The *Ixodes* (Acari: Ixodidae) of Mexico: parasite-host and host-parasite checklists

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Abstract

Parasite-host and host-parasite checklists are provided for all species of *Ixodes* known from Mexico; host and locality data are from specimens housed in the Colección Nacional de Ácaros, Instituto de Biología, Universidad Nacional Autónoma de México, and from literature. Six *Ixodes* species (*I. brunneus, I. conepati, I. dentatus, I. eadsi, I. guatemalensis, I. texanus*) are newly recorded from Mexico; in addition, 17 new locality records are presented for eight species (*I. affinis, I. boliviensis, I. luciae, I. rubidus, I. scapularis, I. spinipalpis, I. tancitarius, I. woodi*), and eight new host records are given for five species (*I. affinis, I. boliviensis, I. rubidus, I. spinipalpis, I. tancitarius*).

Key words: Ixodidae, *Ixodes*, Mexico, checklists, hosts, distribution.

Introduction

*Ixodes* Latreille is the largest genus of ticks in the world, currently comprising 243 species (Guglielmone et al. 2006), more than one quarter of the global tick fauna. In all life history stages, members of this genus possess an anal groove that curves anterior to the anus, forming an arch. Several *Ixodes* species are of major medical and veterinary importance, having been implicated in the transmission of zoonotic disease agents (Sonenshine et al. 2002; Goodman et al. 2005).

Despite the predominance of this genus in the Northern Hemisphere, relatively few species of *Ixodes* have been reported from Mexico. Hoffmann and López-Campos (2000) recorded 18 *Ixodes* species associated with Mexican birds and mammals, while Whitaker and Morales-Malacara (2005), working only with mammals, reported 14 species.

As part of a project to catalog the tick species deposited in the Colección Nacional de Ácaros (CNAC), Instituto de Biología, Universidad Nacional Autónoma de México (IBUNAM), we analyzed all specimens belonging to the genus *Ixodes*. Initially, the CNAC chiefly consisted of Dr. Anita Hoffmann’s personal collection, which was donated to IBUNAM in 1992, and in 1997 was officially designated the National Collection, housing a great variety of mites and ticks from Mexico.

The objective of this paper is to compile parasite-host and host-parasite checklists for all known Mexican species of *Ixodes* and to report new host, distribution and taxonomic data derived from specimens deposited in the CNAC.
### The Ixodes (Acari: Ixodidae) of Mexico: parasite-host and host-parasite checklists

**Defense Pest Management Information Analysis Center (DPMIAC), Armed Forces Pest Management Board (AFPMB), Walter Reed Army Medical Center, Washington, DC, 20307-5001**

**Abstract**

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Materials and methods

To construct our checklists, we first conducted a number of online bibliographic searches, using such databases as AGRICOLA, BIOSIS, CAB Abstracts, Medline, and the Zoological Record; these were supplemented by information contained in the CNAC database (Biota version 1.6.1). Unidentified *Ixodes* specimens were determined using conventional morphological keys to this genus (Cooley & Kohls 1942; Cooley 1943; Cooley & Kohls 1945; Kohls 1956; Kohls & Clifford 1966; Keirans & Clifford 1978; Robbins & Keirans 1992; Durden & Keirans 1996), and the resulting records were entered into the CNAC database.

The parasite-host checklist comprises previously published records obtained through bibliographic searches and, when available, new records resulting from examination of CNAC specimens. Tick collection records are presented in the following order: state (capitalized and in **boldface**), number and sex or stage of tick specimens, locality, date, host species name (updated, if necessary), and, for published records, references (in brackets) and depository (in parentheses). Some new records are accompanied by geographic coordinates, and all have been assigned CNAC accession numbers (in parentheses). Abbreviations: NA, no information available; ENV, École Nationale Vétérinaire, Toulouse, France; and RML, Rocky Mountain Laboratories. All RML specimens are now in the United States National Tick Collection (USNTC), Institute of Arthropodology and Parasitology, Georgia Southern University, Statesboro, USA.

The host-parasite checklist presents host species alphabetically within each vertebrate order and family. Host names have been updated to accord with those of Ramírez-Pulido et al. (1996) and Ceballos and Oliva (2005) for mammals, and the American Ornithologists' Union (1998) for birds.

Results

Our checklists contain host and distributional data for 26 *Ixodes* species parasitizing 28 species of vertebrates (five birds and 23 mammals) in Mexico. Eleven earlier records were corroborated from specimens in CNAC; the remainder are from literature. The species *I. brunneus*, *I. conepati*, *I. dentatus*, *I. eadsi*, *I. guatemalensis* and *I. texanus* represent new records for Mexico. In addition, we provide 17 new locality records for eight tick species (*I. affinis*, *I. boliviensis*, *I. luciae*, *I. rubidus*, *I. scapularis*, *I. spinipalpis*, *I. tancitarius* and *I. woodi*), and eight new host records for five species (*I. affinis*, *I. boliviensis*, *I. rubidus*, *I. spinipalpis*, and *I. tancitarius*). The records for *I. granulatus* are erroneous.

Parasite-host list

*Ixodes affinis* Neumann

Previous records

CHIAPAS: 1♀, Ocozocoautla, XII-1946, *Nasua narica* [Kohls & Rogers 1953]; same data except 1♂; 7♀, *Mazama americana*; NA, Mapastepec, “deer” [Hoffmann 1962].

New records


Comments: The earlier record from Mapastepec, cited by Hoffmann (1962), lacks a date, and the collector was recorded as Macías. Our new record includes a date, and the collector was a Dr. Tort.
**Ixodes angustus** Neumann

Previous records


**Comments:** We examined the specimens cited by Estébanes-González & Cervantes (2005) from *Reithrodontomys microdon* and *Peromyscus melanocarpus* and have concluded that they do not correspond to *I. angustus*, thus casting doubt on all determinations of this species by these authors. We have not seen the specimens studied by Hoffmann (1962), but in light of this species’ largely North Temperate distribution (Robbins & Keirans 1992), we can only tentatively include it in the Mexican tick fauna.

**Ixodes bequaerti** Cooley and Kohls

Previous record

**CHIAPAS:** 1♀, Catharinus (sic), 4-V-1942, NA [Cooley & Kohls, 1945].

**Ixodes boliviensis** Neumann

Previous records


**Comments:** The specimens from Guerrero and Nayarit were originally reported as *Ixodes bicornis* Neumann, which was relegated to a junior synonym of *I. boliviensis* by Kohls (1956).

**New records**

**CHIAPAS:** 11♀, Finca Prusia, 12-XII-1944, NA (CNAC005123). **OAXACA:** 1♀, Tarabundí (17°36'34"N, 96°18'55"W), 6-XII-1948, “coati” (CNAC002252); 2♀, Tarabundí, 10-XII-1948, “pheasant” (CNAC002253). **VERACRUZ:** 1♀, 0.8 km NE Las Minas (19°41’27"N, 97°8’47"W), 10-V-1963, *Sciurus* sp. (CNAC002352); 1♀, Rancho la Encantada, San Andrés Tuxtla, 5-XI-2002, NA (vegetation) (CNAC005059); 1♀, Cerro el Vigía, Santiago Tuxtla, 7-IV-1967, *Homo sapiens* (recorded as “man”) (CNAC005075).

**Ixodes brunneus** Koch

New record

**MEXICO D. F.:** 1♀, Chapultepec, 4-XI-1950, NA (CNAC005161).

**Ixodes conepati** Cooley and Kohls

New records

**COAHUILA:** 1♀, Cueva la Manga, Rancho San Judas Tadeo, Acuña (29°21’47"N; 101°1’47"W), 2-
IV-2005, NA (cave) (CNAC002353); 1♀, Cueva Popo de Oso, Zaragoza (28° 38' 4"N; 101° 7' 17"W), 24-XI-2006, NA (cave) (CNAC002362).

**Ixodes cookei** Packard

Previous records


**Ixodes cuernavacensis** Kohls and Clifford

Previous record

**MORELOS**: 1♀, Cuernavaca, 30-V-1961, *Streptoprocne semicollaris* [Kohls & Clifford 1966] (RML 37920).

**Ixodes dampfi** (Cooley)

Previous records

**ESTADO DE MÉXICO**: 5♀, Valle de México, Chalco, IV-1932, *Geomys* sp. [Cooley 1943] (RML 20165); Collection of Dr. A. Dampf (Mexico City): National Museum of Natural History (formerly United States National Museum), Washington, DC; and Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA.

**Ixodes dentatus** Marx

New record

**NUEVO LEÓN**: 2♀, 2♂, El Potosí (24° 49’ 42”N; 100° 20’ 26”W), 22-V-1963, *Sylvilagus* sp. (CNAC002366).

**Ixodes eadsi** Kohls and Clifford

New record

**PUEBLA**: 1♀, 6 km E Totimehuacán, 13-III-1965, *Liomys* sp. (CNAC002287).

**Ixodes granulatus** Supino

Previous records


**Comments**: *Ixodes granulatus* is an exclusively Asian species, ranging from Japan through Southeast Asia and westward to India (Petney & Keirans 1994). The larvae from *Peromyscus mexicanus totontepecus* do not correspond to this species, and other purported Mexican “*I. granulatus*” should also be redetermined.

**Ixodes guatemalensis** Kohls

New records

**GUERRERO**: 6♀, Omiltemi (17° 33’ 24”N; 99° 41’ 8”W), 4-IV-1963, *Sciurus* sp. (CNAC002325); 2♀, Omiltemi, 5-IV-1963, *Sciurus* sp. (CNAC002359); 2♀, Omiltemi, IV-1963, *Sciurus* sp. (CNAC002356); 1♀, Omiltemi, 2-IV-1963, *Sciurus* sp. (CNAC002360); 3♀, 1.6 km NW Omiltemi, 13-IV-1963, *Sciurus* sp. (CNAC002335); 1♀, 0.8 km NE Las Minas, 5-V-1963, *Sciurus* sp. (CNAC002337).
**Ixodes loricatus** Neumann

Previous record

**TABASCO**: NA, Frontera, Ateles geoffroyi [Nuttall & Warburton 1911].

**Comments:** The locality cited by Nuttall and Warburton (1911), “Tabasco de la Frontera,” is probably the city of Frontera, in Tabasco. Ateles “melanochoerus” (= melanocercus or melanochir) is a junior synonym of A. geoffroyi.

**Ixodes luciae** Sénevet

Previous records

**CHIAPAS:** 1♀, 1♂, Finca Germania, 27-XII-1943, Didelphis sp. [Vázquez 1946] (CNAC000569, CNAC000570). **TABASCO:** 3♀, Frontera, V, “large opossum” [Nuttall 1910; Nuttall & Warburton 1911].

**Comments:** The specimens from Finca Germania were originally reported as *Ixodes scuticrenatus* Vázquez, while those from Frontera were reported as *Ixodes loricatus* variety spinosus Nuttall; both these names are junior synonyms of *I. luciae* (Camicas et al. 1998). The locality cited by Nuttall and Warburton (1911), “Tabasco de la Frontera,” is probably the city of Frontera, in Tabasco.

New records

**COLIMA:** 1♀, 1♂, La Barragana, 12-IX-1978, Didelphis marsupialis (CNAC002316). **VERACRUZ:** 4♂, 0.8 km NE Las Minas, 9-V-1963, Didelphis sp., (CNAC002354).

**Comments:** The specimens from Colima were previously identified by R. H. Manzanilla L.; however, this is a new locality record for Mexico.

**Ixodes mexicanus** Cooley and Kohls

Previous records

**MICHOACÁN:** 1♀, Cerro Tancítaro, VIII-1940, Campylorhynchus gularis [Cooley & Kohls 1942]; same data except 17-VII-1940, Junco phaeonotus (RML 17469).

**Ixodes murreleti** Cooley and Kohls

Previous record

**BAJA CALIFORNIA SUR:** 1♀, Isla los Coronados, 4-IV-1940, “Scripps’ [= Xantus’s] murrelet,” Synthliboramphus hypoleucus (formerly Endomychura hypoleucus) [Cooley & Kohls 1945] (RML 17799).

**Ixodes pacificus** Cooley and Kohls

Previous record

**BAJA CALIFORNIA:** NA, NA [Bishopp & Trembley 1945].

**Comments:** Bishopp and Trembley (1945) stated that *Ixodes ricinus californicus* Banks occurs along the Pacific coast of North America from Mexico to British Columbia; however, this name is a junior synonym of *I. pacificus* (Cooley & Kohls 1945). Hoffmann (1962), citing Bishopp and Trembley (1945) but using the nomenclature of Cooley and Kohls (1945), referred Mexican records of *I. pacificus* to Baja California.

**Ixodes rubidus** (Neumann)

Previous records

**GUANAJUATO:** 1♀, 3NN, NA, Bassariscus astutus [Neumann 1911; Nuttall & Warburton 1911; Cooley & Kohls 1945] (ENV).

New record

**GUERRERO:** 3♂, 36NN, Omiltemi, 8-IV-1963, Urocyon sp. (CNAC002364).

**Comments:** The host of these specimens must be *Urocyon cinereoargenteus* because only one species of this genus occurs in Mexico (Ceballos & Oliva, 2005).
Ixodes scapularis Say

Previous records


Comments: Chavarría (1941) used the name *Ixodes ricinus* variety *scapularis* Say, which is a junior synonym of *I. scapularis* (Camicas et al. 1998). Hoffmann (1962), citing Macías Valadez (1923), stated that Felis pardalis, now Leopardus pardalis, is a host of *I. scapularis*; however, this record is from Costa Rica.

New record

COAHUILA: 9♀, 1♂, Las Herminias, Zaragoza, 23-II-1975, *Bos taurus* (recorded as “bovine”) (CNAC002166).

Comments: These specimens were previously identified by A. de la Torre; however, this is a new locality record for Mexico.

Ixodes sinaloa Kohls and Clifford

Previous records


Ixodes spinipalpis Hadwen and Nuttall

Previous record


Comments: Hoffmann’s (1962) record was for *Ixodes neotomae* Cooley; however, Norris et al. (1997) argued that this taxon is conspecific with, and therefore a junior synonym of, *I. spinipalpis*.

New records

GUERRERO: 1N, Omiltemi, (17° 33’ 24”N; 99° 41’ 8”W), 2-IV-1963, NA (CNAC002358); 5NN, Omiltemi, 3-IV-1960, *Peromyscus* sp. (CNAC002331); 6NN, Omiltemi, 3-IV-1963, *Peromyscus* sp. (CNAC002332); 7NN, Omiltemi, 6-IV-1963, *Peromyscus* sp. (CNAC002333); 3NN, Omiltemi, 5-IV-1963, *Sciurus* sp. (CNAC002341); 2NN, 1.6 km NW Omiltemi, 2-IV-1963, *Peromyscus* sp. (CNAC002355). MORELOS: 2NN, Zempoala, *Peromyscus* sp. (CNAC002326). VERACRUZ: 1N, 0.8 km NE Las Minas, 2-V-1963, *Peromyscus* sp. (CNAC002350).

Ixodes tamaulipas Kohls and Clifford

Previous record


Ixodes tancitarius Cooley and Kohls

Previous record

MICHOACÁN: 1♀, Cerro Tancítaro, 5-VII-1941, *Reithrodontomys* sp. [Cooley & Kohls 1942] (RML 19236).
New record

**VERACRUZ:** 1♀, 0.8 km NE Las Minas, 2-V-1963, *Peromyscus* sp. (CNAC002336).

**Ixodes texanus** Banks

New records

**GUERRERO:** 1♀, 1N, Omiltemi (17° 33' 24"N; 99° 41' 8"W), 6-IV-1963, *Bassariscus* sp. (CNAC002370).

**Ixodes tovari** Cooley

Previous records

**GUANAJUATO:** 2♀, 2♂, Torrecilla and Comontoso, “hares” [Cooley 1945] (RML 21620–21621);
**NUEVO LEÓN:** 19 “adults,” 9♂, 7NN, 2LL, Bravo, “hares” [Cooley 1945] (RML 21618, 21623–21625, 21628).

**Ixodes woodi** Bishop

Previous records


New record

**MORELOS:** 1♀, Zempoala (19° 3’ 11”N; 99° 18’ 44”W), 23-III-1963, *Neotoma* sp. (CNAC002340)

**Host-parasite list**

**AVES**

**APODIFORMES**

Apodidae

*Streptoprocne semicollaris* (De Saussure)  *Ixodes cuernavacensis*

**CHARADRIIFORMES**

Alcidae

*Synthliboramphus hypoleucus* (Xantus de Vesey)  *Ixodes murreleti*

**GALLIFORMES**

“pheasant”  *Ixodes boliviensis*

**PASSERIFORMES**

Emberizidae

*Junco phaeonotus* Wagler  *Ixodes mexicanus*

Trogodytidae

*Campylorhynchus gularis* Sclater  *Ixodes mexicanus*

**MAMMALIA**

**ARTIODACTYLA**
<table>
<thead>
<tr>
<th>Taxonomy</th>
<th>Host Species</th>
<th>Ixodes Species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bovidae</strong></td>
<td><em>Bos taurus</em> L.</td>
<td><em>Ixodes affinis</em></td>
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<tr>
<td></td>
<td>“cattle”</td>
<td><em>Ixodes scapularis</em></td>
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<td></td>
<td><em>Cervidae</em></td>
<td><em>Ixodes scapularis</em></td>
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<td>“deer”</td>
<td><em>I. affinis</em></td>
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<td></td>
<td><em>Mazama americana</em> (Erxleben)</td>
<td><em>I. boliviensis</em></td>
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<td><strong>CARNIVORA</strong></td>
<td><em>Canidae</em></td>
<td><em>Ixodes boliviensis</em></td>
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<td></td>
<td>“fox”</td>
<td><em>Ixodes scapularis</em></td>
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<td><em>Canis familiaris</em> L.</td>
<td><em>Ixodes boliviensis</em></td>
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<td></td>
<td><em>Urocyon cinereoargenteus</em> (Schreber)</td>
<td><em>Ixodes cookei</em></td>
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<td><em>Urocyon sp.</em></td>
<td><em>Ixodes rubidus</em></td>
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<td><em>Felidae</em></td>
<td><em>Ixodes boliviensis</em></td>
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<td><em>Panthera onca</em> (L.)</td>
<td><em>Ixodes cookei</em></td>
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<td><em>Procyonidae</em></td>
<td><em>Ixodes rubidus</em></td>
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<td><em>Bassariscus astutus</em> (Lichtenstein)</td>
<td><em>Ixodes cookei</em></td>
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<td><em>Bassariscus sp.</em></td>
<td><em>Ixodes texanus</em></td>
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<td>“coati”</td>
<td><em>Ixodes boliviensis</em></td>
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<td></td>
<td><em>Nasua narica</em> (L.)</td>
<td><em>Ixodes affinis</em></td>
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<td><strong>DIDELPHIMORPHA</strong></td>
<td><em>Didelphidae</em></td>
<td><em>Ixodes luciae</em></td>
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<td><em>Didelphis marsupialis</em> L.</td>
<td><em>Ixodes luciae</em></td>
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<td><em>Didelphis sp.</em></td>
<td><em>Ixodes luciae</em></td>
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<td>“opossum”</td>
<td><em>Ixodes luciae</em></td>
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<td><strong>LAGOMORPHA</strong></td>
<td><em>Leporidae</em></td>
<td><em>Ixodes tovari</em></td>
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<td><em>Lepus sp.</em> (“hares”)</td>
<td><em>Ixodes spinipalpis</em></td>
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<td><em>Romerolagus diazi</em> (Ferrari-Pérez)</td>
<td><em>Ixodes dentatus</em></td>
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<td><em>Sylvilagus sp.</em></td>
<td><em>Ixodes sp.</em></td>
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<td><strong>PRIMATES</strong></td>
<td><em>Atelidae</em></td>
<td><em>Ixodes loricatus</em></td>
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<td><em>Ateles geoffroyi Kuhl</em></td>
<td><em>Ixodes boliviensis</em></td>
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<td></td>
<td><em>Hominidae</em></td>
<td><em>Ixodes boliviensis</em></td>
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<tr>
<td></td>
<td><em>Homo sapiens</em> L.</td>
<td><em>Ixodes sp.</em></td>
</tr>
<tr>
<td><strong>RODENTIA</strong></td>
<td>“mouse”</td>
<td><em>Ixodes sp.</em></td>
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</tbody>
</table>
Geomyidae
Geomys sp.
Heteromyidae
Liomyss pictus esquinapae J. A. Allen
Liomyss sp.
Muridae
Microtus guatemalensis Merriam
Neotoma micropus Baird
Neotoma sp.
Oryzomys alfaroi (J. A. Allen)
Oryzomys couesi (Alston)
Peromyscus melanocarpus Osgood
Peromyscus sp.
Reithrodontomys microdon microdon Merriam
Reithrodontomys sp.
Sciuridae
Sciurus deppei negligens Nelson
Sciurus sp.
SORICOMORPHA
Soricidae
Sorex sp.

Discussion

Mexico is considered a megadiverse country, so it is not surprising that its invertebrate fauna has been incompletely cataloged. Taxonomic knowledge of Mexican ticks remains limited, particularly in the case of *Ixodes*, which is currently represented by just 26 species, *i.e.*, only 10.7% of the known species in this genus (Mexican records of *I. granulatus* are erroneous). By contrast, 35 species of *Ixodes* are known from the United States and Canada, despite the temperate and boreal conditions that prevail over most of northern North America. Furthermore, in the United States, species of *Ixodes* are known to parasitize reptiles, birds and mammals (Cooley & Kohls 1945, Durden & Keirans 1996, Wright et al. 1998, Tälleklint-Eisen & Eisen 1999, and Eisen et al. 2001), whereas in Mexico only birds and mammals have been reported as hosts, and among mammals, rodents predominate, hosting 11 *Ixodes* species. Of some 1,050 species of birds and 452 species of mammals found in Mexico, only 0.47% and 5.1%, respectively, have been recorded as hosts for *Ixodes* ticks. Clearly, there is a pressing need for extensive parasitological sampling of Mexico’s approximately 2,306 species of terrestrial vertebrates (Flores-Villela 1993, Ramírez-Pulido et al. 1996, Ceballos & Márquez 2000, Flores-Villela & Canseco-Márquez 2004, Ceballos & Oliva 2005). Currently, *Bassariscus astutus, Bos taurus* and *Canis familiaris* are each known to host two *Ixodes* species; the rodent genera *Peromyscus* and *Sciurus* both host three *Ixodes* species, but in these cases more than one host species may be involved.

To date, research on Mexican *Ixodes* has largely been conducted outside Mexico (Cooley & Kohls 1942, Kohls & Clifford 1966), with the result that most literature records are based on specimens in foreign collec-
tions, such as the RML and ENV. Currently, the CNAC contains representatives of only 15 of the 26 *Ixodes* species known to occur in Mexico. We have corroborated the identity of three of the CNAC species (*I. boliviensis*, *I. luciae*, and *I. spinipalpis*); 12 more, including six new national records, resulted from the present study. All determinations were based on adults except for *I. spinipalpis*, which was based on nymphs. The first report of *Ixodes cookei* in Mexico was published separately (Montiel-Parra et al. 2007).

Species of *Ixodes* have been collected in 21 of the 32 states of Mexico; the highest number of species has been recorded in Veracruz (six species), followed by Chiapas and Guerrero (five species), and Coahuila (four species). The most widespread tick species in Mexico appear to be *I. boliviensis* (Chiapas, Guerrero, Nayarit, Oaxaca, Quintana Roo and Veracruz), *I. luciae* (Chiapas, Colima, Tabasco, Veracruz), and *I. scapularis* (Coahuila, Jalisco, Oaxaca, Tamaulipas). The broad range of *I. boliviensis* also corresponds with the highest number of associated hosts.

Additional systematic research on Mexican ticks is urgently needed, not only to catalog this group, but also to augment regional studies of ecology, biogeography, and host-parasite coevolution. Moreover, taxonomic elucidation of the Mexican tick fauna will substantively contribute to investigations of zoonotic infections, such as Lyme disease, that merit increased attention in Mexico.

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