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Heligmosomoides thomomyos sp. n. (Nematoda: Heligmosomidae) from Pocket Gophers, *Thomomys* spp. (Rodentia: Geomyidae), in Oregon and California

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ABSTRACT: The nematode *Heligmosomoides thomomyos* sp. n. is described from the small intestine of *Thomomys bulbivorus* and *T. bottae*. This is the first report of *Heligmosomoides* from rodents of the family Geomyidae.

Nematodes of the genus *Heligmosomoides* Hall, 1916 occur most commonly in arvicolid rodents. Of the 26 known species of the genus, 11 have been recorded from Nearctic rodents (Rausch and Rausch, 1973). In North America, *Heligmosomoides* spp. have been recorded not only from voles, but also from cricetids and murids. *Heligmosomoides* spp. characteristically inhabit the small intestine or cecum of their host, where they usually are found tightly coiled around the intestinal or cecal villi (Durette-Desset, 1971).

Nematodes representing an undescribed species of *Heligmosomoides* were found by us in the small intestine of pocket gophers (Geomyidae) of two species, *Thomomys bulbivorus* (Richardson), from Benton County, Oregon, and *T. bottae* (Eydoux and Gervais), from Humboldt County, California (collected respectively by S.L.G. and D.P.J.). Rodents of the genus *Thomomys* have an extensive geographic range in central and western North America. *Thomomys bulbivorus* is endemic to the Willamette Valley of Oregon, and *T. bottae* occurs from southwestern Oregon southward to Arizona and northern Mexico (Hall and Kelson, 1959; Ingles, 1965).

It is the purpose of the present paper to describe this nematode, which is the first species of *Heligmosomoides* to be recorded from rodents of the family Geomyidae.

Materials and Methods

Gophers were necropsied as soon as possible after collection. Organs of the gastrointestinal tract of *T. bulbivorus* were opened and washed separately in fresh water. The intestinal contents were examined in a Petri dish marked with a grid, under a dissecting microscope. The intestines of *T. bottae* were opened and examined under a dissecting microscope without washing. All nematodes were removed, preserved in 70% ethanol, cleared by evaporation of 70% ethanol with 5%; glycerine, and mounted whole in glycerine-jelly or in glycerine and 2% lactic acid. The structure of the synlophe (Durette-Desset, 1971) was determined from transverse sections taken approximately 2 mm from the anterior and posterior ends, and near midbody of both male and female specimens. The ovejector was dissected from one female for detailed study.

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The type specimen, No. 205 H, of *Heligmosomoides montanus* Durette-Desset, 1968 was obtained from the Muséum National d'Histoire Naturelle, Paris, for comparative studies. Two cotype specimens, one male (No. 2288) and one female (No. 30455), of *Heligmosomoides longispiculatus* (Dikmans, 1940) were obtained from the USNM Helminthological Collection, USDA, Beltsville, Maryland 20705 for comparisons with our material.

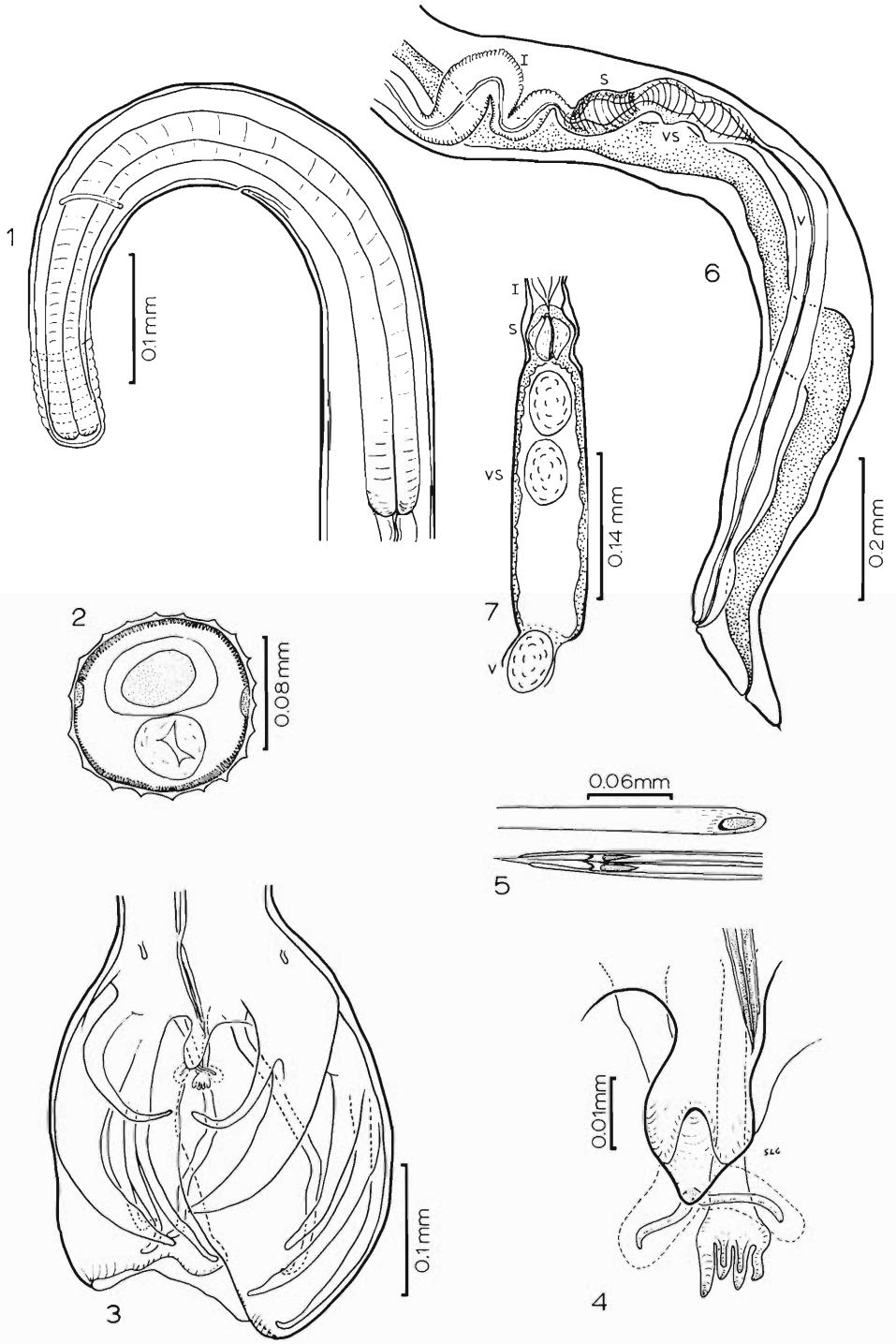
Results

The nematodes considered in this study were usually found tightly coiled and free in the intestinal contents. The following description is based on five male and 15 female specimens. Measurements are in micrometers unless otherwise indicated; means are in parentheses.

Heligmosomoides thomomyos sp. n. (Figs. 1-7)

DESCRIPTION: MALE: Length 5.12–6.45 mm (5.60 mm). Maximum diameter, at level about 7/8 of length from anterior extremity, 85–124 (112). Width at anterior end 26–40 (35). Width at base of esophagus 89–112 (102); at level just anterior to bursa 76–120 (101). Cephalic inflation about 37 by 62. Excretory pore 225–320 (294) and nerve ring 180–263 (205) from anterior extremity. Distance from nerve ring to excretory pore 67–110 (89) (Fig. 1). Cuticle about 3 thick, provided with 18 or 19 longitudinal ridges, 3–7 high and decreasing in height dorsad. Esophagus 429–666 (577) long and 89–112 (102) wide at base. Spicules subequal, 3.40–3.73 mm (3.60 mm) long, with attenuated slender tips, joined at distal end (Fig. 5); each consisting of 2 cylindrical processes discernible in cross section. Bursa somewhat asymmetrical, with the sinistral lobe slightly larger. One pair of prebursal papillae, 11–28 (26) long, present ventrally (Fig. 3). Genital cone well developed, possessing 2 slender projections about 19 long by about 1 wide (Fig. 4). Dorsal ray complex, 54–62 (58) long, having 6 slender projections, of which the medial pair is about 12 long; 1 lateral pair about 10 long; 1 dorsal pair 6 long, lying just dorsal to and overlapping medial pair. Slender externodorsal rays 120–182 (148), mediolateral rays 113–220 (166), and posterolateral rays 115–220 (184) in length. Anteroventral rays 80–113 (99) long; thick posteroventral rays 120–265 (207) long. Bursal membrane well developed.

FEMALE: Length 8.70–11.95 mm (10.21 mm). Maximum diameter at level about 2/5 of length from anterior extremity 131–249 (191). Width at anterior end 21–57 (37). Width at level of nerve ring 54–86 (70); at base of esophagus 83–131 (107); at level of vulva 63–125 (82); at level of anus 21–55 (39). Cephalic inflation 34–69 wide by 47–100 long. Excretory pore 151–389 (295) and nerve ring 85–250 (176) from anterior extremity. Distance from nerve ring to excretory pore 52–140 (104). Cuticle provided with 18–20 longitudinal ridges, 2–11 high, decreasing in height dorsad (Fig. 2). Esophagus 539–729 (628) long and 33–63 (45) wide at base. Anus 21–55 (39) anterior to end of tail; tail provided with a caudal spine 7–13 long (Fig. 6). Vulva 106–253 (158) anterior to end of tail (to base of caudal spine). Vagina 605–1.0 mm (841) long. Ovejector 103–324 (227) long, with anterior chamber (sphincter) averaging 46 by 58, posterior chamber (vestibule) averaging 88 by 150, and infundibulum averaging 39 by 84 (Figs. 6, 7). Thin-shelled eggs 38–47 by 61–68 (44 by 64) (Fig. 7).



Figures 1-7. ***Heligmosomoides thomomyos*** **sp. n. 1. Male, cephalic end, lateral view. 2. Female, synlophe. Transverse section through vagina approximately 0.5 mm anterior to vulva. 3. Male, bursa, ventral view. 4. Male, details of dorsal ray and genital cone, ventral view. 5. Male, details of spicule.**

Table 1. Morphological characteristics of *Heligmosomoides montanus, H. longispiculatus,* and *H. thomomyos.* (Measurements in micrometers unless otherwise indicated; asterisks indicate measurements obtained from type material in 1982.)

Character	*H. montanus* Durette-Desset, 1968	*H. longispiculatus* (Dikmans, 1940)	*H. montanus* sp. n.
Total length (mm): Male	6.0	5.5–6.5	5.12–6.45
Female	11.4	12–13	8.70–11.95
Maximum width: Male	95	140	85–124
Female	150	150–160	131–249
Cephalic inflation (length × width): Male	—	—	37 × 62
Female	—	—	34–69 × 47–100
Sexes combined	40 × 60	35–40 × 70	—
Number of cuticular ridges: Male	17	?	18–19
Female	19	?	18–20
Nerve ring to anterior end: Male	200	123*	180–263
Female	180	?	85–250
Excretory pore to anterior end: Male	325–330	137*	255–320
Female	270–280	149*	151–389
Vulva to end of tail	150	210–220	106–253
Anus to end of tail: Female	50	60	21–55
Esophagus length: Male	630	—	429–666
Female	800	—	539–729
Sexes combined	—	700–800	—
Anterior chamber, ovejector	70 long	54* long	22–61 × 33–73
Posterior chamber, ovejector	110 × 390	94* long	22–97 × 59–278
Dorsal ray, length	38	?	54–61
Dorsal ray, number of terminal projections	4	?	6
Spicule length (mm)	3.9	3.9–4.0	3.42–3.73
Eggs	50 × 80	40–45 × 80–90	38–47 × 61–68

TYPE HOST: *Thomomys bottae* (Eydoux and Gervais).

SITE OF INFECTION: Anterior portion of small intestine (duodenum).

TYPE LOCALITY: Humboldt County, California (lat. 41°57′N, long. 124°05′W).

HOLOTYPE: Male, from *Thomomys bottae* (Eydoux and Gervais), U.S.N.M. Helm. Coll. No. 76610.

ALLOTYPE: Female, from *Thomomys bulbivorus* (Richardson), U.S.N.M. Helm. Coll. No. 76611.

PARATYPES: Two females and 1 male from *T. bottae,* collected by D.P.J. in July 1979 in Humboldt County, California (lat. 41°57′30″N, long. 124°05′W), U.S.N.M. Helm. Coll. No. 76612; 2 females and 1 male from *T. bulbivorus,* collected by S.L.G. on 9 June 1979 in Benton County, Oregon (lat. 44°30′N, long. 123°15′W), U.S.N.M. Helm. Coll. No. 76613.

←

6. Female, caudal end, lateral view. 7. Female, details of ovejector. Abbreviations: i = infundibulum; s = sphincter; vs = vestibule; v = vagina.

Comparisons

The family Geomyidae is of Nearctic origin, with a fossil record extending at least from the late Miocene (Kurtén and Anderson, 1980). The dispersal of members of some genera into northern South America occurred during the Pleistocene (Thenius, 1972). There is no evidence of the presence of the family Geomyidae in the Palearctic (Simpson, 1945), and *H. thomomyos* sp. n. therefore is compared only with Nearctic species of *Heligmosomoides.*

Heligmosomoides thomomyos sp. n. can be immediately separated from nine of 11 Nearctic congeners on the basis of spicule length. Of these, eight occur in rodents of the family Arvicolidae: *H. bullosus* Durette-Desset, 1967; *H. carolinensis* (Dikmans, 1940); *H. hudsoni* (Cameron, 1937); *H. johnsoni* Rausch and Rausch, 1973; *H. microti* Kuns and Rausch, 1950; *H. tenorai* Durette-Desset, 1967; *H. wisconsinensis* Durette-Desset, 1967; and *H. polygyrus americanus* Durette-Desset, Kinsella, and Forrester, 1972. *Heligmosomoides douglasi* Durette-Desset, Kinsella, and Forrester, 1972 is found in murids and arvicolids (Rausch and Rausch, 1973).

The remaining two Nearctic congeners, *H. montanus* Durette-Desset, 1968 and *H. longispiculatus* (Dikmans, 1940), have been recorded from arvicolid rodents: *H. montanus* in *Microtus longicaudus* (Merriam) from southeastern Alaska (Durette-Desset, 1968) and *Microtus californicus* (Peale) from northern California (Durette-Desset et al., 1972), and *H. longispiculatus* in *Ondatra zibethicus* (Linnaeus) and *Microtus pennsylvanicus* (Ord) in the northeastern United States (Washington, D.C., and New Jersey) (Dikmans, 1940).

Heligmosomoides thomomyos resembles both *H. montanus* and *H. longispiculatus* with regard to spicule length and relative dimension of the body (Table 1). However, it differs from *H. montanus* in the following details: the eggs are smaller than those of *H. montanus* (50 × 80), the esophagus is longer (800) in *H. montanus* (female), the posterior chamber of the ovejector of *H. montanus* is much longer (390), and the distance from the excretory pore to the anterior end in males in consistently greater in *H. montanus* (325–350).

Detailed study of the type specimen (male) of *H. montanus* revealed that the dorsal ray is as described by Durette-Desset (1968, Fig. 5). She stated (p. 195) that "La côte dorsale, longue de 38μ, se termine par 4 extrémités élargies." This differs significantly from the dorsal ray of *H. thomomyos,* which has six fingerlike projections posteriorly.

As described by Durette-Desset (1968) and confirmed by our measurements, there is little, if any, bursal asymmetry in *H. montanus.* The bursal asymmetry of *H. thomomyos* is due to the larger left lateral rays (Fig. 3). *Heligmosomoides thomomyos* also differs in the number of cuticular ridges (crêtes) at midbody; males and females were found to have 18–19 and 18–20 longitudinal ridges, respectively, compared with 17 in the male and 19 in the female of *H. montanus* (Durette-Desset, 1968).

Heligmosomoides thomomyos differs from *H. longispiculatus* in that the latter has a relatively longer esophagus (700–800), and in the females, larger eggs (40–45 × 80–90), greater total length (12–13 mm), and a greater distance from anus to tip of tail (60). Detailed examination of *H. longispiculatus* by us revealed that the asymmetrical condition of the bursa results primarily from the greatly enlarged

right ventral rays, which is in good agreement with Dikmans (1940, Fig. 1). This differs significantly from *H. thomomyos,* which has larger left lateral rays. The position of the male *H. longispiculatus* as mounted permanently on the slide precluded a determination of both the prebursal papillae and the dorsal ray. Additional material is needed before definite statements concerning these structures can be made.

Discussion

The presence of nematodes of the genus *Heligmosomoides* in North America is probably attributable to their dispersal in rodents from the Palearctic that were involved in faunal exchanges across Beringia during the Pleistocene epoch (Durette-Desset et al., 1972; Rausch and Rausch, 1973).

All rodents of the family Geomyidae lead a fossorial existence (Hall and Kelson, 1959; Russell, 1968). However, some arvicolid rodents occupy much the same habitat as geomyids. In Oregon, for example, voles such as *Microtus canicaudus* Miller use abandoned tunnels of gophers for food storage, reproduction, and shelter (Maser and Storm, 1970). Because rodents of the two families are often sympatric, and may share the same habitat, transfer of the precursor of *H. thomomyos* to geomyids might have occurred at least as early as Pleistocene time.

Thomomys mazama (Merriam), a pocket gopher that has an extensive range in western Oregon and northern California, is both parapatric with *T. bulbivorus* at the periphery of the Willamette Valley, and parapatric with *T. bottae* in southwestern Oregon (Hall and Kelson, 1959; Ingles, 1965; Maser et al., 1980). Because *H. thomomyos* is not host specific at the level of the species, it might be expected that it may also occur in *T. mazama* and perhaps in pocket gophers of other species in the Pacific Northwest.

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