TRICHOSTRONGYLINA (NEMATODA) FROM MALAGASY MURIDAE. II - DESCRIPTION OF TWO NEW SPECIES OF *HELIGMONINA* (HELIGMONELLIDAE) IN *NESOMYS RUFUS* AND *ELIURUS TANALA*

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Summary:

Two new species of Heligmonellidae from Madagascar are described, *Heligmonina madagascariensis* n. sp. in *Nesomys rufus* and *Heligmonina tanala* n. sp. in *Eliurus tanala*. Both species belong to the *Heligmonina* species with a pattern of type 1-3-1 for the right lobe of the caudal bursa and 1-4 for the left lobe. In *H. madagascariensis*, *H. dupuisi* (Desset, 1964) and *H. praomyos* Baylis, 1928, left ray 6 arises before ray 3 from the common trunk to rays 3 to 6 while in *H. tanala* and the other species, it arises at the same level. *H. madagascariensis* is differentiated from *H. dupuisi* and *H. praomyos* by the symmetry of the branches of the dorsal ray. *H. tanala* is differentiated from *H. malacomyx* Sakka & Durette-Desset, 1988, the closely related species by a different pattern of the cuticular ridges at mid-body, by the sharpness of the tips of the spicules and by the ratio of the length of the spicules on the length of the body (6.9, 8.8 % versus 25-27.8 %). *Heligmonina chippauxi* (Desset, 1964) a parasite of *Oenomys hypoxanthus* from the Republic of Central Africa is considered a valid species.

KEY WORDS : *Heligmonina madagascariensis* n. sp., *Heligmonina tanala* n. sp., Trichostrongylina, Heligmonellidae, Nippostrongylinae, *Nesomys rufus*, *Eliurus tanala*, Muridae, Madagascar.

Résumé : TRICHOSTRONGYLINA (NEMATODA) PARASITES DE MURIDAE MALGACHES. II - DEUX NOUVEAUX *HELIGMONINA* (HELIGMONELLIDAE) PARASITES DE *NESOMYS RUFUS* ET D'*ELIURUS TANALA* (NESOMYINAE)

Deux nouveaux Nippostrongylinae, *Heligmonina madagascariensis* n. sp. parasite de *Nesomys rufus* et *Heligmonina tanala* n. sp. parasite d'*Eliurus tanala* sont décrits à Madagascar. Les deux espèces appartiennent aux *Heligmonina* dont la bourse caudale a une disposition des côtes bursales de type 1-3-1 pour le lobe droit et de type 1-4 pour le lobe gauche. Chez *H. madagascariensis*, *H. dupuisi* (Desset, 1964) et *H. praomyos* Baylis, 1928, la côte 6 gauche se détache avant la côte 3 du tronc commun aux côtes 3 à 6 tandis que chez *H. tanala* et les autres espèces, elle se détache au même niveau. *H. madagascariensis* se différencie d'*H. dupuisi* et d'*H. praomyos* par la symétrie des deux branches de la côte dorsale. *H. tanala* se différencie de l'espèce la plus proche *H. malacomyx* Sakka et Durette-Desset, 1988 par une disposition différente des crêtes cuticulaires au milieu du corps, par des spicules dont l'extrémité est effilée et par un rapport longueur des spicules sur longueur du corps de 6,9, 8,8 % au lieu de 25-27,8 %. L'espèce *Heligmonina chippauxi* (Desset, 1964) parasite d'*Oenomys hypoxanthus* en République Centrafricaine est revalidée.

MOTS CLÉS : *Heligmonina madagascariensis* n. sp., *Heligmonina tanala* n. sp., Trichostrongylina, Heligmonellidae, Nippostrongylinae, *Nesomys rufus*, *Eliurus tanala*, Muridae, Madagascar.

INTRODUCTION

In the present study, the taxonomical analysis of the trichostrongylid fauna of endemic rodents from Madagascar i.e the genera *Nesomys* and *Eliurus* is continued (Durette-Desset, Lehtonen & Haukisalmi, 2002), with the description of two new species of the genus *Heligmonina* Baylis, 1928 (Heligmonellidae, Nippostrongylinae). This work is a 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 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

Rodents were collected in Ranomafana National Park (RNP: 21° 16', 47° 20') in southeastern Madagascar between 15 September and 3 December, 1998 and between 22 September and 8 December, 1999. The gastrointestinal tract was preserved in the field in 70 % ethanol or buffered 10 % formalin. Later the stomach, small intestine, caecum and rectum were examined for helminths. The small intestine was divided into ten equivalent sections, numbered SI 1 to

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SI 10 from the duodenum to the ileo-caecal junction. The worms were stored in 70 % ethanol.

The nomenclature used above for 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). The nomenclature of the hosts follows Musser & Carleton (1993).

HELIGMONINA MADAGASCARIENSIS N. SP.

Material studied: holotype male, allotype female MNHN 195 MQa, 21 male, 23 female paratypes, MNHN 195 MQb.

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

Site: small intestine (SI 1-2, SI 5-6).

Geographical origin: Ranomafana National Park, Madagascar; 14 October 1998, coll: J.T. Lehtonen.

DESCRIPTION

Very small nematodes with body uncoiled or coiled mainly in anterior part. Excretory pore at level of posterior third of oesophagus. Deirids situated near level of excretory pore (anterior or posterior to it or at same level). Vestibule almost as wide as long and about three times shorter than infundibulum. Very short uterus less than 15 % of body length.

Head: Cephalic vesicle present. In apical view, rounded buccal opening surrounded by two small amphids, six externo labial papillae of which two lateral papillae are joined with amphids and four submedian cephalic papillae (Fig. 1B).

Synlophe: (studied in one male and one female paratype) (Fig. 1D-J). In both sexes, cuticle bears longitudinally uninterrupted ridges. Ridges appearing at different levels between cephalic vesicle and excretory pore and disappearing at about 50 anterior to caudal bursa in male and anterior to vulva in female.

At mid-body, presence of carene resulting of hypertrophied left ridge and together with thin right ridge which appears at oesophago-intestinal junction in female (Fig. 1D) and posterior to this junction in male (Fig. 1H). In posterior third of female, size of carene decreases and becomes of equivalent size of other ridges at level of vestibule (Fig. 1G)). Number of ridges: at level of oesophago-intestinal junction, 12 (left ridge of carene, five dorsal, six ventral) in male (Fig. 1H); 13 (carene, five dorsal, six ventral) in female (Fig. 1D). At mid-body 11 in both sexes with different pattern, in male (carene, five dorsal, three left ventral, one right ventral) (Fig. 1D); in female, (carene, 5 dorsal, 2 left ven-

tral, two right ventral) (Fig. 1E). In posterior third of body, 13 (carene, five dorsal, three left ventral, three right ventral) in male, with appearance of two new right ventral ridges, (Fig. 1J); in female, 11 (carene, four dorsal, two left ventral, three right ventral) (Fig. 1F), at level of ovejector 14 (carene, six dorsal, six ventral), with appearance of three new ridges, two ventral and one opposite right lateral field (Fig. 1G).

Ridges of unequal size. On left ventral side, ridges strongly developed (comaretes) all along body in male, in median part of body in female; on dorsal side, size of ridges decreasing from right to left. In posterior part of female, all ridges are of equivalent size (Fig. 1G). At mid-body, ridges orientated at 50° on sagittal axis in male and 70° in female. At oesophago-intestinal junction, axis orientated at 50° in female. (Fig. 1E, I). Tips of ridges directed from right ventral to left dorsal side.

Holotype male: 1.6 mm long and 65 wide at mid-body, including carene 25 long; cephalic vesicle 28 long by 15 wide; nerve ring, excretory pore and deirids situated at 115, 162 and 172 from apex, respectively; oesophagus 220 long (Fig. 1A).

Asymmetrical caudal bursa with left lateral lobe more developed and pattern of type 1-3-1 (rays 2 and 6 separating the first from common trunk of rays 2 to 6) in right lobe and 1-4 (rays 2 separating the first from common trunk of rays 2 to 6) in left lobe (Fig. 1K). Rays 2 and 3 totally separated up to their base. Left ray 6 arising the first from common trunk of rays 3 to 6, then ray 3. Rays 4 thicker and longer than rays 5. Rays 4 and 5 distally divergent. Rays 6 small. Rays 8 arising at base of dorsal ray, slightly longer than dorsal ray. Dorsal ray divided into two branches at its proximal third, each branch giving rise to two small branches, rays 9 (external branches) and rays 10 (internal branches). Rays 9 slightly curved at their extremity and longer than rectiline rays 10.

Filiform, alate spicules, 160 long, with sharp tips (Fig. 1K). Ratio of spicule length on body length: 10 %. Genital cone, 14 long and 12 wide at base with papilla zero on ventral lip and small papillae 7 on dorsal lip (Fig. 1K'). Gubernaculum absent.

Main measurements (average and range) of ten paratypes: body: 1. 5 (1. 35-1. 7) mm long; excretory pore: 175 (155-205) from apex; oesophagus: 227 (205-240) long; spicules: 140 (112-160) long, ratio of spicule length on body length: 9. 4 (7.9-10. 7) %.

Allotype female: 1.7 mm long and 48 wide at mid-body, including carene 27 long. Cephalic vesicle 29 long by 17 wide; nerve ring, excretory pore and deirids situated at 115, 170 and 170 from apex, respectively; oesophagus 235 long.

Monodelphic: vulva at 130 from caudal extremity. *Vagina vera*: 22 long. Ovejector 106 long with vesti-

Fig. 1. – *Heligmonina madagascariensis* n. sp. in *Nesomys rufus*. A, male, anterior extremity, right lateral view. B-G, female. B, head, apical view. C, posterior extremity, right lateral view. D-G, synlophe in transverse sections of body of a paratype female 1.55 mm long. D, at level of oesophago-intestinal junction. E, at mid-body (700 μ m from apex). F, at 950 μ m from apex. G, at 350 μ m from caudal extremity. H-K', male. H-J, synlophe in transverse sections of a paratype male 1.55 mm long. H, at 20 μ m posterior to oesophago-intestinal junction. I, at mid-body (600 μ m from apex). J, at 350 μ m anterior to caudal bursa, ventral view. K, caudal bursa, ventral view. K', detail of the genital cone, ventral view.

Abbreviations: v: ventral side, r: right side.

The arrows indicate the appearance of new ridges.

bule 25 long by 24 wide, sphincter 11 long by 19 wide and infundibulum 70 long. Uterus 240 long with three eggs, 56 long by 26 wide. Ratio of uterus length on body length: 14.1 %. Tail 40 long by 14 wide at base with sharp extremity (Fig. 1C).

Main measurements (average and range) of ten paratypes: body 1.7 (1.55-1.85) mm long; excretory pore 161 (130-170) from apex; oesophagus 220 (200-240) long; vulva at 130 (110-155) from caudal extremity; (ovjector observed only in seven specimens), vestibule 26 (23-31) long by 20 (16-22) wide; sphincter 15 (12-17) long by 19 (17-27) wide; infundibulum 76 (60-95) long; uterus 210 (180-230) long with 3 (1-4) eggs 58 (52-60) long by 27 (25-30) wide; tail 38 (31-45) long by 13 (12-15) wide at base; ratio of uterus length on body length 11.4 (11-14.4) %.

DIAGNOSIS

For the reasons specified hereafter (see diagnosis of *Heligmonina tanala* n. sp. below) we consider the specimens from *Nesomys rufus* belong to a new species we have named *Heligmonina madagascariensis* n. sp. in reference to the geographical origin of the host.

HELIGMONINA TANALA N. SP.

Material studied: holotype male, allotype female MNHN 204 MQa, one male, one posterior part male, two female, one anterior part, four posterior part female paratypes, MNHN 204 MQb.

Host: *Eliurus tanala* (Muridae, Nesomyinae) Major, 1896.

Site: small intestine (SI 1- SI 5).

Geographical origin: Ranomafana National Park, Madagascar; 14 November 1998, coll: J.T. Lehtonen.

Voucher material: two males, a posterior part of male, MNHN 242 MQ (SI 1, 5 and 10), two males, four females MNHN 244 MQ, (SI1, 4-6) parasites of the small intestine of *E. tanala* in Ranomafana National Park, Madagascar, 8 October 1999 and 15 November 1999, coll: J.T. Lehtonen.

DESCRIPTION

Very fragile, small nematodes with body uncoiled, curved along ventral side. Excretory pore at level of posterior third of oesophagus. Deirids situated near level of excretory pore (either anterior or posterior to it). Length of vestibule slightly greater than width and very short. Twisted infundibulum, difficult to measure accurately. Very short uterus between 15.6 and 17.4 % of body length.

Synlophe: (studied in one male of voucher material and one female paratype) (Fig. 2C-G, I-K). In both sexes, cuticle bears longitudinally uninterrupted ridges appearing just behind cephalic vesicle (Fig. 2C) except one right ventral appearing at level of oesophago-intestinal

junction (Fig. 2D). Ridges disappearing at about 50 anterior to caudal bursa in male and anterior to vulva in female.

At mid-body, presence of carene resulting of hypertrophied left ridge (ala) and very small dorsal ridge. Regular increase in size of carene in both sexes from cephalic vesicle until about 100 above caudal bursa in male (Fig. 2K) and mid-body in female (Fig. 2E). In posterior third of female (Fig. 2F), decrease in size of carene which becomes of equivalent size of other ridges at level of distal part of uterus (Fig. 2G). Number of ridges: in both sexes, at level of oesophago-intestinal junction, 13 (ala, six dorsal, six ventral) (Fig. 2D, I); at mid-body, 12 (ala, six dorsal, five ventral) with disappearance of right ventral ridge (Fig. 2E, J). In posterior third of body in male, 11 (ala, five dorsal, five ventral) with disappearance of second left dorsal ridge (Fig. 2K), at level of distal part of uterus in female, 11 (ala, six dorsal, four ventral) with disappearance of right ventral ridge.

Double gradient of size of ridges from right to left for dorsal side and from left to right from ventral side, well marked in median part of body. In posterior part of female, decrease in size of all ridges up to level of ovjector where ridges are of equivalent size except ala (Fig. 2G).

At mid-body, ridges orientated at 65° on sagittal axis in both sexes. Tips of ridges directed from right ventral to left dorsal side (Fig. 2E, J).

Holotype male: 1.65 mm long and 80 wide at mid-body, including carene 38 long; cephalic vesicle 45 long by 20 wide; nerve ring, excretory pore and deirids situated at 140, 170 and 175 from apex, respectively; oesophagus 250 long.

Slightly asymmetrical caudal bursa with left lateral lobe more developed and pattern of type 1-3-1 (rays 2 and 6 separating the first from common trunk of rays 2 to 6 in right lobe) and 1-4 (ray 2 separating the first from common trunk of rays 2 to 6) in left lobe (Fig. 2H). Left rays 3 and 6 separating at same level from common trunk of rays 3 to 6. Rays 4 slightly longer than rays 5. Rays 4 and 5 distally divergent. Rays 8 slightly shorter than dorsal ray, arising on trunk of latter at level of its division. Dorsal ray divided into two branches at proximal half, each branch giving rise distally to two small branches, rays 9 (external branches) and rays 10 (internal branches). Extremities of rays 9 slightly curved and longer than rectiline rays 10.

Filiform, alate spicules, 145 long, with sharp tips (Fig. 2H). Ratio of spicule length on body length: 8.8 %. Genital cone, 17 long and 10 wide at base with triangular papilla zero on ventral lip and rounded papillae 7 on dorsal lip (Fig. 2H'). Very small gubernaculum observed, 20 long and one wide, not seen in paratypes.

Main measurements of the paratype male: body: 1.8 mm long; excretory pore: 180 from apex; oesophagus: 260

Fig. 2. – *Heligmonina tanala* n. sp. in *Eliurus tanala*. A-G, female. A, anterior extremity, left lateral view. B, posterior extremity, right lateral view. C-G, synlophe in transverse sections of a female from the voucher material, 2.3 mm long. C, posterior to cephalic vesicle. D, at level of the end of the oesophagus. E, at mid-body (1.2 mm from apex). F at 700 μm from the caudal extremity G, at 450 μm from the caudal extremity. H-K, male. H, caudal bursa, ventral view. H' detail of the genital cone, ventral view. I-K, synlophe in transverse sections of a paratype male, 1.65 mm long. I, at level of oesophago-intestinal junction. J, at mid-body (700 μm from apex). K, at 150 μm anterior to caudal bursa.

Abbreviations: v: ventral side; r: right side.

long; spicules: 125 long, ratio of spicule length on body length: 6.9 %.

Allotype female: 2.5 mm long and 60 wide at mid-body, including carene 25 long. Cephalic vesicle 55 long by 22 wide; nerve ring, excretory pore and deirids situated at 185, 250 and 245 from apex, respectively; oesophagus 295 long (Fig. 2A).

Monodelphic: vulva at 165 from caudal extremity. *Vagina vera*: 19 long. Ovejector 150 long with vestibule 40 long, sphincter 20 long by 25 wide and infundibulum about 90 long. Uterus 390 long with seven eggs, 55 long by 27 wide. Ratio of uterus length on body length: 15.6 %. Tail 50 long with rounded extremity (Fig. 2B).

Main measurements of the two paratype females: body 2.3, 2.2 mm long; excretory pore 230, 180 from apex; oesophagus 280, 230 long; vulva at 140, 130 from caudal extremity; vestibule 40, 30; sphincter 20, 16 long by 30, 22 wide; infundibulum about 110, 90 long; uterus 400, 380 long with 6, 7 eggs, 60, 55 long by 30, 30 wide; tail 47, 50 long; ratio of uterus length on body length 17.4, 17.3 %.

DIAGNOSIS

For the reasons given below, we consider the specimens from *Eliurus tanala* to belong to a new species we named *Heligmonina tanala* n. sp. in reference to the specific name of the host.

The genus *Heligmonina* Baylis, 1928 (*Heligmosomoida*, *Heligmonellidae*, *Nippostrongylinae*) redefined by Durette-Desset (1971) is mainly characterised by one left hypertrophied ridge in both sexes. Fourteen species were described from Africa (12 in *Murinae*, one both in *Murinae* and *Cricetomyinae*, one in *Cricetomyinae*) and three species from Madagascar in *Nesomyinae*.

In this genus, the pattern of the caudal bursa is variable (1-3-1, 1-4, 2-2-1) and can differ for each lobe. The two species described above belong to the *Heligmonina* species with a pattern of type 1-3-1 for the right lobe and 1-4 for the left lobe of the caudal bursa. This group includes *H. albignaci* Quentin & Durette-Desset, 1974, a parasite of *Brachyuromys betsiloensis* from Madagascar and seven parasites from Africa: *H. bignonensis* Diouf, Bâ & Durette-Desset, 1997, a parasite of *Mastomys erythroleucus* from Senegal, *H. chippauxi* (Desset, 1964), a parasite of *Oenomys hypoxanthus* from the Republic of Central Africa, *H. dupuisi* (Desset, 1964), a parasite of *Praomys jacksoni* from the Republic of Central Africa, *H. malacomys* Sakka & Durette-Desset, 1988, a parasite of *Malacomys longipes* from the Republic of Central Africa, *H. praomyos* Baylis, 1928, a parasite of *Praomys tullbergi* from Nigeria, *H. stellenboschius* (Ortlepp, 1939), a parasite of *Myomys verroxii* from South Africa and

H. thamnomyysi (Durette-Desset, 1966), a parasite of *Thamnomyys rutilans* and *Cricetomys gambianus* from the Republic of Central Africa.

In *H. madagascariensis* n. sp., *H. dupuisi* and *H. praomyos*, left ray 6 arises before ray 3 from the common trunk to rays 3 to 6. The latter species are differentiated from *H. madagascariensis* by the asymmetry of the two branches of the dorsal ray. In addition, in *H. praomyos* the tips of the spicules are hook-shaped and in *H. dupuisi*, the carene and the comaretes are absent at mid-body.

In *H. tanala* n. sp. and the other species cited below, left ray 6 arise at same level as ray 3 on the common trunk of rays 3 to 6. Among these species, *H. bignonensis*, *H. malacomys* and *H. thamnomyysi* possess neither a carene, nor comaretes at mid-body like in *H. tanala*. *H. bignonensis* and *H. thamnomyysi* are differentiated from *H. tanala* by rays 8 longer than rays 9. *H. malacomys* is the most closely related species but the pattern of the cuticular ridges at mid-body is different, the spicules are spatulate at their extremity and the ratio of the length of the spicules on the length of the body is 25-27.8 % versus 7.9-10.3 %.

The synlophe of *H. stellenboschius* was not described but this species is distinguished from *H. tanala* by a strong asymmetry of the caudal bursa.

Revalidation of *Heligmonina chippauxi*: this species was described by Desset (1964) as *Longistriata chippauxi*, then synonymized by Durette-Desset (1971) with *Heligmonina spira* (Ortlepp, 1939). Only the caudal bursa of *H. spira* was described and the pattern of the two lobes are different from those of *H. chippauxi*. The right lobe is of type 1-4 in *H. spira* and 1-3-1 in *H. chippauxi*, the left lobe is of type 1-4 in both species but ray 3 and ray 6 arise at the same level on the common trunk of rays 3 to 6 in *H. spira* while in *H. chippauxi*, ray 6 arises first. Since the pattern of the caudal bursa has a great specific value in the genus *Heligmonina* we can consider that *H. chippauxi* is a valid species.

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