TRICHOSTRONGYLINA (NEMATODA) FROM MALAGASY MURIDAE. I - DESCRIPTION OF TWO NEW SPECIES OF HELIGMONELLIDAE IN *NESOMYS* SPP.

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Summary :

Two new species of Heligmonellidae, *Heligmonina wrightae* n.sp. (Nippostrongylinae) and *Nesomystrongylus fissicauda* n.gen., n. sp. (Brevistriatinae) are described from Madagascar in *Nesomys rufus* and *N. audeberti* (Muridae). In *Nesomys audeberti*, the species are coparasites. *Heligmonina wrightae* is differentiated from all the other species of the genus, except *H. malacomysi* Sakka & Durette-Desset, 1988, by the ratio of the length of the spicules on the length of the body (25-27.8 % versus 9.5-7 %). It differs from *H. malacomysi* by the pattern of the caudal bursa and by the angle of the axis of orientation of the cuticular ridges on the sagittal axis. *Nesomystrongylus fissicauda* is related to the genus *Fissicauda* Durette-Desset & Krishnasamy, 1976, by the absence of the carene, by the ridges discontinuous on all the sides of the body and by the deeply divided dorsal ray. It differs from this genus by a different structure of the ridges, by the pattern of the caudal bursa, (very tiny rays 2 and strongly developed rays 3, rays 8 arising from common trunk of rays 2 to 6) and by the presence of a caudal tip in the female.

KEY WORDS : *Heligmonina wrightae* n. sp., *Nesomystrongylus fissicauda* n. gen., n. sp. Trichostrongylina, Heligmonellidae, Brevistriatinae, Nippostrongylinae, *Nesomys audeberti*, *Nesomys rufus*, Muridae, Madagascar.

Résumé : TRICHOSTRONGYLINA (NEMATODA) PARASITES DE MURIDÉS MALGACHES. I- DESCRIPTION DE DEUX NOUVELLES ESPÈCES D'HELIGMONELLIDAE CHEZ *NESOMYS* SPP.

Deux nouveaux Heligmonellidae, *Heligmonina wrightae* n. sp. (Nippostrongylinae) et *Nesomystrongylus fissicauda* n. gen., n. sp. (Brevistriatinae) sont décrits à Madagascar chez *Nesomys rufus* et *N. audeberti*. Les deux espèces sont coparasites chez *Nesomys audeberti*. *Heligmonina wrightae* se différencie de toutes les espèces du genre, à l'exception d'*H. malacomysi* Sakka et Durette-Desset, 1988, par le rapport de la longueur des spicules sur la longueur du corps (25-27.8 % contre 9.5-17 %). Elle se distingue d'*H. malacomysi* par le type de bourse caudale et par l'inclinaison de l'axe d'orientation des crêtes cuticulaires sur l'axe sagittal. *Nesomystrongylus fissicauda* se rapproche du genre *Fissicauda* Durette-Desset et Krishnasamy, 1976, par l'absence de la carène, par des crêtes interrompues sur toute les faces du corps et par la profonde division de la côte dorsale. Elle s'éloigne de ce genre par la structure particulière des crêtes cuticulaires, par le type de la bourse caudale (côtes 2 grêles et côtes 3 très développées, côtes 8 naissant sur le tronc commun aux côtes 2 à 6) et par la présence d'une pointe caudale chez la femelle.

MOTS CLÉS : *Heligmonina wrightae* n. sp., *Nesomystrongylus fissicauda* n. gen., n. sp., Trichostrongylina, Heligmonellidae, Brevistriatinae, Nippostrongylinae, *Nesomys audeberti*, *Nesomys rufus*, Muridae, Madagascar.

INTRODUCTION

The present study is part of a project on the potential effects of endoparasites introduced by the non-native black rat *Rattus rattus* on the endemic small mammals in Madagascar. The authors carry put the project in collaboration with J.P. Hugot (Muséum National d'Histoire Naturelle, France), J. Laakkonen (University of California, USA) and H. Ramiarinjanahary (University of Diantananarivo, Madagascar). We have found several new, host-specific species of nematodes from native rodents which belong to the

sub-family Nesomyinae (Muridae) as defined by Musser & Carleton (1993).

Previously gastrointestinal helminths were studied from four species of nesomyine rodents, i.e. *Hypogeomys antimena*, *Gymnuromys roberti*, *Brachyuromys ramirohitra* and *B. betsiloensis* (Chabaud *et al.*, 1967; Quentin & Durette-Desset, 1974; Durette-Desset & Chabaud, 1992), but not from the genera *Nesomys* and *Eliurus*. The aim of this work is to describe two new species of Trichostrongylina found in *Nesomys* spp. The conclusions concerning the Trichostrongylina will be presented when the taxonomical analysis of the trichostrongylid fauna is completed. General conclusions and the summary of the project will be published elsewhere when all the parasitic fauna is analysed.

MATERIAL AND METHODS

Rodent hosts were collected in Vevembe forest in southeastern Madagascar between 12 and 15 December, 1995 and in Ranomafana

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National Park in southeastern Madagascar between 15 September and 3 December 1998. The gastrointestinal tract was preserved in 70 % ethanol or buffered 10% formalin in the field. Later the stomach, small intestine, caecum and rectum were examined for helminths. The small intestine was divided in ten sections of equivalent length, numbered SI 1 to SI 10 from the pyloric valve to the ileo-caecal junction. The helminths were stored in 70 % ethanol.

The nomenclature used above the family-group is that of Durette-Desset & Chabaud (1993). The synlophe was studied following the method of Durette-Desset (1985), and the nomenclature used for the study of the caudal bursa is that of Durette-Desset & Chabaud (1981). Measurements are in micrometres except where stated otherwise. Type specimens were deposited in the Helminthological Collections of the Muséum national d'Histoire naturelle, Paris, France (MNHN).

HELIGMONINA WRIGHTAE N. SP.

Material studied : holotype male, allotype female MNHN 194 MQa, 19 male, 23 female paratypes, MNHN 194 MQb.

Host: *Nesomys rufus* Peters, 1870 (Muridae) immature male.

Site: small intestine (SI 1-SI 6).

Geographical origin: Ranomafana National Park, Madagascar; 11 November 1998, coll: J. T. Lehtonen.

Other material: one male, seven females, a posterior part of female, MNHN 196 MQa, parasites of the small intestine (SI 1- SI 4) of *Nesomys audeberti* (Jentink, 1879) male in Vevembe, Madagascar; 13 December 1995, coll: J. Jernvall, coparasites of *Nesomysstrongylus fissicauda* n. gen., n. sp.

DESCRIPTION

Very small nematodes with body uncoiled or coiled only in its anterior part. Excretory pore within third posterior part of oesophagus on average. Deirids situated at same level as excretory pore.

Head: Cephalic vesicle present. In apical view, rounded buccal opening surrounded by two amphids, four externo labial papillae and four cephalic papillae (Fig. 1B).

Synlophe: (studied in one male and one female paratype) (Fig. 1C-H). In both sexes, cuticle bears longitudinally continuous ridges. Ridges appearing at different levels posterior to cephalic vesicle and disappearing at about 100 anterior to caudal bursa in male and anterior to vulva in female.

Presence of carene made up of hypertrophied left ridge and well developed right ridge (compared to the other ridges) joined by a chitinous bridge. In posterior part of female, bridge disappears and right ridges

decrease in size (Fig. 1F). Number of ridges: at level of oesophago-intestinal junction, 12 (carene, 3 strongly developed left ventral, 2 right ventral, 5 dorsal) (Fig. 1C). At mid-body in male, 12 (carene, 2 strongly developed left ventral, 3 right ventral, 5 dorsal) (Fig. 1G); in female, 11 (carene, 2 strongly developed left ventral, 2 right ventral, 5 dorsal) (Fig. 1D). In posterior part of body in both sexes, 13 (carene, 6 ventral, 5 dorsal) with progressive decreasing of size of 2 left ventral ridges and appearance of 1 (male), 2 (female) ventral ridges (Fig. 1E, H). Just above vulvar opening, 13 (left ala, 5 ventral, 7 dorsal) with appearance of one new dorsal ridge (Fig. 1F). Ridges of unequal size. At mid-body, right dorsal ridges more developed than left ones.

At mid-body, ridges orientated at 60° on sagittal axis and directed from right ventral to left dorsal side (Fig. 1D, G).

Holotype male: 2.0 mm long and 40 wide at mid-body, including carene 22 long; cephalic vesicle 30 long by 22 wide; nerve ring, excretory pore and deirids situated at 95, 140 and 145 from apex, respectively; oesophagus 270 long. Ratio of position of excretory pore on oesophagus length, 82 %.

Strongly asymmetrical caudal bursa with left lateral lobe more developed and pattern of type 1-3-1 (rays 2 and 6 separating first from common trunk of rays 2 to 6) (Fig. 1K). Rays 2 and 3 totally separated up to their base. Rays 4 and 5 thick, strongly divergent at distal third. Spindly rays 6. Rays 8 arising from proximal third of dorsal ray at varying levels (Fig. 1I, K). Dorsal ray divided at mid length into two branches, each branch giving rise to 2 small branches, rays 9 (external branches) being thicker and slightly longer than rays 10 (internal branches).

Filiform, alate spicules, 490 long, with sharp extremities (Fig. 1J, K). Ratio of spicule length on body length: 24 %. Genital cone with linguiform papilla zero and 2 rounded papillae 7 (Fig. 1J). Gubernaculum absent.

Main measurements (average and range of ten paratype males): body 1.9 (1.6-2.1) mm long; excretory pore 175 (140-210) from apex; oesophagus 229 (200-285) long; ratio of position of excretory pore on oesophagus length, 76.4 % (61.5-95) %; spicules 465 (370-530) long, ratio of spicule length on body length 24.5 (17.6-27.9) %.

Allotype female: 2.0 mm long and 100 wide at mid-body, including carene 25 long. Cephalic vesicle 40 long by 25 wide; nerve ring, excretory pore and deirids situated at 110, 150 and 150 from apex, respectively; oesophagus 240 long (Fig. 1A). Ratio of position of excretory pore on oesophagus length, 62.5 %.

Fig.1- *Heligmonina wrightae* n. sp. A, female, anterior extremity, right lateral view; B, female, head, apical view; C-H, cuticular ridges, transverse sections, C-F, female, C, at the beginning of the intestine, D, at mid-body, E, at 900 from caudal extremity, F, at 100 from vulvar opening; G, H, male, G, at mid-body, H, in front of caudal bursa; I, male, arising of rays 8, dorsal view; J, male, genital cone, right lateral view; K, other male, caudal bursa, ventral view; L, female, posterior extremity, right lateral view. Transverse sections orientated as figure 1, D.

Abbreviations : V, ventral side; L, left side.

Monodelphy: vulva at 90 from caudal extremity. *Vagina vera* 30 long. Ovejector 178 long with vestibule 70, sphincter 38 long by 20 wide and infundibulum 70 long (Fig. 1L). Uterus 380 long with 5 eggs, 50 long by 30 wide at 2 blastomere stage near vulva. Ratio of uterus length on body length: 19 %. Tail 35 long with rounded extremity (Fig. 1L).

Main measurements (average and range of ten paratype females): body 2.2 (1.8-2.4) mm long; excretory pore 168 (150-180) from apex; oesophagus 242 (200-270) long; ratio of position of excretory pore on oesophagus length, 69.3 % (61.2- 77.3) %; vulva at 104 (80-130) from caudal extremity; vestibule 84 (65-90) long; sphincter 28 (20-30) long by 31 (25-40) wide; infundibulum observed only in three specimens, 97 (90-100) long; uterus 440 (350-550) long with 5 (3-7) eggs 62 (50-70) long by 33 (30-40) wide; tail 38 (35-40) long; ratio of uterus length on body length: 20 (16.2-27.8) %.

DIAGNOSIS

These specimens belong to the genus *Heligmonina* Baylis, 1928 (Heligmosomoidea, Heligmonellidae, Nippostrongylinae), redefined by Durette-Desset (1971). This genus, mainly characterised by one left hypertrophied ridge in both sexes, occurs in the Muridae from Africa and Madagascar. Sixteen species were described, 14 from Africa of which 12 are parasites of Murinae, one both from Murinae and Cricetomyinae, one of Cricetomyinae and two species from Madagascar parasites of Nesomyinae.

In the genus *Heligmonina*, the pattern of the caudal bursa is variable (1-3-1, 1-4, 2-2-1...) and can be different for each lobe. Five species of *Heligmonina*, including the specimens described above have the pattern of type 1-3-1 for each lobe. It concerns with *H. betsiloensis* Quentin & Durette-Desset, 1974, a parasite of *Brachyuromys betsiloensis* from Madagascar and two parasites from Africa: *H. chabaudi* (Desset, 1964), a parasite of *Mastomys natalensis* and *Lemniscomys striatus* from the Central African Republic, *H. possompesi* (Durette-Desset, 1966) a parasite of *Mus (Leggada) minutoides* from the Central African Republic and *H. praomyos* Baylis, 1928, a parasite of *Praomys tulbergi* from Niger. The specimens described above are differentiated from these species by strongly divergent extremities of rays 4 and 5.

Among the species with known synlophe, three species are related to the Malagasy specimens: *H. malacomys* Sakka & Durette-Desset, 1988, a parasite of *Malacomys longipes* from the Central African Republic, *H. albignaci* Quentin & Durette-Desset, 1974, a parasite of *Brachyuromys betsiloensis* from Madagascar and *H. betsiloensis*. *H. malacomys* and *H. albignaci* possess ventral comaretes, *H. albignaci* and *H. betsiloensis* possess a carene at mid-body. Therefore, the axis of

orientation of the cuticular ridges at mid-body is subfrontal in *H. betsiloensis*, inclined at 70° on sagittal axis in *H. albignaci*, 45° (male), 50° (female) in *H. malacomys* versus 60° in the Malagasy specimens.

The specimens from Madagascar are also differentiated from all the other species, except *H. malacomysi* by the ratio of the length of the spicules on the length of the body. This ratio varies between 9.5 % and 17 % within the species of *Heligmonina*. It is 25 % in *H. malacomys* and 17.6-27.9 % in the specimens from Madagascar.

The new species is named *Heligmonina wrightae* n. sp. after Patricia Wright and in appreciation of her achievements in lemur and biodiversity conservation and research in Madagascar.

NESOMYSTRONGYLUS FISSICAUDA N. GEN., N. SP.

Studied material: holotype male, allotype female MNHN 196 MQb, 3 male, 7 female paratypes, MNHN 196 MQc, coparasites of *Heligmonina wrightae* n. sp. Host: *Nesomys audeberti* (Jentink, 1879) (Muridae) male.

Site: small intestine (SI 1- SI 4).

Geographical origin: Veveombe, Madagascar, December 1995, coll. J. Jernvall.

Other material: 1 male, 1 anterior part of female MNHN 190 MQ, parasites of the stomach of *Nesomys rufus* in Ranomafana National Park, 10 November 1998, coll: J.T. Lehtonen.

DESCRIPTION

Very small nematodes with body uncoiled or coiled only in its anterior part. Excretory pore situated at midway between nerve ring and end of oesophagus. Deirids situated at same level as excretory pore, setiform with rectangular basis (Fig. 2K).

Head: Cephalic vesicle present, strongly striated and slightly longer on dorsal side. In apical view, rounded oral opening surrounded by two amphids, four externo labial papillae and four cephalic papillae. Oesophageal dorsal gland well developed (Fig. 2A').

Synlophe: (studied in one male and one female paratype). In both sexes, body bearing ridges regularly interrupted and set out in alternate series (Fig. 2B, C). Ridges appearing behind cephalic vesicle and disappearing in front of caudal bursa in male and vulvar opening in female. In transverse sections, strut of each ridge ending in small tip apparently extending outside cuticle. Number of ridges: at oesophago-intestinal junction, 20 (10 dorsal, 10 ventral) in both sexes, at mid-body, 21 (10 dorsal, 11 ventral) in males (Fig. 2G) and 25 (12 dorsal, 13 ventral) in female (Fig. 2F). Ridges disappearing about 50 above caudal bursa in male and at level of infundibulum in female. Ridges of similar

Fig. 2. — *Nesomystrongylus fissicauda* n. gen., n. sp. A-E, female, A, anterior extremity, right lateral view, A', head, apical view; B, C, beginning of cuticular ridges, respectively left lateral and ventral view, D, caudal extremity with spine, left lateral view, E, posterior extremity, left lateral view; F-G, cuticular ridges, transverse sections at mid-body. F, female, G, male; H-J, caudal bursa of male, H, right lobe, ventral view, I, left lobe, latero dorsal view, J, left lobe, ventral view; K, female, detail of the deirids and the excretory pore, ventral view; L, male, caudal bursa, ventral view; M, male, detail of the dorsal ray and rays 8, dorsal view; N, male, tips of the spicules, ventral view. Transverse sections orientated as figure 2, F. Abbreviations: V, ventral side; L, left side.

size, slightly smaller in front of left lateral field, orientated from right to left, according to a sub-frontal axis. Holotype male: 2.0 mm long and 40 wide at mid-body; cephalic vesicle 53 long by 25 wide; nerve ring, excretory pore and deirids situated at 163, 230 and 235 from apex, respectively; oesophagus 320 long.

Caudal bursa symmetrical, of very particular pattern: very short rays 2 separated from common trunk belonging to rays 2 to 8, arising at same level as dorsal ray on common trunk (Fig. 2H-J). Rays 3 strongly developed; length of rays decreasing from rays 3 to rays 8. Dorsal ray deeply divided almost up to its base (Fig. 2L, M). Each branch divided at its distal part into two branches, each one giving rise to 2 small twigs, rays 9 (external) and rays 10 (internal) (Fig. 2M).

Filiform, alate spicules, 300 long, each ending in sharp tip (Fig. 2N). Genital cone discrete, 25 long and 15 wide with two small round papillae 7. Papilla zero not observed. Gubernaculum 12 long and 10 wide (Fig. 2L). Main measurements (average and range of the three paratypes): body: 2.02 (2.0 - 2.05) mm long and 42 (40-45) wide; cephalic vesicle: 50 (48-52) long by 20 (20-20) wide; nerve ring, excretory pore and deirids situated at 148 (130-150), 215 (175-240), 225 (185-250) from apex, respectively; oesophagus 300 (260-320) long; spicules 297 (280-310) long.

Allotype female: 2.65 mm long and 50 wide at mid-body. Cephalic vesicle 50 long by 28 wide; nerve ring, excretory pore and deirids situated at 155, 250 and 245 from apex, respectively; oesophagus 360 long (Fig. 2A). Monodelphy: vulva at 162 from caudal extremity. *Vagina vera* 30 long. Ovejector 140 long with vestibule 40, sphincter 20 long by 22 wide and infundibulum 80 long (Fig. 2E). Uterus 360 long with 6 eggs, 55 long by 30 wide at 2 blastomere stage near vulva; ratio of uterus length on body length: 13.4 %. Tail 50 long with caudal spine 12 long (Fig. 2D).

Main measurements (average and range of the seven paratypes): body 2.65 (2.6-2.75) mm long and 47 (40-50) wide; cephalic vesicle 50 (48-55) long by 24.5 (22-28) wide; nerve ring, excretory pore and deirids situated at 162 (150-195), 243 (232-266) and 241 (220-260) from apex, respectively; oesophagus 342 (315-360); vulva at 144 (112-162) from caudal extremity; *vagina vera* 28 (20-30) long; vestibule 42 (40-45) long; sphincter 24 (20-28) long by 26 (20-30) wide; uterus: 393 (260-420) long with 6 (4-7) eggs 53 (46-60) long by 28 (22-30) wide; tail 50 (42-60) long; caudal spine 11.5 (10-12) long; ratio of uterus length on body length: 14.8 (10.0-16.5)%.

DIAGNOSIS

The Malagasy specimens belong to the sub-order Heligmosomoidea by the features of the synlophe which is not symmetrical in relation to the sagittal axis (Durette-

Desset & Chabaud, 1993). Amongst the six families of the sub-order, the presence of discontinuous, alternate ridges likens them most to the Brevistriatinae (Heligmonellidae). They are closely related to the genus *Fissicauda* Durette-Desset & Krishnasamy, 1976, by the absence of the carene, by the ridges being discontinuous on all sides of the body and by the deeply divided dorsal ray. However, in comparison to *Fissicauda*, they possess very particular features: different structure of the ridges; caudal bursa with rays 2 to 6 fanned out and not of type 2-2-1; rays 2 very tiny and rays 3 strongly developed with length decreasing from rays 3 to rays 8; rays 8 arising from common trunk of rays 2 to 6; female tail with a spine. In all the other genera of the Heligmonellidae, the female tail is without a spine.

The new genus is named *Nesomystrongylus* after the host and the new species is named *fissicauda* according to the division of the branches of the caudal bursa. Definition of *Nesomystrongylus* n. gen.: Heligmonellidae, Brevistriatinae with synlophe without carene; ridges interrupted regularly all along body; in transverse section, each ridge ending in a small tip extending outside cuticle; ridges orientated from right to left according to a sub-frontal axis; ridges of similar size. Caudal bursa with rays 2 to 6 fanned out; rays 2 arising at same level as dorsal ray on common trunk; rays 8 arising on common trunk of rays 2 to 6; dorsal ray deeply divided; female tail with spine.

Parasites from Malagasy Nesomyinae (Muridae).

Type and sole species: *Nesomystrongylus fissicauda* n. gen., n. sp.

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