1918; Barros & Baggio, 1992) that could be considered accidental, 15 % of records of *I. loricatus* (all stages) had Rodentia as hosts.

Most larvae and nymphs of *I. loricatus* were found on *Akodon*, mainly on *Akodon azarae* (Fischer). Previous studies in central Argentina stressed that *Akodon* is more prone to be infested with this tick species than other sympatric Sigmodontinae (Lareschi, 1996; Nava *et al.*, 2003; Lareschi *et al.*, 2003). It would be of value to perform epidemiological studies to quantify level of

Tick stage	Host	Locality	Coordinates		Date	Collector
			S	W		
Argentina, province of Buenos Aires						
7 LL 2 NN	5 <i>Akodon azarae</i>	Hudson	34°45'	58°06'	Apr. 1995	S. Nava & M. Lareschi
1 LL	1 <i>Akodon azarae</i>	–	–	–	Sep. 1995	–
4 LL 1 NN	2 <i>Akodon azarae</i>	INTA Delta del Paraná	34°09'	58°57'	Jan. 1994	M. Lareschi, M. López & S. Nava
1 LL 1 NN	1 <i>Akodon azarae</i>	–	–	–	Mar. 1994	–
9 LL	3 <i>Akodon azarae</i>	–	–	–	Apr. 1994	–
1 NN	1 <i>Akodon azarae</i>	–	–	–	July 1994	–
2 LL 1 NN	1 <i>Akodon azarae</i>	–	–	–	Jan. 1995	–
2 LL	1 <i>Akodon azarae</i>	La Balandra	34°56'	57°42'	Dec. 1995	–
2 LL	1 <i>Akodon azarae</i>	Punta Lara	34°47'	58°01'	Mar. 1990	M. Lareschi
1 LL	1 <i>Akodon azarae</i>	–	–	–	Sep. 1990	–
2 LL	1 <i>Akodon azarae</i>	–	–	–	May 1991	–
2 LL	2 <i>Akodon azarae</i>	–	–	–	June 1991	–
2 LL	2 <i>Akodon azarae</i>	–	–	–	Oct. 1996	S. Nava & M. Lareschi
16 LL 6 NN	4 <i>Akodon azarae</i>	San Nicolás	33°20'	60°13'	Jan. 2001	–
1 NN	1 <i>Oligoryzomys delticola</i>	Hudson	34°45'	58°06'	Sep. 1995	–
3 LL	1 <i>Oligoryzomys flavescens</i>	–	–	–	Sep. 1995	–
4 LL	3 <i>Oligoryzomys flavescens</i>	Punta Lara	34°47'	58°01'	Mar. 1990	M. Lareschi
2 LL	1 <i>Oligoryzomys flavescens</i>	–	–	–	Aug. 1990	–
1 LL 1 NN	1 <i>Oligoryzomys flavescens</i>	–	–	–	Apr. 1991	–
1 NN	1 <i>Oligoryzomys flavescens</i>	Ramallo	33°32'	59°52'	Feb. 2000	S. Nava & M. Lareschi
3 NN	1 <i>Oxymycterus rufus</i>	La Balandra	34°56'	57°42'	Oct. 1996	–
1 LL	1 <i>Oxymycterus rufus</i>	Punta Lara	34°47'	58°01'	Mar. 1990	M. Lareschi
1 LL	1 <i>Oxymycterus rufus</i>	–	–	–	Nov. 1990	–
2 NN	2 <i>Oxymycterus rufus</i>	–	–	–	Dec. 1990	–
1 LL	1 <i>Oxymycterus rufus</i>	–	–	–	July 1991	–
1 LL	1 <i>Oxymycterus rufus</i>	–	–	–	Aug. 1991	–
1 LL	1 <i>Oxymycterus rufus</i>	–	–	–	Nov. 1991	–
1 LL 1 NN	2 <i>Scapteromys aquaticus</i>	–	–	–	Mar. 1990	–
1 LL 1 NN	1 <i>Scapteromys aquaticus</i>	–	–	–	Aug. 1990	–
1 NN	1 <i>Scapteromys aquaticus</i>	–	–	–	Nov. 1990	–
1 LL 1 NN	2 <i>Scapteromys aquaticus</i>	–	–	–	Jan. 1991	–
1 LL	1 <i>Scapteromys aquaticus</i>	–	–	–	Apr. 1991	–
1 NN	1 <i>Scapteromys aquaticus</i>	–	–	–	Sep. 1991	–
4 LL 2 NN	3 <i>Scapteromys aquaticus</i>	–	–	–	Nov. 1991	–
1 NN	1 <i>Scapteromys aquaticus</i>	–	–	–	Dec. 1991	–
Argentina, province of Salta						
1 NN	1 <i>Akodon</i> spp	Parque Nacional El Rey	24°15'	64°40'	Dec. 5, 2000	P.M. Beldoménico
1 NN 1 LL	1 <i>Calomys</i> spp	–	–	–	Dec. 4, 2000	–
1 NN	1 <i>Calomys</i> spp	–	–	–	June 6, 2001	–
Argentina, province of Santa Fe						
13 LL 1 NN	3 <i>Akodon azarae</i>	Funes	32°55'	60°48'	Oct. 2001	C. Zerpa
4 LL 4 NN	3 <i>Akodon azarae</i>	–	–	–	Oct. 2002	–
3 LL 1 NN	3 <i>Oligoryzomys flavescens</i>	–	–	–	June 2001	–
5 LL 1 NN	3 <i>Akodon</i> spp.	Santa Clara de Saguier	31°20'	61°49'	June 14, 2003	P.M. Beldoménico
Uruguay, department Canelones						
1 NN	1 <i>Oligoryzomys flavescens</i>	Solymar Norte	34°47'	55°56'	Mar. 8, 1998	A. Mignone
Uruguay, department Maldonado						
1 LL	1 <i>Oxymycterus nasutus</i>	Barra Arroyo Maldonado	34°58'	54°56'	May 28, 2000	J.M. Venzal

Table 1. – Larvae, nymphs and adults of *Ixodes loricatus* collected on different types of rodents in central and northern Argentina and Uruguay.

infestations with larvae and nymphs of *I. loricatus* on sympatric Sigmodontinae.

Sigmodontinae are separated phylogenetically from Didelphimorphia. Its infestation with *I. loricatus* may result from sympatry and sharing of habitat with Didelphimorphia. Research on the biotic fitness of *I. loricatus* feeding on rodents are needed to define more precisely the index of host specificity of this species

(Poulin & Mouillot, 2003). *Akodon azarae* constitutes the first target species to this aim in central Argentina. In any event, the statement of Hoogstraal & Aeschlimann (1982) considering *I. loricatus* with strict total specificity to Didelphimorphia does not appear justified. Following the classification of tick host specificity proposed by these authors, we tentatively consider *I. loricatus* moderately specific to Didelphimorphia.

The study was not conducted to determine the seasonality of *I. loricatus*; nevertheless, the wide distribution of records of larvae and nymphs of this species along the year becomes evident. Additional studies are needed to known seasonalities of all *I. loricatus* parasitic stages.

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