

A new species of *Trichuris* Roederer, 1761 (Nematoda: Trichuridae) from *Heteromys gaumeri* Allen & Chapman (Rodentia: Heteromyidae) in Yucatan, Mexico

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Abstract In Mexico, four species of *Trichuris* Roederer, 1761 have been recorded in wild rodents belonging to the family Heteromyidae. In the present paper, we describe a new species based on specimens collected from *Heteromys gaumeri* Allen & Chapman (Heteromyidae: Heteromyinae) in the tropical forests of the Yucatan Peninsula, Mexico. *Trichuris silviae* n. sp. can be differentiated from the congeners described in North and South American rodents by morphological and morphometric features, such as the possession of a wide spicular tube, a thicker proximal cloacal tube, a shorter distal cloacal tube and a cylindrical spicular sheath. This is the first description of a *Trichuris* spp. from heteromyid rodents in Mexico and the fourth in North America. Despite the broad distribution of *Heteromys* spp., few cases of *Trichuris* infection have been reported. Further studies are necessary to verify if the new species is present in other heteromyid rodents in order to increase our knowledge about its geographical and host distribution.

Introduction

Species of *Trichuris* Roederer, 1761 (Nematoda: Trichuridae) have a worldwide distribution and parasitise the large intestine (caecum and colon) of a broad range of mammalian hosts, among which are humans, primates, pigs, horses, and rodents (Cafrune et al., 1999; Anderson, 2000). Characteristics such as the spicular tube, the length of the spicule, the shape of the proximal and distal cloacal tube, and the vulvar morphology, along with classical morphometric data have been used with high discriminatory value for differentiating species of *Trichuris* (see Špakulová, 1994; Suriano & Navone, 1994; Rossin & Malizia, 2005; Robles & Navone, 2006). Additionally, scanning electron microscopy (Lanfredi et al., 1995; Robles & Navone, 2006; Robles, 2011; Torres et al., 2011), isoenzyme patterns and molecular tools have been used for species identification (Cutillas et al., 1996, 2002, 2004; Feliu et al., 2000; Callejón et al., 2015).

Until now, 25 species of *Trichuris* have been described from ten families of North and South American rodents, i.e. the Caviidae, Cricetidae, Ctenomyidae, Dasyproctidae, Echimyidae, Geomyidae, Heteromyidae, Myocastoridae, Octodontidae and Sciuridae. Of these, four species have been recorded in wild rodents with geographical distributions that include central Mexico: *Trichuris citelli* Chandler, 1945 from *Spermophilus variegatus* Erxleben in

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Michoacan (García-Prieto et al., 2012); *T. dipodomis* Read, 1956 from *Dipodomys phillipsii* Gray in Veracruz (García-Prieto et al., 2012); *T. elatoris* Pfaffenberger & Best, 1989 from *D. ordii* Woodhouse, *D. merriami* Mearns and *Chaetodipus hispidus* Baird in San Luis Potosi (García-Prieto et al., 2012); and *T. fossor* Hall, 1916 from *Peromyscus difficilis* Allen in Hidalgo (Falcon-Ordaz, 1993) and *Liomys irroratus* Gray in Morelos (Eslava-Araujo, 2005). *Trichuris fossor* is the only species recorded from Mexican rodents of the subfamily Heteromyinae (see Eslava-Araujo, 2005).

Moreover, a cosmopolitan species, *T. muris* Schrank, 1788, has been recorded previously for *Rattus norvegicus* Berkenhout and *R. rattus* Linnaeus in the Distrito Federal (Zerecero, 1943; García-Prieto et al., 2012), *Mus musculus* L. from Hidalgo (Pulido-Flores et al., 2005) and Yucatan (Panti-May et al., 2015), and from *L. irroratus* in Morelos (Eslava-Araujo, 2005).

Heteromys gaumeri Allen & Chapman, is a medium-sized rodent endemic to the Yucatan Peninsula (Schmidt et al., 1989). Its geographic range includes northern Belize, El Petén in Guatemala, and southeastern Mexico (Schmidt et al., 1989). In Mexico, *H. gaumeri* occurs from tall to short semi-deciduous tropical forest (Pozo de la Tijera & Escobedo Cabrera, 1999; Hernández-Betancourt et al., 2003; Cimé-Pool et al., 2010; Canul-Cruz et al., 2012), secondary deciduous forest (Dowler & Engstrom, 1984) and cultivated fields (Birney et al., 1974; Cimé-Pool et al., 2007), where the predominant climate is warm sub-humid with summer rains (Instituto Nacional de Estadística y Geografía, 2015). *Heteromys gaumeri* plays a key role in the ecology of seed dispersal in tropical forests through harvesting and eating seeds (Hernández-Betancourt et al., 2003; Canul-Cruz et al., 2012).

This paper describes a new species of *Trichuris* based on specimens collected from *Heteromys gaumeri* (Heteromyidae: Heteromyinae) from tropical forests in Yucatan, Mexico.

Materials and methods

Seven specimens of *H. gaumeri*, six from the Rancho Hobonil of the Universidad Autónoma de Yucatán (UADY), Municipality of Tzucacab and one from the

Facultad de Medicina Veterinaria y Zootecnia-UADY, Municipality of Merida, Yucatan State, Mexico, were captured between March and October 2013 (see collectors in acknowledgements). Captured rodents were transported to the laboratory and were euthanised with an intraperitoneal injection of sodium pentobarbital. The abdominal cavities and viscera of the hosts were examined for parasites. Nematodes were collected from the caecum and 15 specimens were fixed in 10 % formalin, preserved in 70 % ethanol, cleared in lactophenol for light microscopy.

Drawings were made with the aid of a drawing tube. One male specimen was dehydrated in ethanol series (75, 80, 85, 90, 96 and 100%), dried using the critical point method, and examined with the aid of a scanning electron microscope (SEM, Jeol 6360 LVLV, Tokyo, Japan).

Measurements are presented as follows: holotype male/allotype female and paratypes, mean and range (in parentheses). All measurements are in micrometres unless otherwise stated. Morphological analysis was performed according Robles et al. (2006), followed in a series of communications (Robles & Navone, 2006; Robles, 2011; Robles et al., 2014). The type-material is deposited in the Helminthological Collection of the Museo de La Plata, La Plata, Buenos Aires, Argentina and in the Colección Nacional de Helmintos of the Instituto de Biología-Universidad Nacional Autónoma de México, Mexico City, Mexico. Hosts are deposited in the Mastozoological Collections of the Museo de Zoología (MZ)-UADY, Mérida, Yucatan, Mexico.

Order Enoplida Filipjev, 1929

Family Trichuridae Railliet, 1915

Trichuris silviae n. sp.

Type-host: *Heteromys gaumeri* (Allen & Chapman) (Mammalia: Castorimorpha: Heteromyidae), Gaumer's spiny pocket mouse.

Host vouchers: Symbiotype (female, coll. 27.ix.2013; accession number MZ 1025); other host vouchers (coll. 25-27.ix.2013) housed at the MZ under accession numbers MZ1022–1024 and MZ1009.

Type-locality: Rancho Hobonil (21°01'41.8"N, 89°00'51.2"W), Municipality of Tzucacab, Yucatan State, Mexico.

Other locality: Facultad de Medicina Veterinaria y Zootecnia (20°52'06.5"N, 89°37'04.5"W), Municipality of Merida, Yucatan State.

Type-material: Holotype male (MLP-He 7113), allotype female (MLP-He 7114), 12 paratype specimens (MLP-He 7115, CNHE 9987) deposited in the Helminthological Collection of the Museo de La Plata (MLP-He) and in the Colección Nacional de Helminthos (CNHE) of the Instituto de Biología-Universidad Nacional Autónoma de México, Mexico City, Mexico. *Site in host:* Caecum.

Prevalence and intensity: Overall prevalence 85.7 % (6 infected out of 7 rodents examined); overall intensity 1–45 (mean 12) nematodes; type-locality: prevalence 83.3 % (5 out of 6 hosts infected), mean intensity 14.4 (1–45).

Etymology: This species is dedicated to Dr. Silvia Hernández Betancourt, a well-known mammalogist in Mexico who has contributed to increasing the knowledge of rodent ecology, particularly in the Yucatan Peninsula.

Description (Figs. 1–2)

General. [Based on the holotype, allotype and 12 paratypes.] Cuticle with fine transversal striation. Anterior part of body long, narrow, tapered, whip-like; posterior part of body broad, handle-like (Fig. 1A). Ratio between anterior and posterior body length 0.97:1–1.26:1 in males and 0.90:1–1.12:1 in females. Stichosome with single row of stichocytes, and single pair of conspicuous cells at level of oesophago-intestinal junction (Fig. 1B, C). Male with wide spicular tube. Proximal cloacal tube united laterally to distal cloacal tube (Fig. 1D). Spicular sheath cylindrical with spines distributed from proximal to distal portion; distal spines sharpened and joined together (Figs. 1E, 2D). Testis reaches to near first fifth of proximal cloacal tube (Fig. 1A, arrow). Cloaca subterminal, not ornamented. Female with non-protrusive vulva located at level of oesophago-intestinal junction (Fig. 1C). Anus subterminal; caudal end long (Fig. 1F).

Bacillary band located laterally in anterior portion of body (Fig. 2A, B), at 80–1,000 from anterior end of body, extending to widened part of body 100–190. Cuticular inflations bordering bacillary band 170–210 from anterior end of body, extend to 640–700 from anterior end, forming low rings of thick walls and very reduced interior cavity (Fig. 2B). These structures limit laterally to abundant, visible bacillary glands with conspicuous pore (Fig. 2B, C). Cuticle around vulvar aperture with transversally striated pattern.

Male. [Based on the holotype and 9 paratypes.] Body length 13.89; 16.61 (14.95–18.71) mm. Anterior portion of body 7.27; 8.76 (7.67–9.87) mm long; thick portion of body 6.62; 7.85 (6.78–9.43) mm long (Fig. 1A). Anterior body width 82; 93 (85–110); maximum posterior body width 330; 300 (260–330); width at level of oesophago-intestinal junction 240; 210 (200–230) (Fig. 1B). Total length of oesophagus 7.27; 8.76 (7.67–9.87) mm, muscular portion 590; 560 (470–780) long, stichosome portion 6.68, 8.20 (7.16–9.09) mm long. Spicule tube length 610, 570 (470–640). Spicule total length 1,360; 1,390 (1,300–1,480); width 15; 15 (15–19) at tip, 30; 29 (25–30) at midregion, and 50; 40 (30–50) at base (Fig. 1D). Spicular sheath, when fully extruded, densely spinose 120; 80 (80–130) long (Fig. 1E). Proximal cloacal tube 1,270; 1,570 (1,410–1,730) long, 190; 190 (140–220) wide; distal cloacal tube 550; 670 (550–940) long, 100; 90 (70–120) wide (Fig. 1D). Ratio total body length/posterior portion length 2.10; 2.12 (1.97–2.26). Ratio posterior portion length/ anterior portion length 0.9; 0.90 (0.80–1.03). Ratio total body length/spicule length 10.25; 11.97 (10.68–14.37). Ratio posterior portion length/ spicule length 4.89; 5.66 (4.99–7.28). Ratio proximal cloacal tube length/distal cloacal tube length 2.32; 2.41 (1.79–2.97). Ratio maximum posterior body width/ posterior portion length 0.05; 0.04 (0.03–0.04).

Female. [Based on the allotype and 4 paratypes.] Body length 34.11; 23.86 (22.14–26.13) mm. Anterior portion of body 17.47; 12.15 (11.17–13.81) mm long; thick portion of body 16.64; 11.71 (10.64–12.44) mm long. Anterior body width 130; 110 (90–130); maximum posterior body width 550; 380 (380–400); width at level of oesophago-intestinal junction 300; 200 (190–220) (Fig. 1C). Total length of oesophagus 17.35; 12.15 (11.17–13.81) mm, muscular portion 640; 520 (400–620) long, stichosome portion 16.71; 11.62 (10.56–13.42) mm long. Distance between oesophago-intestinal junction and vulva 0.25 (0–50) (Fig. 1C). Eggs oval, flat, with bipolar plugs 61–65 × 30–31 (n = 4) (Fig. 1G). Ratio total body length/posterior portion length 2.05; 2.04 (1.90–2.12). Ratio posterior portion length/ anterior portion length 0.95; 0.97 (0.90–1.11). Ratio maximum posterior body width/ posterior portion length 0.03; 0.03 (0.03–0.04).

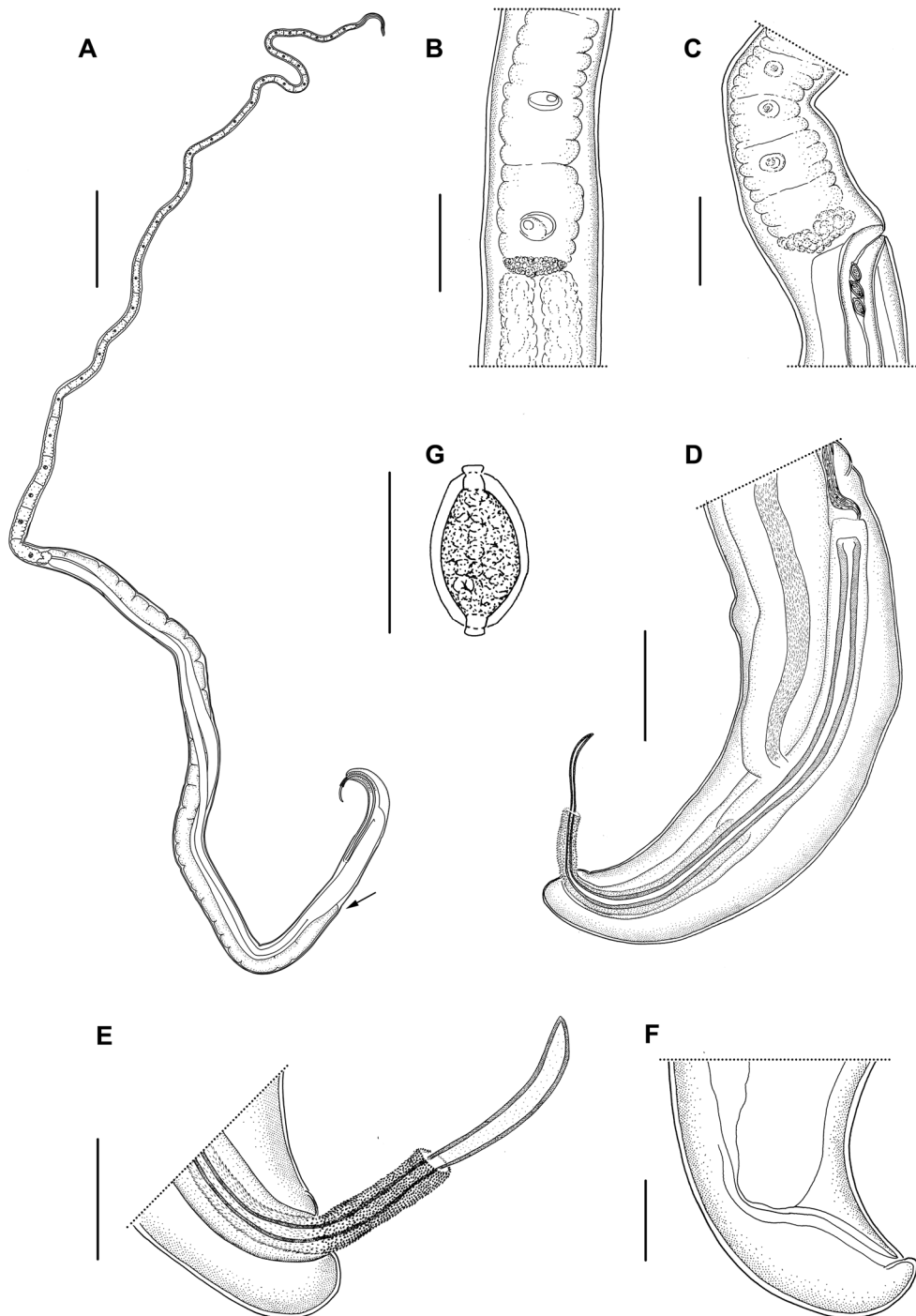


Fig. 1 *Trichuris silviae* n. sp. ex *Heteromys gaumeri*. A, Male, total view (arrow indicates posterior extremity of the testis); B, Male, oesophago-intestinal junction and proximal portion of the testis, lateral view; C, Female, oesophago-intestinal junction and vulva, lateral view; D, Male, posterior extremity, spicule, spicular tube, proximal and distal cloacal tube, and spiny spicular sheath, lateral view; E, Male, detail of the posterior extremity and spiny spicular sheath, lateral view; F, Female, posterior extremity, lateral view; G, Egg. Scale-bars: A, 1,000 μm ; B–D, 200 μm ; E, F, 100 μm ; G, 60 μm

Remarks

Trichuris silviae n. sp. was compared with 25 species of *Trichuris* described from North and South American rodents (Chandler, 1945; Tiner, 1950; Cameron & Reesal, 1951; Morini et al., 1955; Read, 1956; Frandsen & Grundmann, 1961a; Todd & Lepp, 1972; Babero et al., 1975; Barus et al., 1975; Babero et al., 1976; Babero & Murua, 1987; Pfaffenberger & Best, 1989; Babero & Murua, 1990; Gomes et al., 1992; Suriano & Navone, 1994; Robles et al., 2006; Robles, 2011; Torres et al., 2011; Robles et al., 2014). *Trichuris silviae* n. sp. differs from 12 species parasitic in American rodents, i.e. *T. opaca* Barker & Noyes, 1915, *T. myocastoris* Enigk, 1933, *T. bursacaudata*

Suriano & Navone, 1994, *T. pampeana* Suriano & Navone, 1994, *T. pardinasi* Robles, Navone & Notarnicola, 2006, *T. navonae* Robles, 2011, *T. bradleyi* Babero, Cattan, & Cabello, 1975, *T. chilensis* Babero, Cattan & Cabello, 1976, *T. elatoris*, *T. robusti* Babero & Murua, 1990, *T. travassosi* Correa, Lanfredi, Pinto & Souza, 1992, and *T. bainaie* Robles, Cutillas, Panei & Callejón, 2014, by the presence of a spicular tube (in these 12 species, the spicule lies entirely within the distal cloacal tube).

Among the 11 species with spicular tube (i.e. *T. citelli*, *T. perognathi* Chandler, 1945, *T. neotomae* Chandler, 1945, *T. peromysci* Chandler, 1946, *T. madisonensis* Tiner, 1950, *T. fossor*, *T. dipodomis*, *T. fulvi* Babero & Murua, 1987, *T. laevitestis* Suriano &

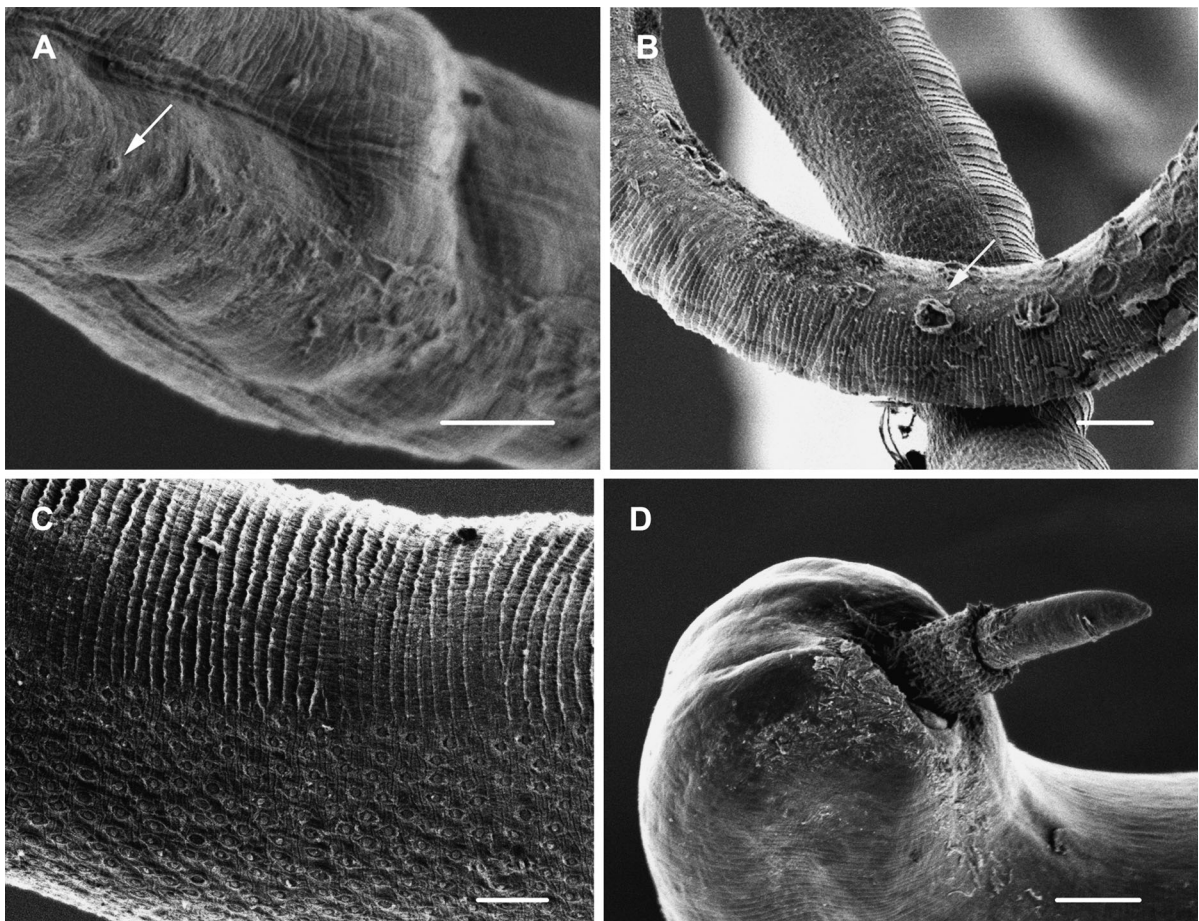


Fig. 2 Scanning electron micrographs of *Trichuris silviae* n. sp. ex *Heteromys gaumeri*. A, Detail of bacillary glands (arrow) in the proximal portion of bacillary band; B, Cuticular inflations (arrow) bordering the bacillary band in its proximal portion; C, Detail of bacillary glands in the distal portion of the bacillary band; D, Male, posterior extremity and spiny spicular sheath, ventro-lateral view. Scale-bars: A, C, 10 μ m; B, D, 20 μ m

Navone, 1994, *T. stansburyi* Frandsen & Grundmann, 1961, and *T. thrichomysi* Torres, Nascimento, Menezes, Garcia, Santos, Maldonado, Miranda, Lanfredi & Souza, 2011) the new species can be differentiated from *T. fossor*, *T. fulvi*, *T. laevitestis*, and *T. thrichomysi* in having a shorter spicular tube; no data for the remaining species are available. Table 1 shows comparative data highlighting the main distinctive features (i.e. spicular length, spicular sheath shape and distal cloacal tube length) of *T. silviae* n. sp. in relation to the congeners described with a spicular tube described from North and South American rodents.

The new species can be separated from *T. opaca*, *T. fossor*, *T. citelli*, *T. neotomae*, *T. dipodomis* and *T. bursacaudata* by the presence of a cylindrical spicular sheath. Among species with a cylindrical spicular sheath, the new species differs from *T. laevitestis*, *T. thrychomysi*, *T. pampeana*, *T. pardinasi*, *T. navonae*, *T. elatoris*, and *T. binae* by the distribution and shape of spines and from *T. peromysci*, *T. fulvi*, *T. stansburyi*, *T. bradleyi*, and *T. robustis* by the length of the spicular sheath.

The new species has a shorter spicule than *T. myocastoris*, *T. fulvi*, *T. laevitestis*, *T. thrichomysi*, *T. bursacaudata*, *T. pampeana*, *T. pardinasi*, *T. bradleyi*, *T. chilensis*, *T. robusti*, *T. travassosi* and *T. binae* and a longer spicule than *T. perognathi*, *T. neotomae*, *T. madisonensis*, *T. stansburyi* and *T. elatoris*. Moreover, *T. silviae* n. sp. has a shorter distal cloacal tube than *T. citelli*, *T. myocastoris*, *T. bursacaudata*, *T. pampeana*, *T. pardinasi*, *T. navonae*, *T. bradleyi*, *T. chilensis*, *T. robusti*, *T. travassosi* and *T. binae* and a longer distal cloacal tube than *T. perognathi* and *T. peromysci*.

Although males of *T. gracilis* Rudolphi, 1819 and *T. dolichotis* Morini, Boero & Rodrigues, 1955 have not been described, females of *T. gracilis* can be separated from the new species by the length of the body (38.5–39.6 vs 22.1–34.1 mm), the length of the anterior portion of the body (21.5–27.4 vs 11.2–17.5 mm) and the size of the eggs (50–59 × 23–28 vs 61–65 × 30–31 μm), and females of *T. dolichotis* differ by the ratio posterior portion/ anterior portion of body length (1.33 vs 0.90–1.11) and the size of the eggs (75 × 45 vs 61–65 × 30–31 μm).

Females of *T. silviae* n. sp. have a smaller distance from the oesophago-intestinal junction to vulva than *T. madisonensis*, *T. gracilis*, *T. fulvi*, *T. bradleyi*, *T. chilensis*, *T. elatoris* and *T. binae*. In addition, the vulva of the new species is distinguishable from *T.*

citelli, *T. perognathi*, *T. neotomae*, *T. gracilis*, *T. dipodomis*, *T. leavitestis*, *T. stansburyi*, *T. chilensis* and *T. binae* by the lack of a marked prominence or evagination.

Most morphometric features of *T. silviae* n. sp. overlap with *T. peromysci*. However, the new species has a longer distal cloacal tube (550–940 vs 380–530 μm) and shorter spicular sheath (80–130 vs 260–360 μm). Females of *T. silviae* n. sp. also have smaller eggs (61–65 × 30–31 vs 87–90 × 40 μm).

A comparison of the length of the bacillary bands, and the size, shape and distribution of the bacillary glands, as well as their number, with respect to the transversal cuticular striations, showed some differences with other species previously studied under SEM such as *T. myocastoris*, *T. travassosi*, *T. pampeana*, *T. pardinasi*, *T. laevitestis*, *T. navonae* and *T. binae*. The bacillary band of *T. silviae* n. sp. begins anteriorly to that reported for *T. laevitestis*, but is similar to the remaining species. The cuticular inflations of the new species form low walls and narrow rings and appear to have a lower density than those observed in other species (Gomes et al., 1992; Lanfredi et al., 1995; Rossin & Malizia, 2005; Robles & Navone, 2006; Robles et al., 2006; Robles, 2011; Robles et al., 2014). Although there may be an effect of the preparation of the material, this observation was confirmed under light microscope.

Discussion

Twenty-six species of *Trichuris* have been described in American rodents, considering the new species. Although the ranges of some morphometric features overlap among these species and some of them share morphological characteristics, the combination of these characters allows species differentiation. The unique features of *T. silviae* n. sp., such as the presence of a wide spicular tube, a thicker proximal cloacal tube, a shorter distal cloacal tube, a cylindrical spicular sheath with sharp and joined together spines, a non-protrusive vulva, and different morphometric characters and ratios, in combination, support the distinct status of this species.

Although the original description of the species of *Trichuris* described in heteromyids (i.e. *T. dipodomis*, *T. elatoris* and *T. perognathi*) or recorded in Mexican rodents (e.g. *T. citelli* and *T. fossor*) are incomplete,

Table 1 Comparative data for the main distinctive features between *Trichuris silviae* n. sp. (highlighted in bold) and other *Trichuris* spp. with spicular tube described from North and South American rodents

Species	Type-host (Family)	Type-locality	Length or shape	Reference
Spicule (1,300–1,480 μm)				
<i>T. neotomae</i> Chandler, 1945	<i>Neotoma fuscipes</i> Baird (Cricetidae)	Hastings Natural History Reservation, California, USA	1,150–1,230	Chandler (1945)
<i>T. perognathi</i> Chandler, 1945	<i>Chaetodipus californicus californicus</i> Merriam (Heteromyidae) ^a	Hastings Natural History Reservation, California, USA	900–1,150	Chandler (1945)
<i>T. madisonensis</i> Tiner, 1950	<i>Tamias striatus</i> L. (Sciuridae)	Madison, Wisconsin, USA	830–950	Tiner (1950)
<i>T. stansburyi</i> Frandsen & Grundmann, 1961	<i>Peromyscus maniculatus sonoriensis</i> Le Conte (Cricetidae)	Stansbury Island, Utah, USA	860–1,160	Frandsen & Grundmann (1961a)
<i>T. fulvi</i> Babero & Murua, 1987	<i>Ctenomys fulvus phillipiensis</i> Philippi (Ctenomyidae)	San Pedro Atacama, Tarapaca, Chile	3,470–3,710	Babero & Murua (1987)
<i>T. laevitestis</i> Suriano & Navone, 1994	<i>Scapteromys aquaticus</i> Thomas (Cricetidae)	Punta Lara, Buenos Aires, Argentina	3,000–3,650	Suriano & Navone (1994)
<i>T. thrichomyi</i> Torres et al., 2011	<i>Thrichomys apereoides</i> Lund (Echimyidae)	Capitão Andrade, Minas Gerais, Brazil	1,860–2,780	Torres et al. (2011)
Distal cloacal tube (550–940 μm)				
<i>T. peromysci</i> Chandler, 1946	<i>Peromyscus californicus</i> Gambel (Cricetidae)	Hastings Natural History Reservation, California, USA	370–520	Chandler (1946)
<i>T. citelli</i> Chandler, 1945	<i>Spermophilus beecheyi</i> Richardson (Sciuridae) ^b	Hastings Natural History Reservation, California, USA	1,000–1,300	Chandler (1945)
Cylindrical spicular sheath with spines				
<i>T. fossor</i> Hall, 1916	<i>Thomomys talpoides</i> Allen (Geomyidae) ^c	Crested Buttes and Livermore, Colorado, USA	With distal spherical bulge and spiny	Hall (1916)
<i>T. dipodomis</i> Read, 1956	<i>Dipodomys ordii</i> Woodhouse (Heteromyidae)	Santa Fe, New Mexico, USA	Campanuliform and spiny	Read (1956)

^a Cited as *Perognathus californicus californicus*; ^b Cited as *Citellus beecheyi*; ^c Cited as *Thomomys fossor*

these species are well distinguished when compared with *T. silviae* n. sp. However, further revisions are needed to clarify some morphological features (e.g. distal cloacal tube) of these *Trichuris* spp. for which no drawings and/or photos are provided in their original descriptions.

The bacillary band of *T. silviae* n. sp. was studied under light microscopy, and only a few studies include SEM descriptions of this structure. Although fixation can alter the structure of the bacillary bands (Wright, 1975), in the new species the bands appear to be very

well conserved, showing some differences in the distribution of the glands, and different sizes and shapes of the cuticular inflations compared to those observed in six other studied species (Gomes et al., 1992; Lanfredi et al., 1995; Rossin & Malizia, 2005; Robles & Navone, 2006; Robles et al., 2006; Robles, 2011). Since the bacillary bands are not known for all *Trichuris* spp., it is possible that the importance of this structure will be assessed only when new studies with detailed descriptions, illustrations, and photographs are provided.

The type-host of *T. silviae* n. sp., *H. gaumeri*, belongs to a genus of Neotropical hosts, abundant from southern Mexico to Ecuador, Colombia and Venezuela (Rogers & González, 2010). However, information on species of *Trichuris* parasitising *Heteromys* spp. is scarce. In Mexico, no previous study has reported the presence of *Trichuris* spp. in *Heteromys* spp. Considering heteromyid hosts, only *T. dipodomis*, *T. elatoris*, *T. fossor* and *T. muris* have been reported in Mexico (Eslava-Araujo, 2005; García-Prieto et al., 2012).

The geographical distribution of *H. gaumeri* (Yucatan Peninsula) does not overlap with areas where other wild rodent hosts of *Trichuris* spp. have been recorded (Falcon-Ordaz, 1993; Eslava-Araujo, 2005; García-Prieto et al., 2012). In Costa Rica, a *Trichuris* sp. has been reported in *H. desmarestianus* Gray (Chinchilla-Carmona et al., 2013). Further studies are necessary to verify if the new species occurs in other sympatric rodents in order to increase our knowledge on its geographical and host distribution.

Trichuris silviae n. sp. is the first species described from heteromyids in Mexico and the fourth in North America (Chandler, 1945; Read, 1956; Pfaffenberger & Best, 1989). Also, this is the sixth record of *Trichuris* spp. from rodents in Mexico, including the cosmopolitan *T. muris* recorded in native and non-native rodents (Eslava-Araujo, 2005; García-Prieto et al., 2012). The family Heteromyidae consists of six genera (*Chaetodipus* Merriam, *Dipodomys* Gray, *Heteromys*, *Liomys* Merriam, *Microdipodops* Merriam and *Perognathus* Wied-Neuwied) with more than 57 species distributed from Canada to Ecuador (Alexander & Riddle, 2005). The helminth fauna of heteromyids comprises more than sixteen nematode genera (see Read & Millemann, 1953; Grundmann, 1957; Frandsen & Grundmann, 1961b; Decker et al., 2001; Falcon-Ordaz & García-Prieto, 2005).

Among heteromyids, *Chaetodipus formosus* Merriam, *C. hispidus*, *C. californicus*, *C. penicillatus* Woodhouse, *Dipodomys deserti* Stephens, *D. merriami*, *D. microps* Merriam, *D. ordii*, *D. phillipsii*, *D. spectabilis* Merriam, *H. desmarestianus* and *L. irroratus* have been reported as hosts of *Trichuris* spp. from Costa Rica, Mexico, and USA (Doran, 1955; Grundmann, 1957; Munger & Slichter, 1995; Decker et al., 2001; García-Prieto et al., 2012; Chinchilla-Carmona et al., 2013). Additional field studies could

determine if *Trichuris* spp. occur in other heteromyid rodents.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All applicable institutional, national and international guidelines for the care and use of animals were followed. Host capture was conducted under license from Mexican Ministry of Environment (SGPA/DGVS/02528/13).

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