

## Studies on the Parasite Fauna of Insectivora

### II. Four new capillarid nematodes from the Japanese shrews, genera *Sorex* and *Crocidura*

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#### Introduction

In the preceding paper (Part I), KAMIYA<sup>4</sup>, one of the present authors, described a new crenosomid nematode, *Paracrenosoma takikawai*. In the present paper, we described four species of capillarid nematodes, including three new species. For the description, the author mainly followed the recent system of MORAVEC<sup>7</sup>.

#### Materials and Methods

From 1974 to 1985, four species of Japanese shrews (229 *Sorex unguiculatus* DOBSON, 99 *S. shinto saevus* THOMAS, 15 *S. minutus* L. and 2 *Crocidura dsinezumi dsinezuni* (TEMMINCK) were collected at several sites in Hokkaido and Shikoku, Japan (Tab. 1).

The capillarid nematodes obtained were fixed in 5% formalin, and for microscopic examination were cleared in lacto-phenol solution. The stichocytes and the bacillary band were examined using an interference microscope (Olympus, BH2-NIS). The tissues in which the nematodes were found were fixed in 10% formalin solution and embedded in paraffin, and the sections made were stained with haematoxylin-eosin for pathological investigations. The authors obtained *Calodium* sp. from the liver of one *S. unguiculatus*, but identification was impossible because the specimens were few in number and damaged. Therefore this species is not described here.

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**Table 1.** Occurrence of four nematodes from Japanese shrews (*Sorex* and *Crocidura*)

GEN. SP.	HABITAT	HOSTS			
		<i>Su</i> (N=229)	<i>Ss</i> (N=99)	<i>Sm</i> (N=15)	<i>Cd</i> (N=2)
<i>Eucoleus oesophagicola</i>	esophagus	7 <sup>†</sup> ( 3.1)*	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)
<i>Aonchotheca soricis</i> n. sp.	stomach	31 (13.5)	32 (32.3)	2 (13.3)	0 ( 0.0)
<i>Aonchotheca crociduri</i> n. sp.	stomach	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)	2 (100.0)
<i>Liniscus hokkaidensis</i> n. sp.	urinary bladder	37 (16.2)	21 (21.2)	3 (20.0)	0 ( 0.0)
<i>Calodium</i> sp.	liver	1 ( 0.4)	0 ( 0.0)	0 ( 0.0)	0 ( 0.0)

† : Number of shrews infected.

\* : Percentage of shrews infected (%).

*Su*: *Sorex unguiculatus*; *Ss*: *S. shinto sacvus*; *Sm*: *S. minutus*; *Cd*: *Crocidura dsinezumi dsinezumi*

### Results and Discussion

- 1) *Eucoleus oesophagicola* (SOŁTYŚ, 1952<sup>10</sup>) SKRJABIN et al., 1957<sup>9</sup>) (Figs. 1-10, 43 & 46)

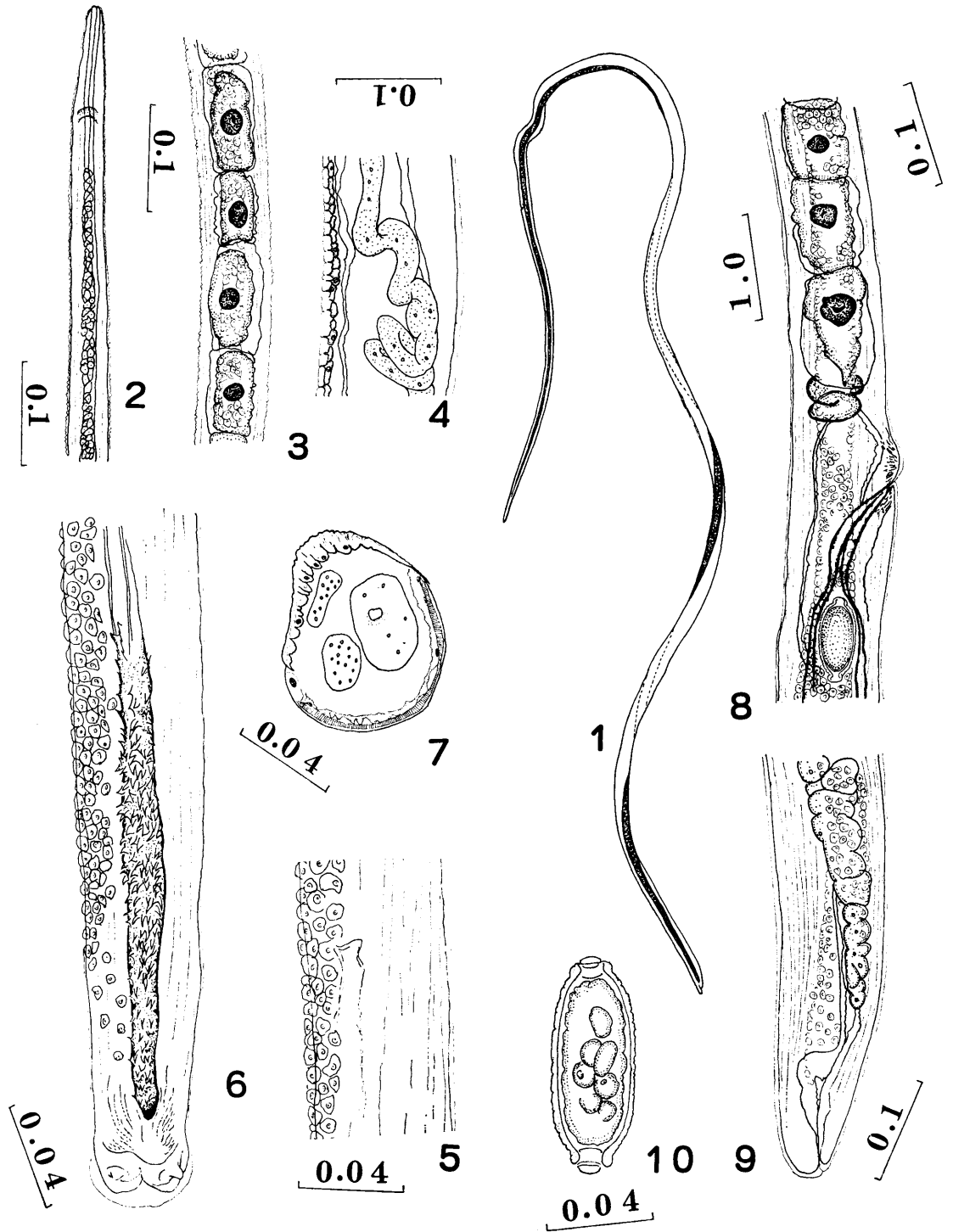
Several specimens were obtained from 7 big-clawed shrews, *Sorex unguiculatus* DOBSON, in Hokkaido. The nematodes was embedded in the esophageal mucous membrane without inflammatory reactions (Fig. 43).

Description (measurements in mm)

Body small and filiform (main measurements in Table 2). Bacillary band present on right lateral side and longitudinal striation are observed (Figs. 1-4). Stichocyte 0.06~0.09 in length and 0.04~0.05 in width, and rectangular in form (Figs. 3 & 8). Number of stichocytes 24~28 in male and 31 in female. Male (three specimens): Spicule moderately sclerotized but the entire structure obscure. Spicule sheath covered with spines (Fig. 6).

#### Figures 1-10. *Eucoleus oesophagicola* (SOŁTYŚ, 1952).

- Fig. 1.** Bacillary band of female.  
**Fig. 2.** Anterior extremity of female, right-lateral view.  
**Fig. 3.** Stichocytes of female, right-lateral view.  
**Fig. 4.** Bacillary band of female.  
**Fig. 5.** Anterior extremity of spicule of male.  
**Fig. 6.** Posterior extremity of male, ventral view.  
**Fig. 7.** Cross-section of mid-body of female.  
**Fig. 8.** Vulva and junction of esophagus and intestine of female, right-lateral view.  
**Fig. 9.** Posterior extremity of female, right-lateral view.  
**Fig. 10.** Egg.

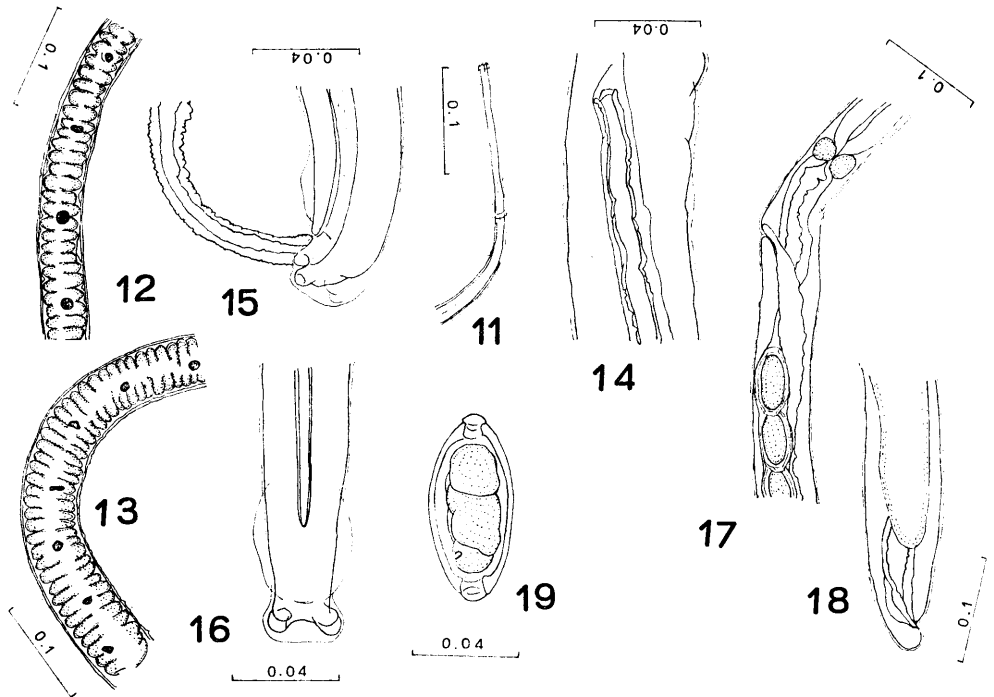


Posterior extremity of body without caudal alae and divided into two lobes with a pair of papillae and a thin membrane on the dorsal side. Female (three specimens): Vulval opening at the junction of esophagus and intestine without a special cuticular formation (Fig. 8). Eggs, about  $0.07 \times 0.03$  in size, barrel-shaped with slightly rough surface (Fig. 10). Posterior extremity of body blunt and anal opening terminal (Fig. 9).

*Eucoleus oesophagicola* seems to occur in the common European shrew, *Sorex araneus*<sup>1,10</sup> L., however, this is the first recording in Japan.

2) *Anochotheca sorcis* n. sp. (Figs. 11-19, 47 & 48)

Hosts: Japanese shrew, *Sorex shinto saevus* THOMAS (type host); big-clawed shrew, *S. unguiculatus* DOBSON; common shrew, *S. minutus* L.



Figures 11-19. *Anochotheca sorcis* n. sp..

- Fig. 11. Anterior extremity of male.
- Fig. 12. Stichocytes of female, antero part of stichosome.
- Fig. 13. Stichocytes of female, posterior part of stichosome.
- Fig. 14. Anterior extremity of spicule of male.
- Fig. 15. Posterior extremity of male, left-lateral view.
- Fig. 16. Posterior extremity of male, ventral view.
- Fig. 17. Vulva and junction of esophagus and intestine, left-lateral view.
- Fig. 18. Posterior extremity of female, right-lateral view.
- Fig. 19. Egg.

**Table 2.** Measurements of four capillarid nematodes from Japanese shrews (in mm)

GEN. SP.	<i>Eucoleus oesophagicola</i>	<i>Anchotheca soricis</i>	<i>Anchotheca crocidus</i>	<i>Liniscus hokkaidi</i>
Male	N=3	N=5	N=3	N=3
Body				
length	6.2-7.2	4.5-7.6	4.2-5.8	10.7-12.5
width (max.)	0.05-0.08	0.04-0.06	0.05-0.06	0.11-0.15
Anterior portion of esophagus				
length	0.26-0.47	0.40-0.91	0.24-0.26	0.28-0.47
Esophagus				
length	1.6-2.0	1.4-2.8	2.0-2.3	4.1-5.2
Nerve ring from				
head end	0.07-0.08	0.09-0.16	0.06-0.11	0.09-0.24
Ratio of esophagus length to body				
length	1: 3.4-1: 4.1	1: 2.2-1: 4.0	1: 1.8-1: 2.5	1: 2.4-1: 2.6
Spicule				
length	unknown	0.36-0.44	0.38-0.39	1.30-1.34
Female	N=3	N=3	N=4	N=4
Body				
length	13.3-15.1	8.6-10.9	8.2-10.1	13.2-14.2
width (max.)	0.11	0.06-0.09	0.09-0.10	0.15-0.19
Anterior portion of esophagus				
length	0.46-0.70	0.70-0.77	0.28-0.36	0.70-1.47
Esophagus				
length	2.2-2.8	2.8-3.2	2.8-2.9	5.8-7.3
Nerve ring from				
head end	0.07-0.09	0.07-0.18	0.07	0.19-0.23
Ratio of esophagus length to body				
length	1: 4.8-1: 6.7	1: 3.1-1: 3.4	1: 2.9-1: 3.4	1: 2.0-1: 2.3
Vulva from				
head end	2.3-2.9	2.9-3.4	2.9-3.0	6.0-7.7
Egg	0.06-0.07	0.05	0.05-0.06	0.05
	× 0.03	× 0.02	× 0.02	× 0.02

N: Number of specimens examined.

Habitat: stomach

Locality: Hokkaido, Japan

Description (measurements in mm)

This species was found freely in the lumen of the stomach. Body small

and filiform. Cephalic vesicule obvious. Main measurements are shown in Table 2. Bacillary band present on right lateral side. Stichocyte 0.03~0.04 in length and 0.02~0.03 in width, and rosary-shaped (Figs. 12, 13, 47 & 48). One stichocyte lighter in color alternating with 1 darker stichocyte (Figs. 47 & 48). Number of stichocytes 19~24 in male and 26~33 in female. A pair of post-esophagal coelomocytes present. Male (five specimens): Spicule well-sclerotized. Surface of spicular sheath smooth. In posterior extremity of body, a pair of caudal alae and a bursa-like structure (pseudobursa) present. Pseudobursa consisting of four papillae (or protuberances) and a thin membrane. Female (three specimens): Vulval opening at junction of esophagus and intestine without a special cuticular formation. Eggs, about  $0.05 \times 0.02$  in size, lemon-shaped with smooth surface. Posterior extremity of body blunt and anal opening subterminal.

Type specimen is deposited in Meguro Parasitological Museum (No. 19495), Tokyo, Japan.

This species belongs to the genus *Anchotheca* LOPEZ-NEYRA, 1947<sup>6)</sup>, because of the following key characteristics: 1) caudal lateral alae present in male, 2) posterior end of male provided with membranous bursa supported on either side by two pairs of lateral projections, 3) spicule present, 4) spicular sheath nonspiny, 5) vulvar appendage absent, 6) parasites of digestive tract of mammals<sup>7)</sup>. Among the 42 known species of this genus, the present species is similar to *A. minuta* (CHEN, 1937<sup>2)</sup>), however, it is distinguishable from *minuta* by the presence of a bacillary band and lack of a spinous vulvar appendage.

3) *Aonchotheca crociduri* n. sp. (Figs. 20-30 & 49-51)

Hosts: Japanese white-toothed shrew, *Crocidura dsinezumi dsinezumi*  
TEMMINCK

Habitat: stomach

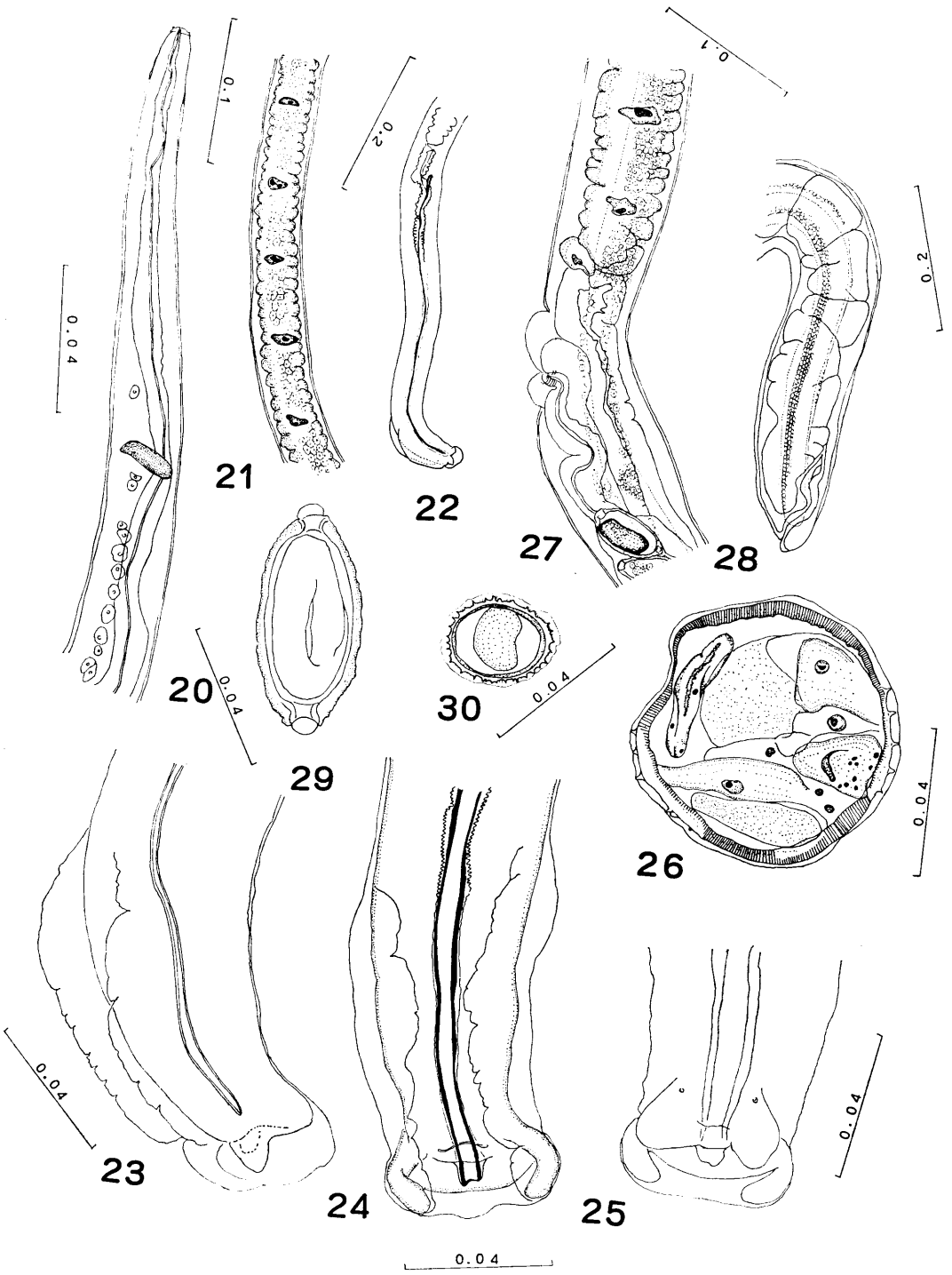
Locality: Shikoku, Japan

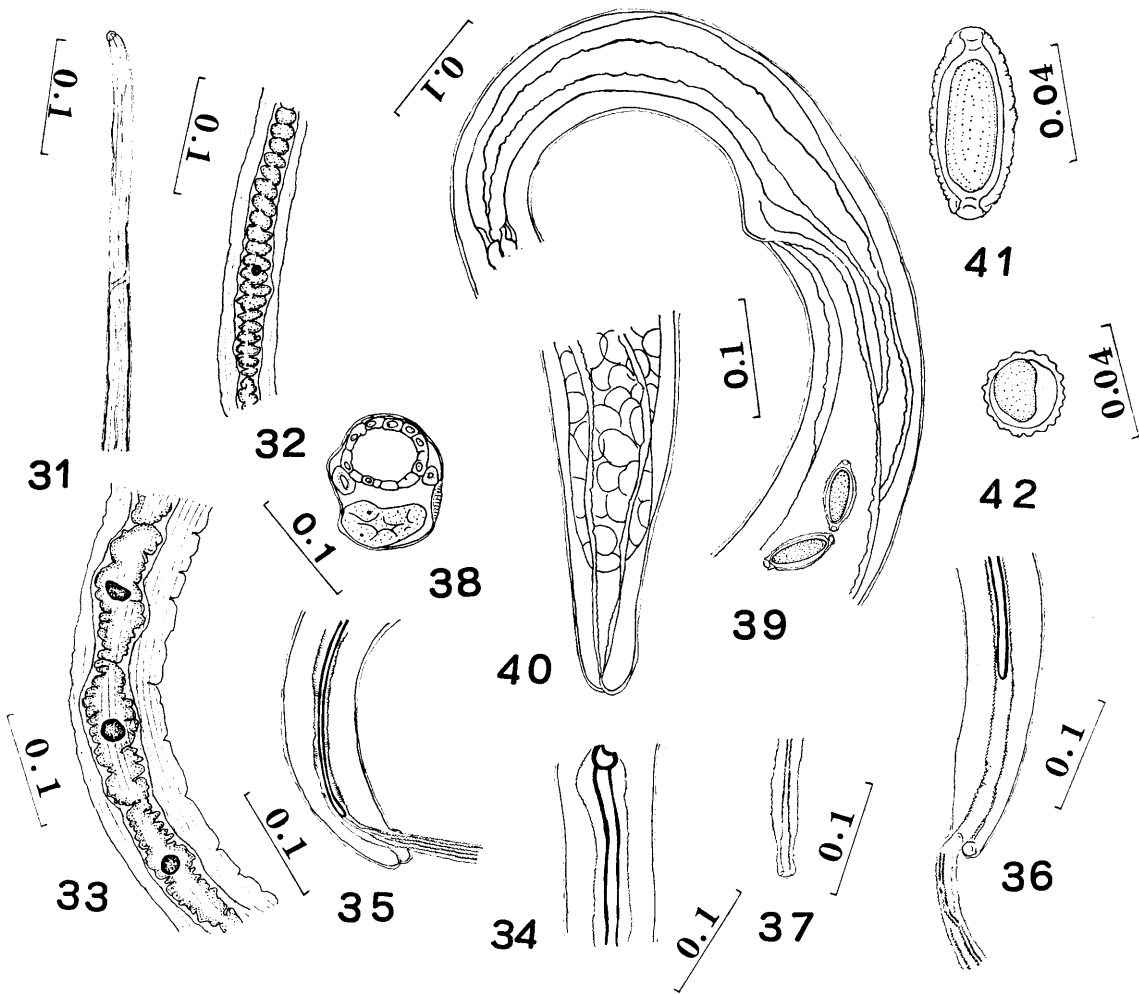
Description (measurements in mm)

Body small and filiform. Main measurements are shown in table 2. Two bacillary bands present bilaterally (Figs. 27 & 28). Stichocyte 0.04~0.06

**Figures 20-30.** *Aonchotheca crociduri* n. sp..

- Fig. 20.** Anterior extremity of female. **Fig. 21.** Stichocytes of female.  
**Fig. 22.** Posterior extremity of male, left-lateral view.  
**Fig. 23.** Posterior extremity of male, left-lateral view.  
**Fig. 24.** Posterior extremity of male, ventral view.  
**Fig. 25.** Posterior extremity of male, dorsal view.  
**Fig. 26.** Cross-section of mid-body of female.  
**Fig. 27.** Vulva and junction of esophagus and intestine of female, left-lateral view.  
**Fig. 28.** Posterior extremity of female, left-lateral view.  
**Fig. 29.** Egg. **Fig. 30.** Cross-section of egg.





Figures 31-42. *Liniscui hokkaidensis* n. sp..

- Fig. 31. Anterior extremity of male.  
 Fig. 32. Stichocytes of female, anterior part of stichosome.  
 Fig. 33. Stichocytes of female, posterior part of stichosome.  
 Fig. 34. Anterior extremity of spicule of male.  
 Fig. 35. Posterior extremity of male, left-lateral view.  
 Fig. 36. Posterior extremity of male, ventral view.  
 Fig. 37. Spicule sheath.  
 Fig. 38. Cross-section of mid-body of female.  
 Fig. 39. Vulva and junction of esophagus and intestine of female, left-lateral view.  
 Fig. 40. Posterior extremity of female, left-lateral view.  
 Fig. 41. Egg.  
 Fig. 42. Cross-section of egg.



in length and 0.02~0.04 in width, and rosary-shaped. One stichocyte lighter in color alternating with one darker stichocyte (Fig. 49). Number of stichocytes 37~41 in male and 38~43 in female. Male (three specimens): Spicule well-sclerotized. Surface of spicular sheath smooth. In the posterior extremity of body, a pair of caudal alae and pseudobursa covered with thin membrane present. In pseudobursa, a pair of papillae present on ventral side and a triangular projection present on dorsal side, respectively. Female (four specimens): Vulval opening with cuticular swelling at junction of esophagus and intestine. Eggs, about  $0.05 \times 0.02$  in size, lemon-shaped with slightly rough surface. Posterior extremity of body blunt and anal opening subterminal.

Type specimen is deposited in Meguro Parasitological Museum (No. 19496), Tokyo, Japan.

This species is very similar to *A. soricis* n. sp.; however, it is distinguishable by the number of bacillary bands and general aspect of the pseudobursa and vulva.

4) *Liniscus hokkaidensis* n. sp. (Figs. 31-42, 44, 45 & 52-54)

Hosts: Japanese shrew, *Sorex shinto saevus* THOMAS (type host); big-clawed shrew, *S. unguiculatus* DOBSON and common shrew, *S. minutus* L.

Habitat: urinary bladder

Locality: Hokkaido, Japan

Description (measurements in mm)

This species was found freely in the urinary bladder, which manifested epithelial hyperplasia (Figs. 44 & 45). Body filiform. Cephalic vesicle obvious.

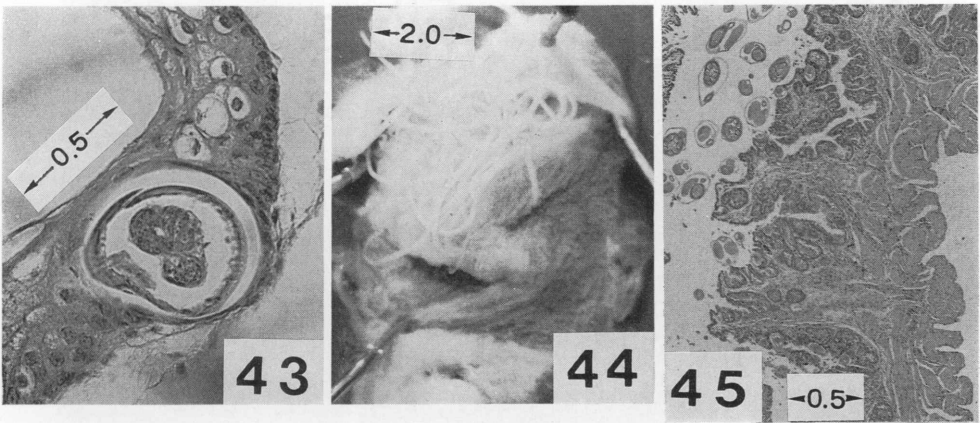
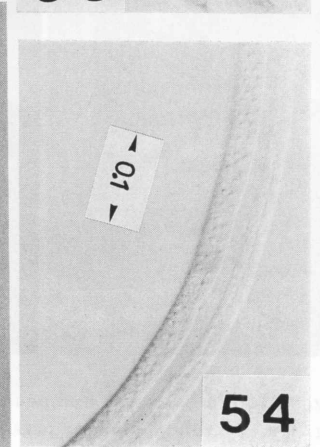
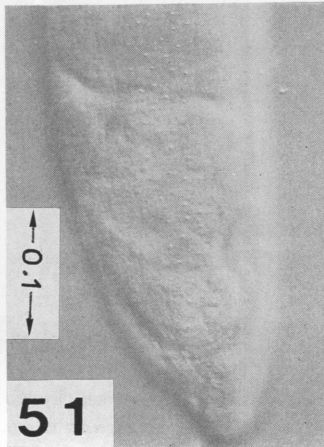
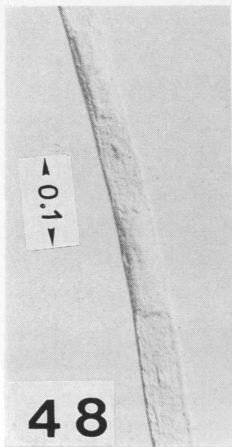
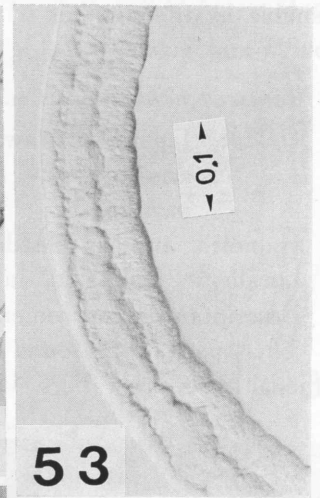
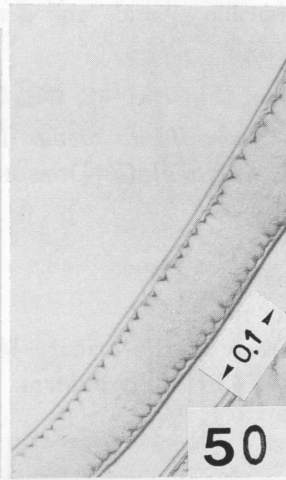
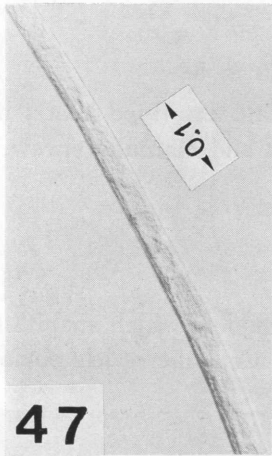
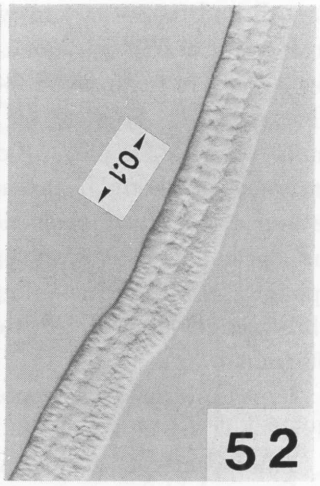
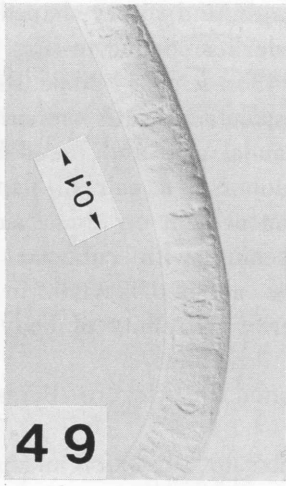
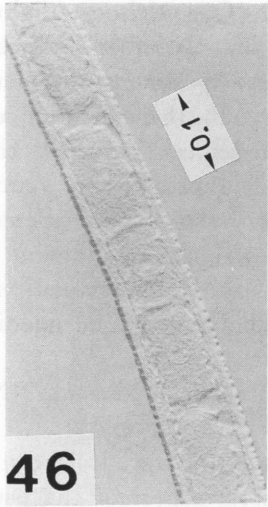


Fig. 43. Pathological findings of esophagus parasitized by *E. oesophagicola*.

Fig. 44. Urinary bladder parasitized by *L. hokkaidensis* n. sp..

Fig. 45. Pathological findings of urinary bladder parasitized by *L. hokkaidensis* n. sp..



Main measurements are shown in Table 2. One bacillary band present on right or left lateral side and longitudinal striations are observed. Stichocyte 0.11 in length and 0.04 in width (female), and having an indeterminate form. Number of stichosomes 30~46 in male and 30 in female. Male (three specimens). Spicule well-sclerotized. Surface of spicular sheath rough showing numerous minute folds without spines. Caudal alae absent, a pair of papillae present and cloacal opening terminal. Female (four specimens): Vulval opening at junction of esophagus and intestine accompanied by a small cuticular swelling without a special appendage. Eggs, about  $0.05 \times 0.02$  in size, lemon-shaped with rough surface. Posterior extremity of body blunt and anal opening terminal.

Type specimen is deposited in Meguro Parasitologica Museum (No. 19497), Tokyo, Japan.

This species belongs to the genus *Liniscus* DUJARDIN, 1845<sup>3)</sup>, because of the following characteristics: 1) caudal lateral alae absent in male, 2) small membranous bursa present, being supported by two short, simple and round dorsolateral projections, 3) spicule thin and long, 4) spicular sheath nonspiny, 5) vulvar appendage absent, 6) parasites of urinary bladder of small mammals (insectivores)<sup>7)</sup>. Among the 7 known species of this genus, the present species is similar to *L. capillaris* (LINSTOW, 1882<sup>2)</sup>), *L. urinicola* (SOËTYS, 1952<sup>1)</sup>) and *L. maseri* (RAUSCH and RAUSCH, 1975<sup>8)</sup>). However, the present species is distinguishable from the three species by 1) the presence of longitudinal striations, 2) rough surface of egg, 3) spicule length, 4) presence of vulvar process.

### Summary

Three new species and one known species of the capillarid nematodes from four species of Japanese shrews, *Sorex unguiculatus* DOBSON, *S. shinto saevus* THOMAS, *S. minutus* L. and *Crocidura dsinezumi dsinezumi* TEMMINCK, were described and/or redescribed. i) *Eucoleus oesophagicola* (SOËTYS 1952) from the esophageal mucous membrane of *S. unguiculatus* DOBSON is redescribed. This species is the first recorded in Japan. ii) *Anochotheca*

#### Figures 46-54. Stichocytes and bacillary bands.

- Fig. 46. Stichocytes of female of *E. oesophagicola*.  
 Fig. 47. Stichocytes of female of *A. soricis* n. sp., anterior part of stichosome.  
 Fig. 48. Stichocytes of female of *A. soricis* n. sp., posterior part of stichosome.  
 Fig. 49. Stichocytes of female of *A. crociduri* n. sp., anterior part of stichosome.  
 Fig. 50. Stichocytes of female of *A. crociduri* n. sp., posterior part of stichosome.  
 Fig. 51. Bacillary band of *A. crociduri* n. sp., posterior extremity of female.  
 Fig. 52. Stichocytes of female of *L. hokkaidensis* n. sp., anterior part of stichosome.  
 Fig. 53. Stichocytes of female of *L. hokkaidensis* n. sp., posterior of stichosome.  
 Fig. 54. Bacillary band of *L. hokkaidensis* n. sp., mid-part of esophagus of female.

*soricis* n. sp. from the stomach of *S. shinto saevus*, *S. unguiculatus* and *S. minutus* is similar to *A. minuta*, but is distinguished from *minuta* by the presence of a bacillary band and the lack of a spinous vulvar appendage. iii) *A. crociduri* n. sp. from the stomach of *C. d. dsinezumi* is characterized by the presence of two bacillary bands. iv) *Liniscus hokkaidensis* n. sp. from the urinary bladder of *S. shinto saevus*, *S. unguiculatus* and *S. minutus* is similar to *L. capillaris*, *L. urinicola* and *L. maseri*. However, *L. hokkaidensis* is distinguishable by morphological characteristics of the male and female genital organs.

**Key words:** *Eucoleus oesophagicola* (SOŁTYS, 1952); *Aonchotheca soricis* n. sp.; *A. crociduri* n. sp.; *Liniscus hokkaidensis* n. sp.; *Sorex* spp.; *Crocidura dsinezumi*; Japan

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### 要 旨

北海道産オオアシトガリネズミ (*Sorex unguiculatus* DOBSON), エゾトガリネズミ (*S. shinto saevus* THOMAS), トウキョウトガリネズミ (*S. minutus* L.) およびサイゴクジネズミ (*Crocidura dsinezumi dsinezumi* TEMMINCK) から得た Capillariidae 科線虫の三新種と一既知種について記載または再記載した。

(1) *Eucoleus oesophagicola* (SOŁTYS, 1952): オオアシトガリネズミの食道粘膜内に認められた (本邦初記録)。

(2) *Aonchotheca soricis* n. sp.: トガリネズミ三種の胃に認められた。*A. minuta* に似るが, bacillary band が存在することと陰門部の“刺状構造物”を欠く点で区別された (新種)。

(3) *Aonchotheca crociduri* n. sp.: サイゴクジネズミの胃に認められた。二組の bacillary band が認められることで既知種と区別された (新種)。

(4) *Liniscus hokkaidensis* n. sp.: トガリネズミ三種の膀胱に認められた。*L. capillaris*, *L. urinicola* および *L. maseri* に似るが, 生殖器系の形態で既知種と区別された (新種)。