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NIPPOSTRONGYLUS SEMBELI, NEW SPECIES (NEMATODA: HELIGMONELLIDAE) COLLECTED FROM *RATTUS XANTHURUS* OF NORTH SULAWESI, INDONESIA

H. Hasegawa and **D. Tarore**

ABSTRACT. - *Nippostrongylus sembeli*, new species (Nematoda: Trichostrongyloidea: Heligmonellidae) was collected from the small intestine of *Rattus xanthurus* (Rodentia: Muridae) in North Sulawesi, Indonesia. This species is closely allied to *N. typicus* and *N. magnus* of Australian murids and *N. marhaeniae* of Moluccas endemic rat in that the left ray 8 is derived from more distal level of the trunk of dorsal ray than the right ray 8, but is easily distinguished from them in that the left rays 6 and 8 are crossed. The morphological resemblance among the endemic *Nippostrongylus* species known from the areas east of Wallace's line suggests their close phylogenetic relationship.

INTRODUCTION

Sulawesi Island, Indonesia, is a famous zoogeographical transitional area between the Oriental and Australian regions. This island has been isolated from the both regions for long time enough for speciation of numerous endemic animals. The murid fauna on this island is composed of 47 species among 14 genera of which 10 genera are endemic (Musser & Holden, 1991). The endemic murines east of Wallace's line have been known to harbour trichostrongyloid nematodes of zoogeographical interest (cf. Mawson, 1961; Durette-Desset, 1985; Hasegawa & Syafruddin, 1994a, b, 1995). During a medicozoological survey in Indonesia, 1991, a trichostrongyloid species belonging to the genus *Nippostrongylus* Lane, 1923 was found from an endemic rat, *Rattus xanthurus*, captured at Mooat, North Sulawesi. Close examination has revealed that this species is new to science, and is described herein.

MATERIALS AND METHODS

Rats were purchased from the farmers, who captured them with traditional snap traps for food. They were dissected and their viscera were fixed and preserved in 10% formalin solution,

Hideo Hasegawa - Department of Parasitology and Research Center of Comprehensive Medicine, Faculty of Medicine, University of the Ryukyus, Nishihara, Okinawa 903-01, Japan. **Dantje Tarore** - Department of Entomology, Faculty of Agriculture, Sam Ratulangi University, Manado 95115, Indonesia

and transported to the laboratory. Then, the alimentary canals were cut open and examined for nematodes under a dissecting microscope. Detected nematodes were rinsed in 70% ethanol, and cleared with glycerol-alcohol solution for microscopical examination. Freehand cross sections were made for observation of the synlophe. Figures were made with the aid of a drawing tube. Measurements, in micrometers unless otherwise stated, given are for the holotype male and the allotype female, followed in parentheses by the range of paratype males and females. The terminology of the bursal structure and synlophe follows Durette-Desset & Chabaud (1981) and Durette-Desset (1983), respectively.

DESCRIPTION

Nippostrongylus sembeli, new species
(Figs. 1-12)

General. - Small red worm, forming sinistral coils on ventral surface. Anterior end with cephalic vesicle (Figs. 1, 2). Mouth triangular (Fig. 1). Four large cephalic papillae, 6 small labial papillae and amphidial pores present (Fig. 1). Cuticle finely striated. Synlophe well developed with pointed ridges, commencing posterior to cephalic vesicle (Fig. 2) and ending slightly anterior to bursa in male (Figs. 6, 7) and at vulval level in female (Fig. 12). In midbody of both sexes 14 ridges present, carene of type A present; axis of orientation of ridges passing from ventral-right to dorsal-left sides, inclined about 45° from sagittal axis; dorsal-right and ventral-left ridges well developed, ventral-right ridges less developed (Figs. 3, 10). Oesophagus club-shaped (Fig. 2). Nerve ring posterior to midoesophagus, excretory pore at midpoint between nerve ring and posterior end of oesophagus, and deirids at level of excretory pore (Fig. 2).

Male (holotype and 7 paratypes). - Length 3.99 (3.37-4.22) mm, width at midbody 118 (90-109). Cephalic vesicle 64 (58-67) long by 38 (34-43) wide. Nerve ring 188 (158-230), excretory pore 271 (218-319) and deirids 271 (225-314) from cephalic end. Oesophagus 336 (294-350) long and 32 (24-31) wide near posterior end. Bursa asymmetrical, right lobe larger than left lobe; bursal rays except rays 6 and 8 in right lobe thicker than corresponding ones in left lobe; bursal rays except right ray 8 and left rays 2, 4 and 5 terminating near bursal rim (Fig. 9). Right lobe: rays 2 and 3 widely divergent; ray 2 slightly longer than ray 3; rays 4 and 5 thick, divergent distally; ray 6 short, small, arising from base of ray 5, divergent widely from ray 5; ray 8 thin, arising from proximal half of trunk of dorsal ray (Figs. 6, 9). Left lobe: rays 2 and 3 divergent, ray 2 shorter than ray 3; rays 4 and 5 directed ventrally and diverging distally; ray 4 shorter than ray 3 but longer than ray 5; ray 6 thickest, directed laterally crossing with ray 8 through ventral side; ray 8 arising from distal half of trunk of dorsal ray, thicker and longer than right ray 8 (Figs. 7, 9). Dorsal ray with thick trunk, divided at distal 2/3 into 2 branches each of which again divided into rays 9 and 10; ray 10 provided with 2 papillae distally (Fig. 9). Genital cone protruded prominently, with papillae zero and 7 (Figs. 8, 9). Spicules equal in length, with thin alae, tips recurved forming small hook, 575 (528-610) long (i.e. 13-16% of worm length) (Figs. 6, 8, 9). Gubernaculum boat-shaped, 40 (32-54) long (Figs. 6, 8, 9).

Female (allotype and 10 paratypes). - Length 6.16 (5.33-6.38) mm, width at midbody 122 (102-137). Cephalic vesicle 69 (59-78) long by 42 (38-48) wide. Nerve ring 210 (174-242), excretory pore 290 (236-320) and deirids 300 (243-339) from cephalic end. Oesophagus 332 (310-388) long and 34 (29-35) wide near posterior end. Vulva 72 (59-78) and anus 32 (29-

43) from caudal end (Fig. 12). Postvulval body bent ventrally (Fig. 12). Vagina vera 25 (19-36) long; vestibule 88 (77-101) long; sphincter 31 (29-41) long; infundibulum 117 (88-159) long (Fig. 12). Cuticule between vulva and anus distended forming small invagination (Fig. 12). Tail conical, with round tip (Fig. 12). Eggs ellipsoidal, thin-shelled, containing morula-stage embryos, and 55-71 by 33-39 (Fig. 12).

Type host. - *Rattus xanthurus* (Muridae: Murinae).

Site. - Small intestine.

Type locality. - Mooat (0°46'12"N 124°27'50"E; 1050m elevation), North Sulawesi, Indonesia.

Date of collection. - 3 August 1991.

Prevalence. - 6 out of 11 *R. xanthurus* harboured *N. sembeli.*

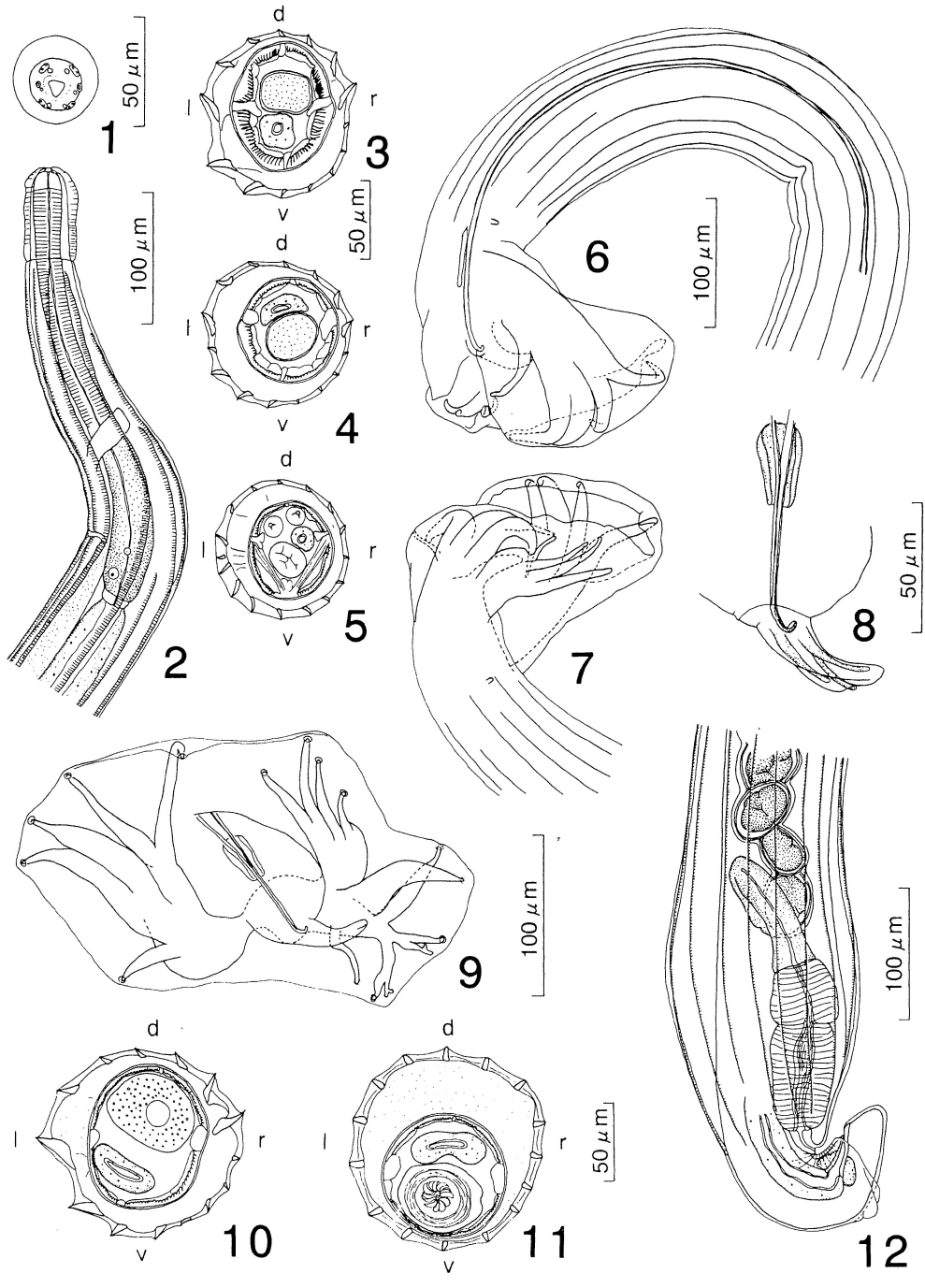
Etymology. - The species name is dedicated to Dr. D. Sembel, Sam Ratulangi University, Manado, Indonesia.

Type specimens. - Museum Zoologi Bogor, Bogor, Indonesia, MZB Ne-261 (holotype and allotype), MZB Ne-262 (3 male and 5 female paratypes), British Museum (Natural History), London, U.K. BM1992.2394-2402 (4 male and 5 female paratypes).

Remarks. - The present species has every morphological feature of the genus *Nippostrongylus* Lane, 1923 (Durette-Desset, 1970, 1983). *Nippostrongylus sembeli* resembles *N. typicus* (Mawson,1961), *N. magnus* (Mawson, 1961) and *N. marhaeniae* Hasegawa & Syafruddin, 1995, in that the left ray 8 is derived from more distal level of the trunk of dorsal ray than the right ray 8 (Mawson, 1961; Beveridge & Durette-Desset, 1992; Hasegawa & Syafruddin, 1995). It differs from *N. marhaeniae* because the latter species has only 12 ridges in midbody of both sexes and almost straight distal ends of the spicules (Hasegawa & Syafruddin, 1995). The present species is closely allied to *N. typicus* and *N. magnus* in having a recurved distal end of the spicule, but is readily distinguished in having a much longer left ray 8 that is crossed with the left ray 6 (Mawson, 1961; Beveridge & Durette-Desset, 1992).

DISCUSSION

Among the heligmonellid genera parasitic in the digestive tract of murines, only *Nippostrongylus* has been known from a wide geographical range through Sundashelf, Sulawesi, Moluccas and Australia (Durette-Desset, 1969, 1971, 1983; Hasegawa & Syafruddin, 1995). Besides *N. brasiliensis*, the cosmopolitan parasite of commensal rats, 5 representatives of the genus have been recorded from the areas east of Wallace's line: 1. *N. typicus* from *Rattus assimilis* and *Rattus sordidus* of Australia, 2. *N. magnus* from *R. assimilis*, *R. sordidus*, *Rattus fuscipes*, *Rattus rattus*, *Rattus norvegicus* and *Melomys cervinipes* of Australia, 3. *N. rauschi* from *Cynocephalus volans* of Philippines, 4. *N. marhaeniae* from *Rattus* cf. *morotaiensis* on Halmahera Island, North Moluccas and 5. *N. sembeli* from *R. xanthurus* of Sulawesi (Mawson, 1961; Durette-Desset, 1971; Obendorf, 1979; Smales, 1992; Beveridge & Durette-Desset, 1992; Hasegawa & Syafruddin, 1995). These species except *N. rauschi* from the dermopteran are principally parasitic in the



Figs. 1-12. *Nippostrongylus sembeli*, new species, from *Rattus xanthurus* of North Sulawesi, Indonesia. 1. Cephalic extremity of male, apical view. 2. Anterior part of holotype, left lateral view. 3-5. Cross sections of male in midbody (3), slightly anterior to spicules (4) and slightly anterior to prebursal papillae (5). 6,7. Posterior part of holotype, right lateral (6) and left lateral (7) views. 8. Genital cone, distal ends of spicules and gubernaculum, ventral view. 9. Bursa copulatrix, ventral view. 10, 11. Cross sections of female through midbody (10) and vestibule (11). 12. Posterior part of allotype, right lateral view. Abbreviations: d. dorsal; l. left; r. right; v. ventral.

endemic rats in the each area. Although *N. magnus* has been also recorded from the commensal rats, it is considered that this nematode has adapted them secondarily.

These endemic murines that harbour the *Nippostrongylus* species in the areas east of Wallace's line belong to clusters that are different from those in Sundashelf (cf. Musser, 1987; Musser & Carleton, 1993). Apparently they have ancient origins in the Asian continent and have speciated in the isolated environments. Durette-Desset (1985) considered that *Nippostrongylus* was derived from an *Orientostrongylus*-like ancestor in the upper Pliocene when the Murinae radiated in the Oriental and Australian regions. It is of interest that the four endemic *Nippostrongylus* in the areas east of Wallace's line have a common morphological characteristic that the left ray 8 is arising more distally than the right one. Moreover, three of them have distally-recurved spicules. It is therefore strongly suggested that they have originated from a common ancestor in Sundashelf, have been introduced into each area by the ancestors of the endemic murines and have speciated. Because only a limited species of the endemic murines of east of Wallace's line have been examined parasitologically, it is strongly expected that there are still many undescribed *Nippostrongylus* species, that would provide fruitful informations on the evolution of thrichostrongyloids, in the endemic murines of New Guinea, Lesser Sunda and Philippines.

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