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HELMINTH PARASITES OF THE JAPANESE MONKEY, *MACACA FUSCATA FUSCATA* IN EHIME PREFECTURE, JAPAN

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Thirty-six Japanese monkeys, *Macaca fuscata fuscata* captured in Ehime Prefecture, Japan, during 1986–1987 were subjected to postmortem examination. The survey revealed 4 species of helminths: *Streptopharagus pigmentatus* (69.9% of monkeys), *Strongyloides fuelleborni* (52.9%), *Trichuris* sp. (52.9%) and *Oesophagostomum aculeatum* (5.6%). No cestodes or trematodes were found. The intensity of infection in the monkeys was low except for 3 cases of heavy infection.

Key words: *Macaca fuscata fuscata*, parasitological survey, *Streptopharagus*, *Trichuris*, *Oesophagostomum*, *Strongyloides*, Japan

INTRODUCTION

Japanese monkeys, *Macaca fuscata fuscata*, are widely distributed in Japan. A few helminthological surveys on the monkeys have been performed, in which five species have been reported; *Streptopharagus pigmentatus*, *Strongyloides fuelleborni*, *Trichuris trichiura*, *Oesophagostomum aculeatum* [NEMATODA] and *Bertiella* sp. [CESTODA] (HAYAMA & NIGI, 1963; YAMASHITA, 1963; TANAKA & NIGI, 1967; NIGI, 1983). Most of the surveys, however, have been carried out using the fecal examination. In the present survey, the prevalence and intensity of the parasites were determined by postmortem examination.

MATERIALS AND METHODS

Thirty-six wild Japanese monkeys were captured in May 1985, Feb. and Nov. 1986, and Jan. 1987, from two areas in the southern part of Ehime Prefecture: 15 from Misho-choh; 21 from Nishiumi-choh. Viscera were removed from carcasses and

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preserved in 10% formalin solution. The heart, liver, lungs, kidneys and spleen were examined macroscopically. Tissues with gross lesions were subjected to histological examination.

The gastrointestinal tract was divided into 4 parts; esophagus-stomach, upper part of small intestine, lower part of small intestine and large intestine. Each part was opened longitudinally. From the solution containing intestinal contents and mucosa, parasites were collected and counted under the dissecting microscope.

The collected worms were preserved in 10% formalin solution, and prior to the morphological observations the parasites were immersed in lacto-phenol solution.

Use of prevalence, intensity, mean intensity, and range of intensity followed the definition of MARGOLIS et al. (1982).

T. trichiura from Japanese monkey in Maruyama Zoo, Sapporo, was observed. *Trichuris* sp. and *T. trichiura* were prepared for electron microscopy as done by YABU & TAKAYANAGI (1988).

Representative specimens have been deposited in the Parasite Collection in the Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University.

RESULTS

Four species of nematodes were found in the alimentary tract of 32 out of 36 monkeys examined, and species detected are as follows; *S. pigmentatus, S. fuelleborni, Oesophagostomum aculeatum* and *Trichuris* sp. No trematodes or cestodes were detected. In the infected monkeys, the number of cases parasitized by 1, 2 and 3 species of helminths was 15, 13 and 4, respectively. The species detected, prevalence and intensity are shown in Table 1.

No helminth was detected in the heart, liver, lungs, kidneys or spleen.

Streptopharagus pigmentatus (LINSTOW, 1897) (SPIRUROIDAE)

S. pigmentatus was the most prevalent parasite at 69.9%. This parasite was found in the stomach and small intestine, especially in the upper part of the small

TABLE 1 Prevalence and intensity of helminth parasites in Japanese monkeys in Ehime Prefecture

Helminth	Prevalence (%)	Range of intensity	Sites
Streptopharagus pigmentatus	25/36 (69.9)	3～52	Stomach & small intestine
Strongyloides fuelleborni	13/36 (52.9)	many	Small intestine
Trichuris sp.	13/36 (52.9)	2～125	Caecum & colon
Oesophagostomum aculeatum	2/36 (5.6)	1～2	Colon

TABLE 2 Measurements of *Streptopharagus pigmentatus* (in mm, egg in μm)

	Male		Female	
	Present authors n=45	YAMAGUTI (1941) n=5	Present authors n=40	YAMAGUTI (1935*, 1941) n=5*, n=8
Body length	26.7 – 45.6	30 – 40	44.4 – 72.6	47 – 50
width	0.78 – 1.56	0.9 – 1.1	1.11 – 2.22	1.0 – 1.5
(mid boby)				
Head diameter	0.17 – 0.19	0.15 – 0.19	0.18 – 0.20	0.15 – 0.24
Nerve ring from head end	0.48 – 0.74	0.52 – 0.63	0.67 – 0.81	0.53 – 0.80
Excretory pore from head end	0.58 – 0.60	0.68 – 0.79	0.62 – 0.85	0.60 – 0.87
Pharynx length	0.32 – 0.53	0.28 – 0.37	0.23 – 0.37	0.32 – 0.40
width	0.063– 0.083	0.06 – 0.09	0.078– 0.086	0.065– 0.115
Esophagus				
muscular part				
length	0.51 – 0.86	0.30 – 0.55	0.47 – 0.51	0.37 – 0.60
width	0.11 – 0.13	0.12 – 0.15	0.11 – 0.13	0.12 – 0.19
glandular part				
length	4.08 – 6.52	5.5 – 7.9	7.1 – 7.3	6.7 – 9.1
width	0.31 – 0.35	0.25 – 0.33	0.27 – 0.32	0.24 – 0.36
Tail length	0.45 – 0.58	0.47 – 0.55	0.56 – 0.66	0.45 – 0.65
Spicule length				
right	0.66 – 0.79	0.62 – 0.66	–	–
left	3.75 – 4.80	4.8 – 5.4	–	–
Gubernaculum	0.07 – 0.10	0.06 – 0.09	–	–
Egg	–	–	33–35 × 16–20	36–45×18–22
Vulva from head end	–	–	6.08 – 9.80	9.7*

intestine. The mean intensity was 14.8. The stomach of one male monkey was parasitized by more than 50 worms with mucosal congestion.

The measurement (Table 2) and morphology (Figures 1–5) of the worms were similar to those of YAMAGUTI (1935, 1941) except for the spicule length and egg size. Spicules were unequal: left spicule was more elongated and slender, and distal end sharp; right spicule was massive, and distal end plump and shorter than that of YAMAGUTI (1941). The gubernaculum was broad, rectangular in form. In addition, the complex verrucosity at distal end of the tail was found. Egg size was smaller than that of YAMAGUTI (1941).

Trichuris sp. (TRICHURIDAE)

Trichuris sp. was the second most prevalent parasite in this study. The mean intensity was 26.1. Two cases showed heavy infection (more than 100 worms) with marked mucosal congestion in their caecum, and they were relatively emaciated. Young (<1 year old) monkeys had a significantly higher prevalence value of 71% than either juveniles (1~5 years old) or adults (>5 years old) (<15%).

The measurements of *Trichuris* which were obtained in this survey are shown in Table 3, with the measurements of specimens from Ehime Pref. and from Maruyama Zoo, and descriptions by KONNO (1958) and SKRJABIN et al. (1957, the specimens parasitizing humans). The body length of the parasites from Ehime Pref. tended to be smaller than that of others. A significant difference in spicule length between those from Ehime Pref. and other specimens was noted. The worms from Ehime Pref. were not thought to be immature worms, because mature eggs were present in the uterus. Spicular sheath of the parasites from Ehime Pref. was cylindrical as *T. suis* (Figures 6–9). Moreover, in the scanning electron microscopic observation, the shape of spines on the spicular sheath was seen to be similar to that of *T. suis* rather than *T. trichiura* (specimens from monkey in Maruyama Zoo, and those of KONNO (1958)).

In other species

Oesophagostomum aculeatum (LINSTOW, 1879) (TRICHONEMATOIDAE) was found in the caecum and colon of monkeys obtained from Nishiumi-choh at a prevalence of 9.5% (2 cases). Some nodules were found on the mucosal surface of the large intestine of the infected monkeys.

Strongyloides fuelleborni, LINSTOW, 1905 (STRONGYLOIDAE) was identified according to PREMVATI (1958). It was the second most prevalent parasite recovered as *Trichuris* sp, and many in the small intestine were detected.

DISCUSSION

Present data by postmortem examination were compared with data reported elsewhere in other areas of Japan (Table 4, Figure 10). In Arashiyama, five species including *Bertiella* sp. are found, and positive rate of fecal examination was more than

TABLE 3 Comparison of measurements of *Trichuris* (in mm, egg in μm)

Species	*Trichuris* sp.	*T. trichiura*			*T. suis*
Host	Ehime Pref. Jpn. monkey	Maruyama Zoo Jpn. monkey	KONNO (1958) Jpn. monkey	SKRJABIN et al. (1957) Human	YAMAGUTI (1942) Pig
Male	n=35	n=3	n=5		n=7
Body length	28.8 – 33.3	34.0 – 38.6	28.7 – 41.3	38 – 42	36 – 50
Esophagus length	15.4 – 19.1	22.1 – 25.1	18.1 – 26.0*	25 – 29	
Spicule length	1.56 – 1.65	2.1 – 2.6	2.21 – 2.26	2.7 – 3.9	1.8 – 2.3
Female	n=28	n=3	n=4		n=12
Body length	25.8 – 35.8	40.7 – 46.3	30.2 – 45.0	48 – 50	35 – 50
Esophagus length	15.4 – 19.1	29.3 – 30.1	19.6 – 29.3*	25 – 29	
Egg	46.8 – 58.6 × 19.5 – 22.1	52.3 – 58.6 × 21.5 – 25.4	51 – 57 × 21 – 27	50 – 65 × 20 – 30	54 – 60 × 26 – 29

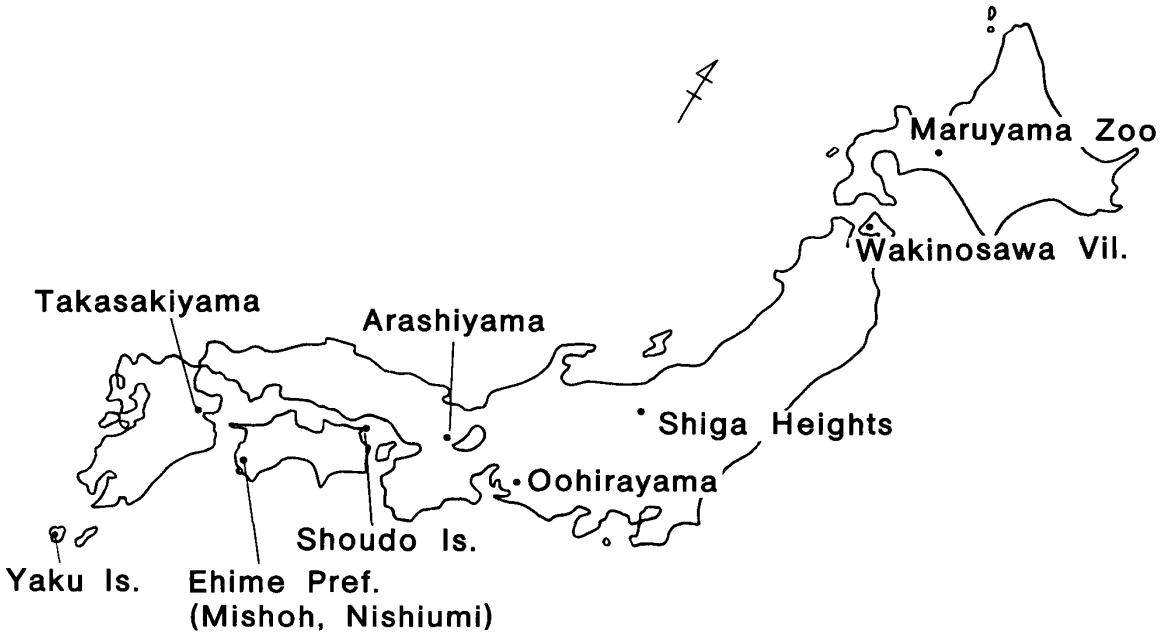
* : Conversion by present authors

TABLE 4 Prevalence of helminth parasites in Japanese monkeys

Locality	Date	No. of examined	Prevalence(%)					Authors
			S. p.*	S. f.*	T*	O. a.*	Cestoda	
POSTMORTEM EXAMINATION								
Ehime Pref.	1986. Feb.	36	69.9	52.9	52.9	5.6	0	Present study
(Mishoh, Nishiumi)	-87. Jan.							
FECAL EXAMINATION								
Wakinosawa Vil.	1979. Nov.	20	—	50	92	—	0	TAKADA et al., 1981
Shiga Heights	1977. Feb.	9	0	0	77.8	0	0	NIGI, 1983
Oohirayama	1980. Jun.	40	0	0	47.5	22.5	0	USUI & HORII, 1982
	1965. Feb.	57	7	28.1	10.5	36.8	0	NIGI, 1983
Arashiyama	1972. Feb.	122	72.1	45.9	78.7	4.1	26.0	MACHIDA & SANO, 1974
Shoudo Is.	1962. Jan.	64	64.1	20.3	67.2	28.1	0	NIGI, 1983
Takasakiyama	1962. Nov.	30	80	13.3	83.3	16.6	0	NIGI, 1983
Yaku Is.	1962 — 67	98	14.3	59.2	31.6	49.6	6.1	NIGI, 1983

*S. p. : *S. pigmentatus* T : *T. trichiura* or *Trichuris* sp.
S. f. : *S. fuelleborni* O. a. : *O. aculeatum*

Fig. 10 Localities collected hosts and fecal samples (in Table 4)



95%. In Wakinosawa Vil. two species (*S. fuelleborni, T. trichiura*) are reported. On the Shiga Heights, only *T. trichiura* is found.

In Ehime Pref. in this study, 4 species except for *Bertiella* sp. were detected, and the prevalence of parasites was similar to that of Shoudo Is. and Takasakiyama (NIGI, 1983), and these three areas are located in southern part of Japan (Figure. 10).

S. pigmentatus requires the intermediate host (beetles) in their life cycle. ARAKI et al. (1977) succeeded the experimental infection of Japanese monkey with larvae obtained from the body cavity of *Geotrupes laevistriatus, Onthophagus ater* and *Onthophagus atripennis*. In the present investigation, beetles were found in the stomach content (5 cases). The difference of the prevalence of *S. pigmentatus* among cold, snow and warm region might be related to the distribution of these beetles and their active season.

O. aculeatum was detected only in 2 cases in this survey. This parasite is one of the noticeable parasites which cause heavy diarrhea among monkeys (HONJO et al., 1963).

Trichuris obtained in this survey were not indentified. According to CHANDLER (1925) the specific features of whipworms are the size of the spicule and the structure of cloaca in male. SCHWARTZ (1926) attached much importance to the size of spicule, structure of spicular sheath and size of embryonated egg in classification of Trichuridae. The validity of *T. suis* and *T. trichiura* is a subject of controversy, and some

workers do not believe the two parasites to be identical. Experimental and accidental infection of humans with *T. suis* have been reported (BEER, 1976). Therefore, there is a great possibility for *T. suis* to infect the Japanese monkey.

Recently, many chances for humans to come into contact with Japanese monkeys are given, as more wild monkey parks have built in every part of Japan. And much attention has been paid to problems of "zoonoses". KOYAMA et al. (1978) showed that Japanese monkey as an experimental animal was infected with entamebiasis. And the experimental infection to men by eggs of *Trichuris* sp. from Japanese monkeys was successful (IMADA et al., 1980). Furthermore, PAMPIGLIONE & RICCIARDI (1972) reported that humans are susceptible to infection with *S. fuelleborni*. For public health importances more attention should be paid to parasites of monkeys.

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EXPLANATION OF PLATES

PLATE I

FIGS. 1–5 *Streptopharagus pigmentatus*

Fig. 1 Anterior end, lateral view

Fig. 2 Cephalic end, apical view

Fig. 3 Egg

Fig. 4 Posterior end of male, lateral view

Fig. 5 Posterior end of female, lateral view

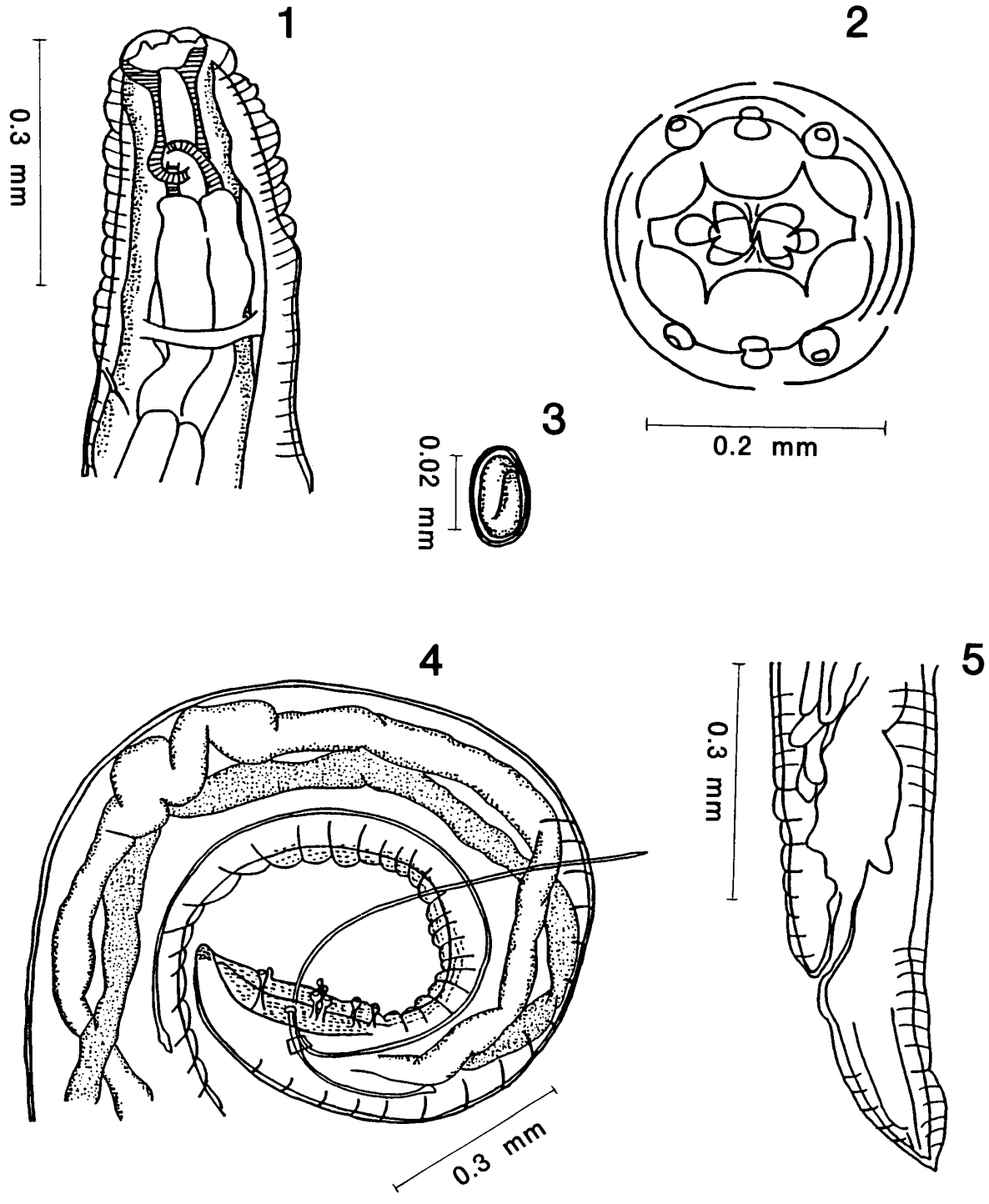
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PLATE II

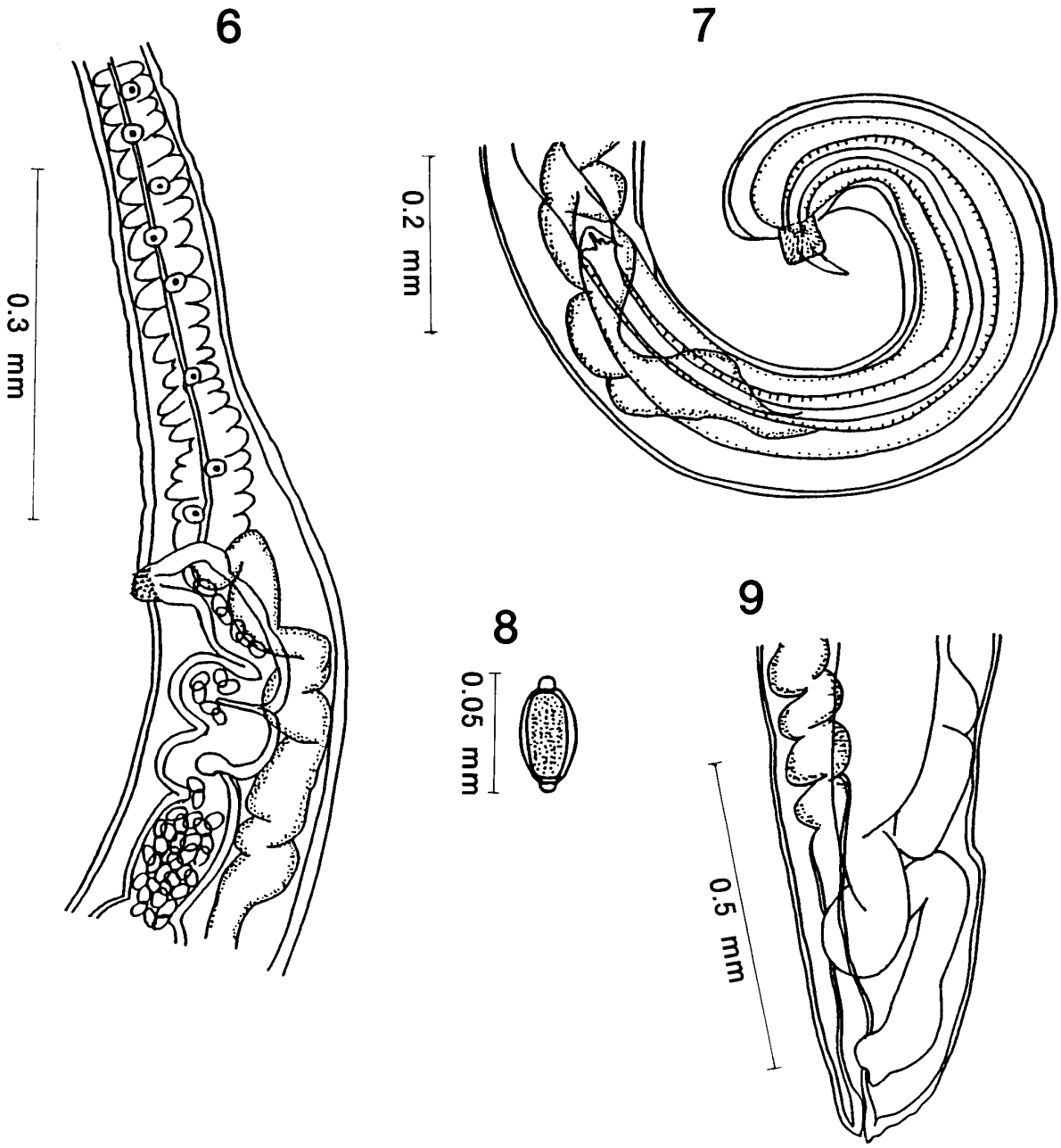
FIGS. 6–7 *Trichuris* sp.

Fig. 6 Vulvar region, lateral view

Fig. 7 Posterior end of male, lateral view

Fig. 8 Egg

Fig. 9 Posterior end of female, lateral view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