

## First Record of *Heligmosomoides polygyrus* from Japan (Nematoda: Heligmosomidae)

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### Introduction

*Heligmosomoides polygyrus* (Dujardin, 1845) (= *Nematospiroides dubius* Baylis, 1926) is a famous nematode since this species has been extensively used as a model host-parasite system in the laboratory. This species is composed of four subspecies and has been known from Europe, Russia and North America (Durette-Desset, 1968a, b; Durette-Desset *et al.*, 1972), but no record has been made from Asian Region. We recently collected a subspecies of this nematode from the mice captured in Chugoku District, Japan. This paper deals with the morphological characters of the worms and some discussions on the taxonomical and biogeographical accounts.

### Materials and Methods

The mice, *Mus musculus*, were collected by using the snap traps in Mizushima Port area, Okayama Prefecture, Japan, and their alimentary canals were cut open to be searched for parasites. Detected

nematodes were fixed in 5% formalin solution, cleared in glycerin-alcohol solution and mounted on slides with 50% glycerin jelly or with gum-chloral solution. In order to count the number of cuticular ridges, worms were cut transversely (at level of proximal part of spicules in male and at anterior to vulval region in female), and mounted with gum-chloral solution. Since the worms were coiled spirally, morphometry was made on the specimens cut into 10 to 20 pieces. Sketches of the worms were made by using a drawing apparatus, Olympus BH-DA-LB.

### Results

During period from May, 1982 to May, 1983, total of 130 mice were captured: 124 mice were in the grass field or around houses and only 4 were in the houses. Sixty-six mice (64 of outdoors and 2 of indoors) were found to be parasitized by a heligmosomid species: incidence was 50.8%. Intensity of infection varied from one to numerous. In mice with many worms, their duodena were expanded markedly.

### Description

Body spirally coiled, more tightly in

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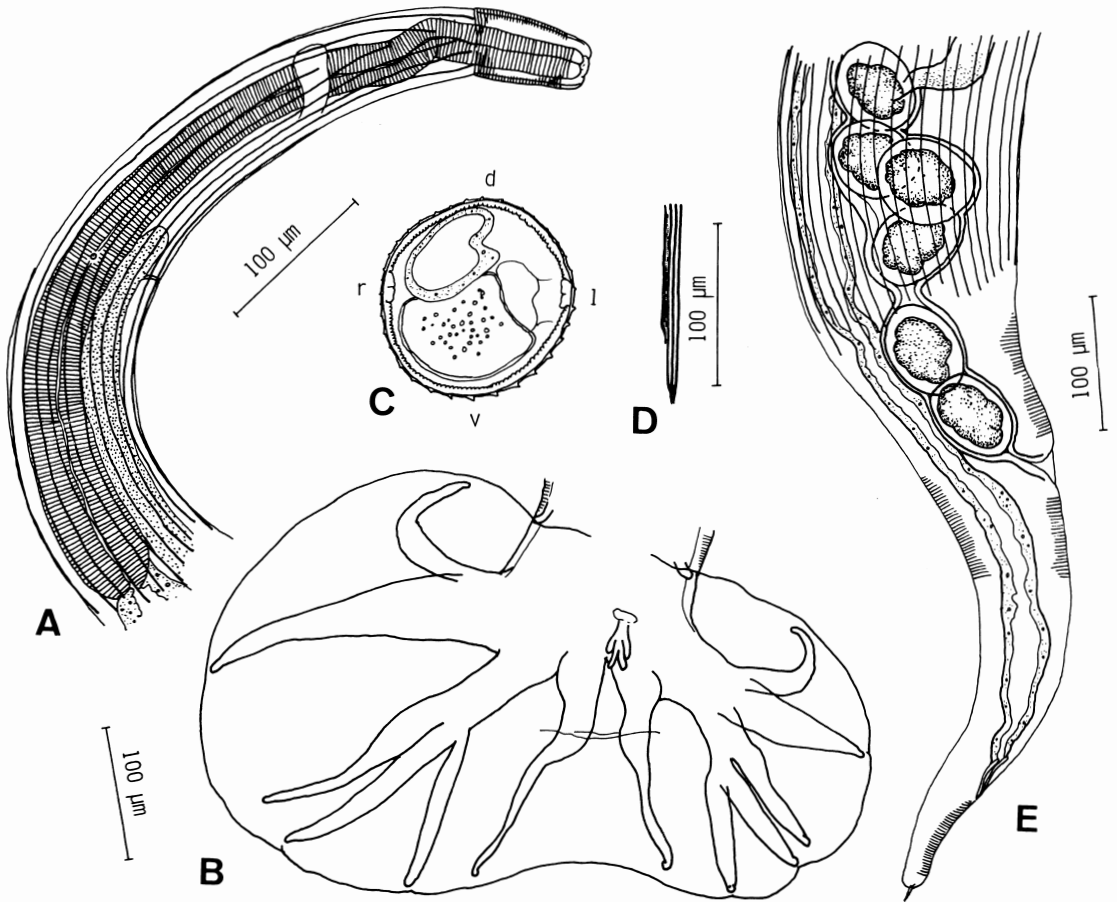


Fig. 1 *Heligmosomoides polygyrus bakeri* collected from *Mus musculus* on Mizushima Port Area, Okayama, Japan.

A, Anterior part of male, lateral view. B, Bursa copulatrix. C, Transverse section of male. D, Distal part of spicules. E, Posterior part of female, lateral view. d, dorsal; l, left; r, right; v, ventral.

female. Color reddish during life. Mouth almost triangular and encircled by four submedian papillae and two amphids. Cephalic vesicle with fine transverse striations present. Cuticle with longitudinal cuticular ridges extending from posterior end of cephalic vesicle to near bursa copulatrix in male and near vulva in female. These ridges not supported by cuticular skeletons. Buccal cavity weakly-developed. Esophagus long-claviform. Excretory pore and deirids on almost same level. Bursa copulatrix markedly asymmetrical; right lobe larger and rays on it larger than

corresponding ones on left lobe. Ventro-ventral ray thickest and straight. Lateral rays arising from a common trunk on each side. Antero-lateral and medio-lateral rays close together, while postero-lateral ray more divergent. Externo-dorsal rays slender and with inflated bases. Dorsal ray very small, divided two times. Pre-bursal papillae minute, sometimes unclear, at level with anterior margin of bursa. Spicules equal, filiform and very slender. Each spicule with two distal points ending separately. In female, vulva situated close to anus, and tail long-conical, with

Table 1 Comparison of morphometric data between the heligmosomid species from mice in Mizushima Port and laboratory-reared *Heligmosomoides polygyrus bakeri*; mean (range)

Host Locality	<i>Mus musculus</i> Mizushima Port	<i>Mus musculus</i> Laboratory-reared
Males:		
No. worms measured	10	10
Body length, mm	5.5 (5.4-6.0)	5.5 (5.0-5.9)
Body width, $\mu\text{m}$	111 (103-123)	113 (103-133)
Head diameter, $\mu\text{m}$	29 (28-31)	32 (30-34)
Cephalic vesicle length, $\mu\text{m}$	62 (55-68)	71 (60-85)
From cephalic apex to:		
nerve ring, $\mu\text{m}$	141 (125-165)	166 (150-185)
excretory pore, $\mu\text{m}$	286 (240-333)	300 (245-353)
Esophagus length, $\mu\text{m}$	498 (463-560)	487 (440-518)
Spicule length, mm	0.50 (0.46-0.54)	0.52 (0.45-0.55)
Bursa copulatrix, mm	0.47 (0.46-0.50) $\times$	0.46 (0.43-0.48) $\times$
	0.29 (0.27-0.30) *	0.28 (0.25-0.31) *
No. cuticular longitudinal ridges	37 (33-40) $\dagger$	34 (32-36) *
Females:		
No. worms measured	10	10
Body length, mm	15.6 (12.8-18.0)	15.5 (13.2-16.9)
Body width, $\mu\text{m}$	176 (160-200)	183 (160-225)
Head diameter, $\mu\text{m}$	32 (30-35)	38 (34-40)
Cephalic vesicle length, $\mu\text{m}$	69 (60-83)	72 (63-83)
From cephalic apex to:		
nerve ring, $\mu\text{m}$	175 (163-213)	171 (143-193)
excretory pore, $\mu\text{m}$	296 (210-388)	315 (263-358)
Esophagus length, mm	0.61 (0.53-0.69)	0.57 (0.54-0.61)
From caudal apex to:		
vulva, mm	0.32 (0.27-0.37)	0.37 (0.33-0.43)
anus, $\mu\text{m}$	96 (83-110)	102 (78-120)
Tail spike length, $\mu\text{m}$	13 (14-15)	12 (10-14)
No. cuticular longitudinal ridges	41 (39-43) *	42 (39-43) *
Egg dimensions, $\mu\text{m}$	80 (73-93) $\times$	82 (78-85) $\times$
	48 (45-50)	46 (43-50)

\* Based on 5 specimens;  $\dagger$  Based on 6 specimens.

a minute spike at tip. Egg elliptical, thin-shelled and containing morula-stage embryo at deposition.

Morphometric data are shown in Table 1 comparing with those of *Heligmosomoides polygyrus bakeri* reared in the Department of Parasitology, National Institute of Health, Tokyo, Japan.

### Discussion

*Heligmosomoides polygyrus* (Dujardin,

1845) was first described from European wood mouse, *Apodemus sylvaticus*, under the name *Strongyles polygyrus*. Since then, this species was transferred to the genus *Heligmosomum* by Railliet and Henry (1909), and later to *Heligmosomoides* by Durette-Desset (1968b). On the other hand, Baylis (1926) named the nematodes from wood mouse of England as *Nematospiroides dubius*, which was later synonymized with *Heligmosomoides polygyrus* (Durette-Desset, 1968a, b).

In Nearctic Region, Roe (1929) described *Sincosta aberrans* from a "wild mouse", but this species was then regarded by Dikmans (1940) to be "*Nematospiroides dubius*". Ehrenford (1954) established a strain of "*Nematospiroides dubius*" which was isolated from a deer mouse, *Peromyscus maniculatus*, in California by using the laboratory mouse as experimental host. Then, this strain has been distributed among many institutes and has been used for various parasitological works. However, Forrester (1971) noticed the significant morphological and biological differences between American and European strains, and Durette-Desset *et al.* (1972) examined this nearctic form precisely and considered it as a new subspecies of *H. polygyrus* and named *H. p. bakeri*. This subspecies resembles *H. p. polygyrus* closely, but is distinguished in having the antero-lateral and medio-lateral rays on the left lobe of bursa of almost same length, an increased number of longitudinal cuticular ridges and separated points of spicule. *H. p. bakeri* is also distinguished from *H. p. corsicus* (Durette-Desset, 1968a) in having larger bursa copulatrix, from *H. p. americanus* in lacking an internal branch on the externo-dorsal ray.

The present specimens from *Mus musculus* in Mizushima Port area had morphological features characteristic to *H. p. bakeri*, i.e. many longitudinal ridges, separated points of spicule, large bursa and unbranched externo-dorsal ray. They are also identical morphometrically with the laboratory-reared *H. p. bakeri* although minute discrepancies were observed in some measurements such as the distance from caudal apex to vulva (Table I). So, we identified the present worms with *H. p. bakeri*.

From Japan, two representatives of the genus *Heligmosomoides* have been known so far: *H. desportesii* (Chabaud *et al.*, 1963)

Durette-Desset, 1967 and *H. kobayashii* (Ishimoto, 1974) from *Apodemus argenteus* and *A. speciosus ainu* in North Japan. *H. kobayashii* was first described as *Heligmosomum*, but should be transferred to *Heligmosomoides* since it has only longitudinal cuticular ridges. This species was also found in *Apodemus speciosus speciosus* in Central Japan (Shogaki *et al.*, 1976; Hasegawa and Otsuru, 1982). *H. desportesii* differs from *H. p. bakeri* in having a branch on the externo-dorsal ray. *H. kobayashii* is also easily distinguished by the longer spicule, more than 2 mm in length.

On the origin of North American *Heligmosomoides polygyrus*, Durette-Desset *et al.* (1972) proposed a hypothesis that the nearctic subspecies were derived from European subspecies which were introduced to North America in very recent period by mice on the transatlantic ships. If this hypothesis is true, it is supposed that the present worms were derived from *H. p. bakeri* introduced with mice from North America because they possessed morphological characteristics identical with those of the nearctic subspecies. Mizushima Port opened in April, 1963 and has been harboured by more than one thousand ships, about a half of which transported beans and grains, from USA so far. We speculate that some mice escaped from such ships might 'import' the nematodes to Mizushima Port area.

### Summary

*Heligmosomoides polygyrus bakeri* Durette-Desset *et al.*, 1972 was first recorded from mice in Japan. 50.8% of mice collected in Mizushima Port area, Okayama, were infected with this nematode. Morphological characteristics were described and figured. This subspecies was thought to be introduced to Japan with mice transported from North America by ships.

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### 日本で初めて見出された *Heligmosomoides polygyrus* (Nematoda: Heligmosomidae)

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1982年5月から1983年5月までの間に、岡山県水島港地域で捕獲された130頭のハツカネズミ *Mus musculus* 中、66頭(50.8%)に、*Heligmosomoides* 属線虫の寄生を認めた。形態学的検討の結果、本種は *Heligmosomoides polygyrus bakeri* Durette-Desset

*et al.*, 1972 と同定された。これまで同種が本邦産ハツカネズミから見出された記録はなく、恐らく船舶に便乗したハツカネズミによって北米から移入され、水島港地域に定着したものと推測された。