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A NEW SPECIES OF *SUBULURA* (NEMATODA: SUBULUROIDEA) FROM GROUND SQUIRRELS, *SPERMOPHILUS SPILOSOMA* BENNETT, 1833, IN NEW MEXICO

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ABSTRACT: A description is presented of a new species of *Subulura* Molin, 1860, *Subulura novomexicanus*, collected from the spotted ground squirrel, *Spermophilus spilosoma* Bennett, 1833, in New Mexico. The males are 24 to 29 mm long, preloacal sucker 1.7–2.0 mm from posterior end, spicules subequal 0.83–1.0 long, and gubernaculum Y-shaped 0.21–0.39 mm long. Females are 34–39 mm long, vulva near middle of body 14.06–22.00 mm from anterior end, and eggs 0.04–0.05 mm long by 0.03–0.04 mm wide. The new species is distinguished from *Subulura unguilatus* Erickson, 1938 in being longer and having spicules that are distinctively different in size and form. It also differs from *Subulura nevadense* Babero, 1973 in being longer and having a larger egg size and smaller spicules. The new species is most similar to *Subulura andersoni* (Cobbold, 1876) (Thwaite, 1927); however, the males of this species are smaller and they have broad cervical alae, and the adults occur in squirrels of India. Reexamination of *S. unguilatus* showed 11 pairs of caudal papillae, including 4 pairs of preanals, 1 pair adanal and lateral, and 6 pairs of postanal papillae located at the end of the tail. *Spermophilus richardsoni* (Sabine, 1822) is a new host record for *S. nevadense*, and Montana is a new distributional record for this nematode. *Eimeria callospermophilii* Henry, 1932, is a new record for *S. spilosoma*.

Here, we describe a new species of *Subulura* Molin, 1860. It was discovered in spotted ground squirrels, *Spermophilus pilostoma* Bennett, 1833, collected on the Sevilleta National Wildlife Refuge, near Sorocco, New Mexico. The only other mention of parasites from this species of ground squirrel is by Broda and Schmidt (1978), who reported the presence of *Hymenolepis citelli* McLeod, 1933, *Citellina triradiata* (Hall, 1916) Morgan, 1930, redescribed by Broda and Schmidt (1978), *Physaloptera massino* Schulz, 1926, and *Trichuris* sp. from Colorado. This is the first report of a species of *Subulura* from *S. pilostoma*.

MATERIALS AND METHODS

In total, 89 spotted ground squirrels were collected as part of The University of New Mexico's Long-Term Ecological Research (LTER) project on the Sevilleta National Wildlife Refuge, Sorocco Co., New Mexico, between 1990 and 1996. Two host specimens contained an undescribed species of *Subulura* that we describe here as a new species. A description of the site and host collection techniques on the LTER was published in Decker et al. (2001).

The parasites were removed from the alimentary tract of their hosts. They were fixed in 5% buffered formalin and later transferred to 70% ethanol. Before examination, worms were cleared in ascending series of glycerin or heated lactophenol. Figures were made with the aid of a drawing tube. Measurements were from 6 male and 3 female worms, and they are given in millimeters (mm). Holotype and paratypes are deposited in the U.S. National Parasite Collection (USNPC), Biosystematics and National Parasite Collection Unit, USDA, Agricultural Research Service, Beltsville, Maryland.

Symbiotype hosts were deposited in the Museum of Southwestern Biology Division of Mammals, at the University of New Mexico, Albuquerque, New Mexico. The squirrels were trapped (University of New Mexico Animal Care Use Permit 9410-B) at the sites during spring and summer (May–August) 1991–1994 using Sherman live-traps (models XLF15 and SFAL; H. B. Sherman Traps, Tallahassee, Florida) baited with rolled oats (Wilson et al., 1997).

DESCRIPTION

Subulura novomexicanus n. sp.

(Figs. 1–5)

Description (based on 9 specimens): With the characteristics of the genus. Whitish nematodes tapering to both extremities, anterior end

with rounded cephalic tips. Cephalic plate with 4 ovoid and striated papillae, 2 prominent submedian amphids, and a hexagonal mouth opening surrounded by 6 smaller papillae. Mouth surrounded by 6 labial lobes, separated by 6 interlabia, characteristic of the subgenus, *Murisubulura* Quentin, 1969. Pharynx of 3 muscular portions, each composed of 3 lobes twisted to make the pharynx have a helicoidal structure. Two narrow lateral alae originate behind cephalic plate and terminate in region of the junction of muscular and glandular parts of esophagus; numerous and varied transversal striations present throughout alae. Esophagus dilated posteriorly with short neck followed by bulb.

Male ($n = 6$): 24–29 long by 0.49–0.59 wide. Buccal cavity 0.05–0.06 long by 0.04–0.048 wide. Nerve ring and excretory canal 0.11–0.12 and 0.34–0.35 from anterior end, respectively; preloacal sucker located 1.7–2.0 from posterior end. Tail with terminal spine. Eleven pairs of ventral caudal papillae with 4 pairs of preanals that begin at the level of the preloacal sucker, 1 pair adanal and lateral, and 6 pairs of postanal, 4 near the end of the tail. Anus to tip of tail, including terminal spine 0.24–0.38. Spicules alated, equal to subequal, 0.83–1.0 long, gubernaculum Y-shaped 0.21–0.39 long.

Female ($n = 3$): 34–39 long by 0.5–0.8 wide. Buccal cavity 0.04–0.07 long by 0.03–0.7 wide. Esophagus length with bulb 1.8–2.1 long. Nerve ring 0.41–0.43 and excretory pore 0.62–0.66 from anterior end. Vulva near middle of body, 14.06–22.58 from anterior end. Eggs 0.04–0.05 mm long by 0.03–0.04 wide. Tail 1.58–1.59 long.

Taxonomic summary

Type host: *Spermophilus spilosoma* Bennett, 1833.

Site of infection: Caecum and large intestine.

Type locality: Sevilleta National Wildlife Refuge, Socorro Co., New Mexico.

Specimens deposited: Holotype male and allotype female and paratypes, USNPC 099587.00, 099588.00, and 099589.00, respectively. Symbiotype hosts: MSB 19049 captured in 1989 and MSB 26856 captured in 1993, both from Five Points Grassland.

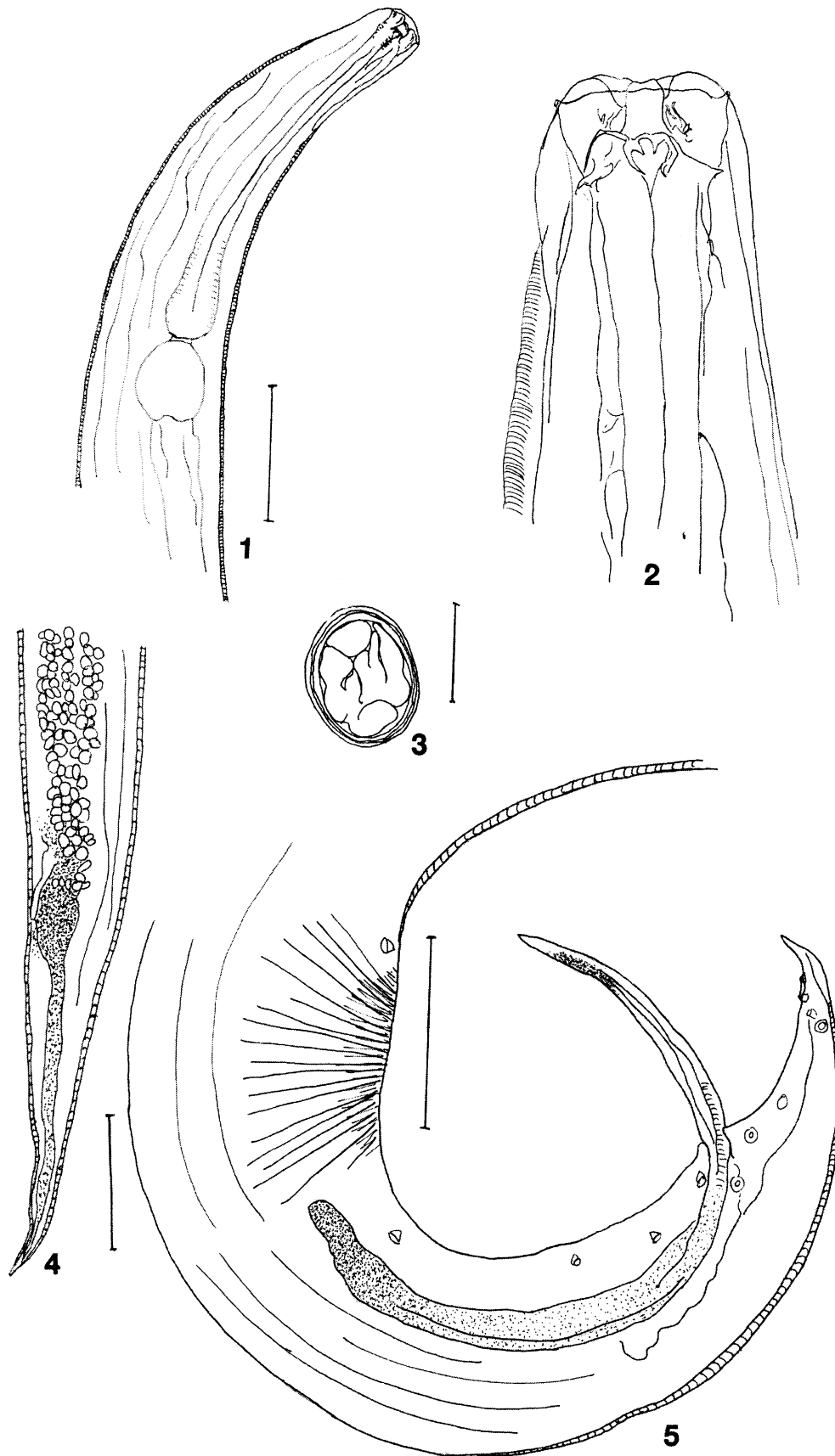
Etymology: The specific name of this species refers to the state of New Mexico, where the specimens were collected.

DISCUSSION

The genus *Subulura* contains many species occurring in both birds and mammals. Two species of *Subulura* are known to occur in rodents in North America. *Subulura unguilatus* Erickson, 1938, from *Zapus hudsonius* (Zimmermann, 1780), collected in Minnesota, is a much smaller nematode (males 15–16 mm long vs. 24–29 mm), with males having spicules similar in length to our new species. Erickson (1938) did not record all the caudal papillae present in the male specimens. Examination of the type specimen revealed that there are 11 pairs of caudal

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FIGURES 1–5. *Subulura novomexicanus* n. sp., parasite of *Spermophilus spilosoma* from New Mexico. (1) Anterior end of male showing esophagus and bulb. Bar = 300 μ m. (2) Anterior end of male with detail of buccal capsule and lateral alae. Bar = 400 μ m. (3) Egg. Bar = 200 μ m. (4) Posterior end of female. Bar = 300 μ m. (5) Posterior region of male showing ventral sucker (vs) and spicules (s). Bar = 400 μ m.

papillae, including 4 pairs of preanals, 1 pair adanal and lateral, and 6 pairs of postanal papillae, including 4 small papillae located at the tip of the tail. Thus, *S. unguatus* is similar to most species of *Subulura* from rodents in the distribution of caudal papillae, including the new species described here.

A second species, *Subulura nevadense* Babero, 1973, occurs in *Spermophilus tereticaudus* Baird, 1858 and *Ammospermophilus leucurus* (Merriam, 1893), from Clark, Lincoln and Nye counties, Nevada (Babero, 1973). The males of *S. nevadense* are significantly shorter (9.9–13) than our new species. In addition, in males of *S. nevadense*, the anterior most caudal papillae are located much anterior to the adanal sucker, and in the females, the egg size is larger (0.08–0.09) than our new species (0.04–0.05). We also examined *Subulura* specimens deposited in the USNPC (042484.00, 042485.00, and 042490.00) collected from *Spermophilus richardsoni* (Sabine, 1822) in Beaverhead, Montana, by Jellison in 1936 and deposited in the USNM Helminthological Collections. These specimens are all similar to *S. nevadense*; thus, *S. richardsoni* represents a new host record, and Montana is a new distributional record for this parasite. In all specimens of *S. nevadense* examined, the males from *S. richardsoni* were within the range reported by Babero (1973) and shorter than those of the new species we report here.

The new species is also morphologically similar to *S. andersoni* as redescribed by Thwaite, 1927, as presented by Baylis (1936). In *S. andersoni*, the males are smaller (13.5–14.9) than *S. novomexicanus*, have broad cervical alae, and the adults are only known to occur in squirrels of India.

In our study, a single host animal (both males) collected in spring 1989 contained 5 male and 1 female *S. novomexicanus*, a juvenile *Physaloptera massino*, and *Eimeria callospermophili* Henry, 1932; and a second animal captured 4 yr later in spring 1993 contained 1 male and 2 female *S. novomexicanus*, a single *Hymenolepis* sp. 1 male and 3 females of *Heligmosoides* sp., 4 females of *P. massino*, and a female of *C. triradiata*, and *E.*

callospermophili. Both ground squirrels occurred in a grassland habitat described by Decker et al. (2001). Broda and Schmidt (1978) surveyed the parasites of this squirrel species, and they did not find *Subulura* species in the 38 animals examined from northern Colorado. They did record the presence of *Eimeria larimerensis*, *Hymenolepis citelli*, *Citellina triradiata*, *Physaloptera massino*, and *Trichuris* sp. in this host. The report here of *E. callospermophili* is a new host record for this ground squirrel.

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