

Two new species of Nippostrongylinae (Nematoda, Trichostrongylina, Heligmonellidae), coparasites of *Mastomys natalensis* (Muridae, Murinae) from Benin

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ABSTRACT

Two new species of Heligmonellidae, coparasites of *Mastomys natalensis* from Benin are described. *Heligmonina kotoensis* n. sp. belongs to the *Heligmonina* species with a 1-3-1 pattern for the right lobe of the caudal bursa and 1-4 for the left lobe. In *H. kotoensis* n. sp., *H. thamnomyisi* (Durette-Desset, 1966) and *H. bignonensis* Diouf, Bâ & Durette-Desset, 1997, the dorsal ray is deeply divided. *Heligmonina kotoensis* n. sp. is differentiated from *H. thamnomyisi* by the strong asymmetry of rays 8 and a different pattern of the synlophe. It is differentiated from *H. bignonensis* by the length of the left ala, which is less than the diameter of the body, by thick left ray 8 and by the length of the vestibule, which is twice as long as the sphincter. *Neohelgmonella lamaensis* n. sp. is related to *N. mastomyisi* Diouf, Bâ & Durette-Desset, 1998 and *N. skirringi* Diouf, Bâ & Durette-Desset, 1998, both parasites of *Mastomys erythroleucus* from Casamance, by the features of the synlophe (dorsal ridge of the carene well developed, no gradient of size of the ridges on the ventral side). *N. lamaensis* n. sp. is differentiated from both species by the

KEY WORDS

Nematoda,
Trichostrongylina,
Heligmosomoidea,
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Nippostrongylinae,
Heligmonina kotoensis n. sp.,
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Muridae,
Benin,
parasites,
new species.

ratio of the length of the spicules to the length of the body and from *N. mastomysi* by the number of cuticular ridges and by rays 8 arising symmetrically from the dorsal ray. It is distinguished from *N. skirringi* by the length of the dorsal ridge of the carene which is smaller than the ventral ridge and by rays 2 and 3 being parallel to the body.

RÉSUMÉ

Deux nouvelles espèces de Nippostrongylinae (Nematoda, Trichostrongylina, Heligmonellidae), coparasites de *Mastomys natalensis* (Muridae, Murinae) au Bénin.

Deux nouvelles espèces d'Heligmonellidae, coparasites de *Mastomys natalensis* au Bénin, sont décrites. *Heligmonina kotoensis* n. sp. appartient aux espèces dont la bourse caudale est de type 1-3-1 pour le lobe droit et 1-4 pour le lobe gauche. Chez *H. kotoensis* n. sp., *H. thamnomysi* (Durette-Desset, 1966) et *H. bignonensis* Diouf, Bâ & Durette-Desset, 1997, la côte dorsale est profondément divisée. *Heligmonina kotoensis* n. sp. se différencie d'*H. thamnomysi* par la forte asymétrie des côtes 8 et par un synlophe différent. Elle se différencie d'*H. bignonensis* par la longueur de l'aile gauche, plus petite que le diamètre du corps, par une côte 8 gauche épaisse et par la longueur du vestibule, deux fois plus longue que celle du sphincter. *Neohelimonella lamaensis* n. sp. est proche de *N. mastomysi* Diouf, Bâ & Durette-Desset, 1998 et de *N. skirringi* Diouf, Bâ & Durette-Desset, 1998, toutes deux parasites de *Mastomys erythroleucus* originaire de Casamance, par les caractères du synlophe (crête dorsale de la carène bien développée, crêtes ventrales sans gradient de taille). *Neohelimonella lamaensis* n. sp. se différencie des deux espèces par le rapport de la longueur des spicules sur la longueur du corps et de *N. mastomysi* par le nombre de crêtes cuticulaires et des côtes 8 naissant symétriquement sur la côte dorsale. Elle se distingue de *N. skirringi* par la longueur de la crête dorsale de la carène, plus petite que la crête ventrale et par des côtes 2 et 3 orientées parallèlement au corps.

MOTS CLÉS

Nematoda,
Trichostrongylina,
Heligmosomoidea,
Heligmonellidae,
Nippostrongylinae,
Heligmonina kotoensis n. sp.,
Neohelimonella lamaensis n. sp.,
Muridae,
Bénin,
parasites,
nouvelles espèces.

INTRODUCTION

Nippostrongylinae Durette-Desset, 1971, Heligmonellidae Skrjabin & Schikobalova, 1952 are widespread in Muridae Illiger, 1815 throughout the World, today. The Ethiopian representatives consist of the closely related genera *Heligmonina* Baylis, 1928 and *Neohelimonella* Durette-Desset, 1970; the genus *Heligmonina* mainly diverging from the genus *Neohelimonella* by the hypertrophy of the

left ventral ridge (Durette-Desset 1971). Heligmosomoid parasites from the small intestine of a single *Mastomys natalensis* from Benin (West Africa) were collected. In the present paper, two new coparasitic species are described, the first belonging to the genus *Heligmonina* and the second to the genus *Neohelimonella*. It is the first record of Nippostrongylinae in this country. To date, *H. chabaudi* (Desset, 1964) is the only Nippostrongylinae described from *Mastomys natalensis*.

MATERIAL AND METHODS

One *Mastomys natalensis* was collected in the village of Koto (Lama Forest) in June 2001 for genetic studies of rodents. Nematodes were collected in the laboratory after killing the host with chloroform. To determine the distribution of the parasites in the small intestine, the intestine was divided into four equivalent parts, numbered SI 1 to SI 4, from the duodenum to the caecum. The worms were fixed in boiling 70% ethanol and stored until required for identification. The nomenclature used above the family group follows 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). The average and range (in parentheses) of the measurements of 10 male and 10 female paratypes are given for both species. Type specimens were deposited in the collections of the Laboratoire de Zoologie des Invertébrés terrestres (ZIT) of the Institut Fondamental d'Afrique Noire C. A. Diop of Senegal (IFAN) and in the Helminthological Collections of the Muséum national d'Histoire naturelle, Paris, France (MNHN). The host nomenclature follows Musser & Carleton (1993).

SYSTEMATICS

Family HELIGMONELLIDAE
Skrjabin & Schikobalova, 1952
Genus *Heligmonina* Baylis, 1928

Heligmonina kotoensis n. sp.
(Fig. 1)

TYPE MATERIAL. — Holotype ♂, allotype ♀, 15.VI.2001, I. A. H. Daouda coll. (MNHN 668 KQa). Paratypes: 15.VI.2001, I. A. H. Daouda coll., 10 ♂♂, 10 ♀♀ (MNHN 668 KQb); 21 ♂♂, 17 ♀♀ (ZIT/IFAN 01 I), coparasites of *Neoheligmella lamaensis* n. sp.

ETYMOLOGY. — After Koto: the name of the forest village where the rodents were captured.

TYPE LOCALITY. — Koto, Republic of Benin.

HOST. — *Mastomys natalensis* (Smith, 1834) (Muridae, Murinae).

SITE. — Small intestine (SI 1-SI 2).

DESCRIPTION

Small nematodes with body uncoiled or slightly coiled along ventral side. Excretory pore situated about at mid-region of oesophagus. Deirids posterior to excretory pore and very distant from it (Fig. 1A). Vestibule twice as long as sphincter. Uterus very short less than 18% of body length.

Synlophe (studied in one male and one female paratypes)

In both sexes, cuticula bearing longitudinal, uninterrupted ridges, all appearing at different levels between cephalic vesicle and end of muscular oesophagus and disappearing anterior to caudal bursal in male. In female, ventral ridges disappearing anterior to vulvar opening, dorsal ridges posterior to vulva. Number of ridges: 11 (six dorsal, four ventral and left hypertrophied) at mid-body (Fig. 1B, C). Double gradient of size decreasing from left to right on ventral side, and from right to left on dorsal side (Fig. 1B, C). In both sexes, tips of ridges orientated from right to left with axis of orientation inclined at about 70° to sagittal axis (Fig. 1B, C). In vulvar region, ridges orientated perpendicularly to body (Fig. 1G).

Holotype male

2.0 mm long, 150 µm wide. Cephalic vesicle 43 µm long, 26 µm wide. Nerve ring, excretory pore and deirids situated at 75 µm, 80 µm and 130 µm from apex, respectively. Oesophagus 225 µm long, with anterior muscular part 85 µm and posterior glandular part 140 µm (Fig. 1A). Asymmetrical caudal bursa with left lateral lobe larger. Pattern of caudal bursa of type 1-3-1 for right lobe and 1-4 for left lobe (ray 2 arising first from common trunk of rays 2 to 6) (Fig. 1F). Prebursal papillae observed only in one specimen (Fig. 1F). Left lobe: rays 2 and 3 separated to their base; rays 3 and 6 separating at same level from common trunk of rays 3 to 6. Rays 4 to 6

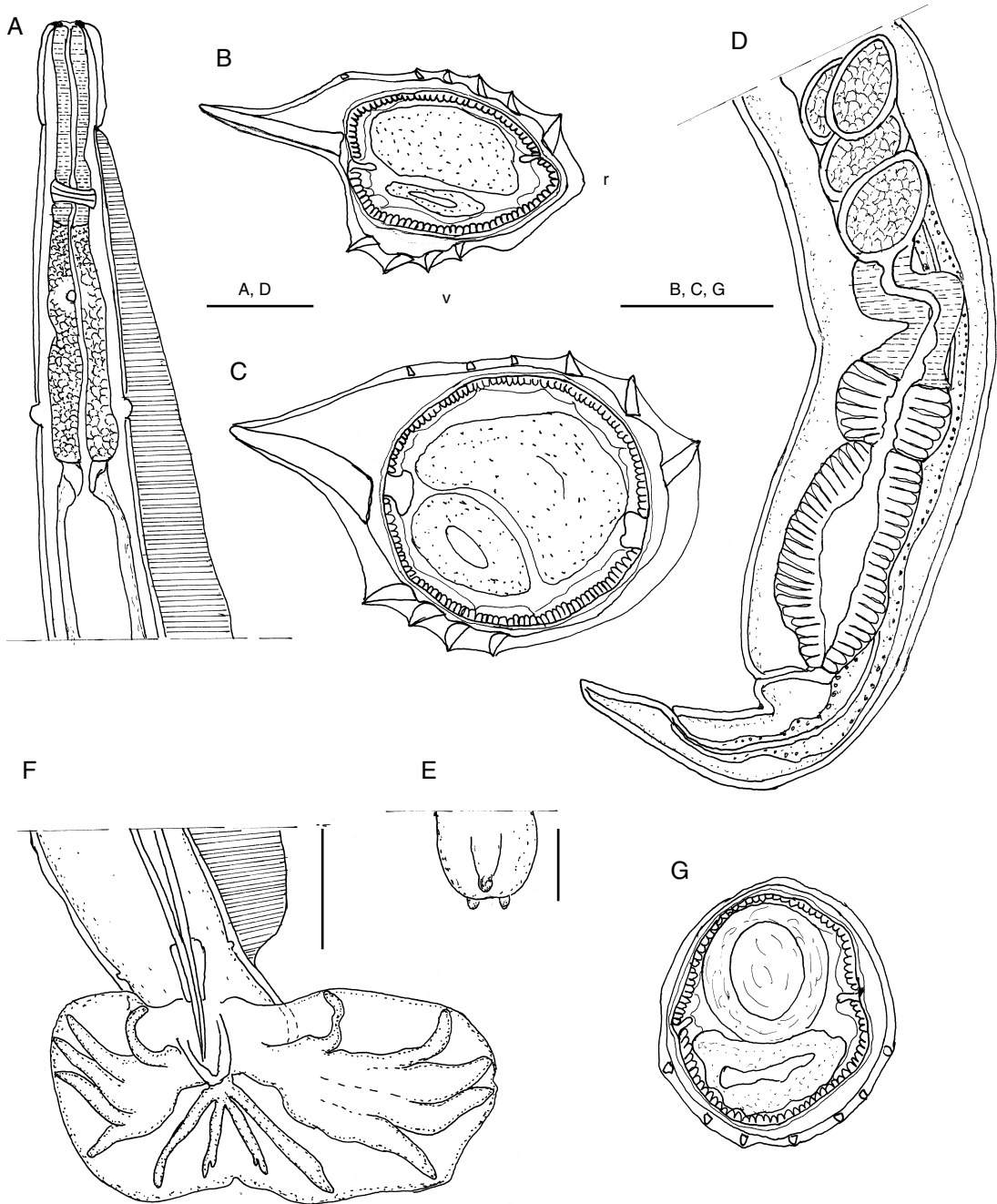


FIG. 1. — *Heligmonina kotoensis* n. sp.; **A**, male, anterior extremity, ventral view; **B**, **C**, transverse sections at mid-body; **B**, male; **C**, female; **D**, female, posterior part, left lateral view; **E**, male, genital cone, ventral view; **F**, male, caudal bursa, ventral view; **G**, female, transverse section of body anterior to vulvar opening. Abbreviations: r, right; v, ventral side. Scale bars: A-D, G, 50 μ m; E, 20 μ m; F, 70 μ m.

thick with ray 4 slightly longer than ray 5. Right lobe: rays 3 to 5 thin, rays 3 and 4 slightly longer than ray 5; ray 6 thin and very short. Rays 8 arising symmetrically at base of dorsal ray, left ray longer, right ray slightly longer than dorsal ray. Dorsal ray deeply divided into two branches at level of rays 8, each branch giving rise to two small branches, rays 9 (external branches) slightly longer than rays 10 (internal branches).

Filiform, alate spicules 350 µm long, with sharp tips. Ratio of spicule length to body length: 17.5%. Rectangular gubernaculum 25 µm long and 15 µm wide at base. Genital cone, 26 µm long and 20 µm wide at base with papilla 0 on ventral lip and small papillae 7 on dorsal lip (Fig. 1E).

Allotype female

3.6 mm long, 125 µm wide. Cephalic vesicle 50 µm long, 30 µm wide. Nerve ring, excretory pore, and deirids 95 µm, 185 µm and 245 µm from apex, respectively. Oesophagus 345 µm long with anterior muscular part 145 µm and posterior glandular part 200 µm. Monodelphic (Fig. 1D): vulva situated at 140 µm from caudal extremity with *vagina vera* 30 µm long. Ovejector 195 µm long with vestibule 90 µm long, sphincter, 35 µm long by 50 µm wide and infundibulum 70 µm long. Uterus 620 µm long with 17 eggs, at morula stage, 60 µm long and 40 µm wide. Tail 50 µm long. Ratio of uterus length to body length 17.2%.

Measurements

Males (10 paratypes). Body: 2.02 (1.75-2.30) mm long; excretory pore situated at 111 (65-165) µm from apex; oesophagus: 216 (190-240) µm long; spicules: 340 (320-375) µm long, ratio of spicule length to body length: 16.8% (17-18.2).

Females (10 paratypes). Body 3.3 (2.5-3.7) mm long; excretory pore situated at 181 (115-230) µm from apex; oesophagus 315 (260-380) µm long; vulva situated at 122 (90-155) µm from caudal extremity; ovejector 199 (150-240) µm long with vestibule 84 (55-110) µm long; sphincter 36 (25-40) µm long, 44 (30-60) µm wide;

infundibulum 76 (65-85) µm long; uterus 546 (510-650) µm long with 13 (8-18) eggs, 67 (59-75) µm long and 41 (37-45) µm wide; tail 46 (41-50) µm long; ratio of uterus length to body length 16.3% (13.2-17.2).

DISCUSSION

The specimens described above possess the principal features of the genus *Heligmonina* as redefined by Durette-Desset (1971) with, in particular, a hypertrophied ala. To date, 20 species have been described in the genus, all parasites of Muridae, 15 in Africa and five in Madagascar.

In this genus, in contrast to other Trichostrongylina, the pattern of the caudal bursa varies greatly (1-3-1, 1-4, 2-2-1, etc.) and can differ for each lobe.

The parasites of *Mastomys* belong to the species with a pattern of type 1-3-1 on the right lobe and 1-4 on the left lobe. Among these species, only two, *H. thamnomyisi* (Durette-Desset, 1966), a parasite of *Grammomys rutilans* (Peters, 1976) and *Cricetomys gambianus* Waterhouse, 1840 from the Republic of Central Africa and *H. bignonensis* Diouf, Bâ & Durette-Desset, 1997, a parasite of *Mastomys erythroleucis* (Temminck, 1853) from the Republic of Senegal, resemble our specimens, with a very deep division of the dorsal ray. *H. thamnomyisi* is differentiated by the strong asymmetry of rays 8 and by the pattern of the synlophe i.e. in the female, three ventral ridges and in the male, at mid-body, a left ala larger than twice the diameter of the body. *H. bignonensis* is the most closely related species. It is distinguished by a very short vestibule which is slightly longer than the sphincter, by thin rays 8 and by the length of the left ala, which is longer than the diameter of the body in male and of equivalent size in female.

Heligmonina chabaudi (Desset, 1964) is also a parasite of *Mastomys natalensis* described in Congo and Centrafrican Republic and of *Lemniscomys striatus* described in Congo. The synlophe is similar to that of the specimens described above but it differs immediately from them by the pattern of the caudal bursa which is of type 1-3-1 for both lobes.

We consider the specimens of *Mastomys natalensis* as belonging to a new species which we have named *Heligmonina kotoensis* n. sp.

Genus *Neohelgmonella* Durette-Desset, 1970

Neohelgmonella lamaensis n. sp.
(Fig. 2)

TYPE MATERIAL. — Holotype ♂, allotype ♀, 15.VI.2001, I. A. H. Daouda coll. (MNHN 668 KQc). Paratypes: 15.VI.2001, I. A. H. Daouda coll., 10 ♂♂, 10 ♀♀ (MNHN 668 KQd); 24 ♂♂, 39 ♀♀ (ZIT/IFAN O2 I), coparasites of *Heligmonina kotoensis* n. sp.

ETYMOLOGY. — After la Lama: the name of the forest where the rodents were captured.

GEOGRAPHICAL ORIGIN. — Koto, Republic of Benin.

HOST. — *Mastomys natalensis* (Smith, 1834) (Muridae, Murinae).

SITE. — Small intestine (SI 1-SI 2).

DESCRIPTION

Small nematodes with body uncoiled or slightly coiled along ventral side. Excretory pore within posterior third of oesophagus. Deirids posterior to excretory pore, just anterior to oesophago-intestinal junction (Fig. 2A). Vestibule twice as long as sphincter. Very short uterus less than 30% of body length.

Synlophe (studied in one male and one female paratypes)

In both sexes, body bearing longitudinal, uninterrupted ridges, appearing between cephalic vesicle and the end of the muscular oesophagus and disappearing just anterior to caudal bursal in male. In female, ventral ridges disappearing anterior to vulvar opening, dorsal ridges at different levels around vulvar region (Fig. 2F, H). Number of ridges 15 (carene, five dorsal, eight ventral) at mid-body (Fig. 2B, C); 13 (seven dorsal, six ventral) at level of vulvar opening (Fig. 2G). Dorsal ridge of carene smaller than ventral ridge (Fig. 2B, C). Size gradient marked, decreasing from right to left on dorsal side and well marked,

decreasing from left to right on ventral side, not gradual (left ridges more pronounced than right ones, particularly in male). In both sexes, tips of ridges directed from right to left with subfrontal axis of orientation. In vulvar region, ridges orientated perpendicularly to body (Fig. 2G).

Holotype male

Length: 2.9 mm, 100 µm wide. Cephalic vesicle 60 µm long, 32 µm wide. Nerve ring, excretory pore and deirids 100 µm, 190 µm and 260 µm from apex, respectively. Oesophagus 370 µm long, with anterior muscular part 160 µm and posterior glandular part 210 µm (Fig. 2A).

Symmetrical caudal bursa with pattern of rays of type 2-2-1 (Fig. 2E). Small prebursal papillae (Fig. 2E). Rays 2 and 3 rectilinear, totally separated up to base, forming a V-shape and almost parallel to body. Extremities of rays 4 curved anteriorly. Rays 8 arising symmetrically at base of dorsal ray, curved at extremities, same length as dorsal ray. Dorsal ray divided at half length into two branches, each branch giving rise distally to two small branches, rays 9 (external branches) slightly longer than rays 10 (internal branches).

Filiform, sub-equal, alate spicules 390 µm long with sharp tips. Ratio of spicule length to body length 13.4%. Gubernaculum 40 µm long and 20 µm wide. Genital cone 26 µm long and 30 µm wide at base, with papilla 0 on ventral lip and two small papillae 7 on dorsal lip (Fig. 2E).

Allotype female

3.45 mm long, 100 µm wide. Cephalic vesicle 70 µm long, 35 µm wide. Nerve ring, excretory pore and deirids 80 µm, 200 µm and 280 µm from apex, respectively. Oesophagus 310 µm long with anterior muscular part 150 µm and posterior glandular part 160 µm. Monodelphic (Fig. 2D): vulva situated at 145 µm from caudal extremity with *vagina vera* 30 µm long. Ovejector 245 µm long with vestibule, 110 µm long, sphincter, 35 µm long by 60 µm wide and infundibulum 100 µm long. Uterus 900 µm long with 17 eggs at morula stage, 80 µm long and 40 µm wide. Tail 50 µm long. Ratio of uterus length to body length 26%.

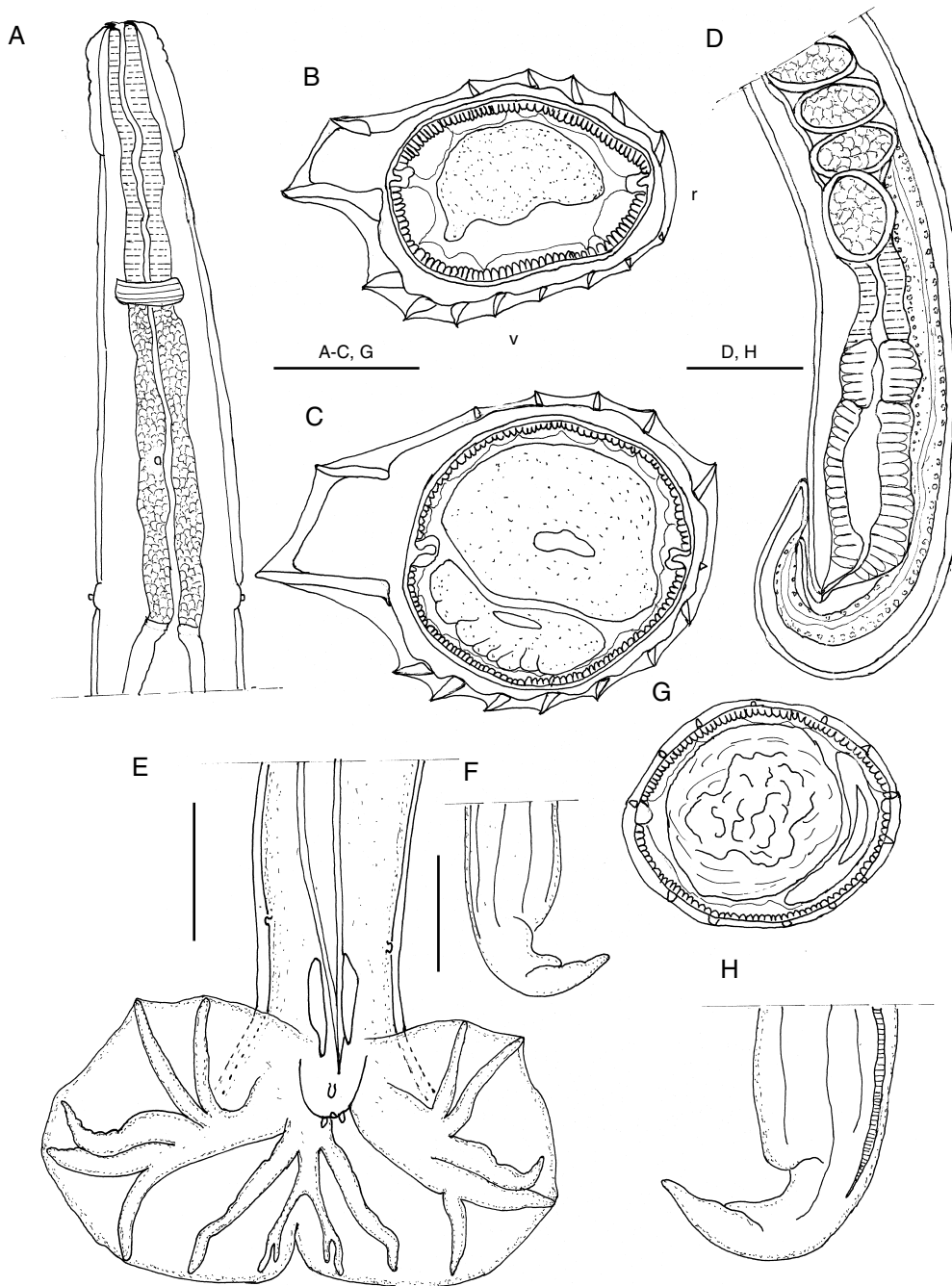


FIG. 2. — *Neoheligmone lammaensis* n. sp.; **A**, male, anterior extremity, ventral view; **B**, **C**, transverse sections at mid-body; **B**, male; **C**, female; **D**, female, posterior extremity, left lateral view; **E**, male, caudal bursa, ventral view; **F**, female, posterior extremity, disappearance of the ridges, right lateral view; **G**, female, transverse section anterior to vulvar opening; **H**, female, posterior extremity, disappearance of the ridges, left lateral view. Abbreviations: r, right; v, ventral side. Scale bars: A-C, G, 50 μ m; D, H, 100 μ m; E, 75 μ m; F, 150 μ m.

Measurements

Males (10 paratypes). Body: 3.3 (2.8-3.65) mm long; excretory pore 198 (140-210) μm from apex; oesophagus: 354 (320-395) μm long; spicules: 403 (340-410) μm long, ratio of spicule length to body length: 12.4% (10.3-13.4).

Females (10 paratypes). Body 3.4 (3.1-4) mm long; excretory pore situated at 195 (175-235) μm from apex; oesophagus 392 (310-535) μm long; vulva situated at 155.5 (105-210) μm from caudal extremity; ovejector 259 (210-285) μm long with vestibule 130 (100-180) μm long, sphincter 36 (30-45) μm long by 47 (40-60) μm wide and infundibulum 92.5 (70-140) μm long; uterus 735 (500-1030) μm long with 18 (14-30) eggs, 73 (60-80) μm long and 45 (40-50) μm wide; tail 48.8 (40-60) μm long; ratio of uterus length to body length 20% (16-26).

DISCUSSION

The specimens described above belong to the genus *Neoheligionella* (Heligionellidae, Nippostrongylinae). This genus is characterised by the following features: axis of orientation of the ridges inclined between 70° and 90° to the sagittal axis, left ventral ridge most strongly developed and pattern of the caudal bursa of type 2-2-1. Apart from one species found in an arvicoline rodent from Thailand, the other species are parasites of murine rodents, one from the Philippines and the other 18 species from Africa.

Among these species, *N. mastomysi* Diouf, Bâ & Durette-Desset, 1998 and *N. skirringi* Diouf, Bâ & Durette-Desset, 1998, both parasites of *Mastomys erythroleucus* from Casamance along with the specimens from Benin share the following common features: the dorsal ridge of the carene is well developed; on the dorsal side, there is a decreasing gradient of size of the ridges from right to left; on the ventral side, there is a decrease in the size of the ridges from left to right but it is not gradual i.e. the left ridges are better developed than the right ones. In addition, in the male, the caudal bursae of the three species are very similar (with rays 2 and 3 as well developed as the lateral trident and rays 8 curved at a right angle at their

extremity) and in the female, the tail is strongly curved ventrally.

They are both differentiated by the ratio of the length of the spicules to the length of the body (5.2% in *N. mastomysi* and 15.9% in *N. skirringi* versus 12.4% in the new species). *N. mastomysi* is also differentiated by the number of cuticular ridges (13 versus 15), the pattern of the synlophe in the posterior part of the body of the female and the asymmetrical arising of rays 8 on the dorsal ray. *N. skirringi* is the most closely related species. It is distinguished by the length of the left dorsal ridge of the carene which is almost as long as the ventral ridge and by rays 2 and 3 which are orientated perpendicularly to the body.

A fourth species of *Neoheligionella*, *N. affinis* (Baylis, 1928), is a parasite of *Mastomys erythroleucus* from Nigeria. There is no illustration of this species and the synlophe was not studied in detail. However, there are 10 to 12 cuticular ridges and we consider the specimens of *Mastomys natalensis* as belonging to a new species which we have named *Heligionina lamaensis* n. sp.

Acknowledgements

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