# A description of the male and redescription of female Mermis athysanota Steiner, 1921 (Nematoda : Mermithidae)

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## SUMMARY

Mermis athysanota Steiner females are redescribed and males described for the first time from specimens from the tablelands of south-eastern Australia. Host associations are based on congeneric juveniles from the same site as adult specimens include Praxibulus sp. (Acrididae) and Bobilla victoriae Otte & Alexander (Gryllidae) and on laboratory infection Chortoicetes terminifera (Walker) (Acrididae).

#### Résumé

#### Description du mâle et redescription de la femelle de Mermis athysanota Steiner, 1921 (Nematoda; Mermithidae)

La femelle de Mermis athysanota Steiner, 1921 est redécrite, et le mâle décrit pour la première fois, à partir de spécimens provenant des plateaux du sud-est australien. L'association avec les insectes-hôtes est fondée sur les juvéniles (stade parasite) congénères provenant du même site que les adultes; ces hôtes comprennent Praxibulus sp. (Acrididae) et Bobilla victoriae Otte & Alexander (Gryllidae) ainsi que Chortoicetes terminifera (Walker) (Acrididae) pour lequel les infestations ont été réalisées au laboratoire.

Mermis athysanota Steiner, 1921 [= Mermis nigrescens Dujardin, 1842 var. athysanota Steiner, 1921 (Baylis 1944)] was described from a single female collected at Namatanai on the Island of New Ireland in Papua New Guinea in 1911. The male was unknown and the species had not been collected since its original discovery. Despite the paucity of the type material M. athysanota has not been declared species inquirenda by reviewers of the genus (Baylis, 1944; Kiryanova, Karavaena & Romanenko, 1959; Poinar, Remillet & Van Waerebeke, 1978) because of the adequate description and unique features of the egg.

In December 1985 a series of conspecific mermithid nematodes (three females and seven males) were collected from a single soil sample (0.2 m<sup>2</sup> to a depth of 50 cm) in an improved pasture at Hernani in the Northern Tablelands of New South Wales, Australia by the first named author and A. J. Campbell. All seven males were associated with a single maturing female, the remaining two females (both gravid) were found separately. The tail section of one of the latter two gravid females was damaged during collection.

Both sexes were identified as M. athysanota : the females on the basis of the structure of their eggs, and the males on account of their in copula association with one of the three females.

As the male of *M. athysanota* was previously unknown it is herein described together with a redescription of the female.

Coils or individual specimens were placed in separate vials of distilled water on collection and subsequently stored at 5° until examined live. After examination they were heat killed, fixed in 3 % formalin and then processed to glycerine. Measurements were made after processing to glycerine.

In the following description the first figure is the mean and the figures in parentheses give the range.

## Mermis athysanota Steiner 1921 (Figs 1-5)

Mermis Dujardin, 1842 (amended by Poinar, Remillet & Van Waerebeke, 1978) (Mermithidae Braun, 1883).

#### **MEASUREMENTS**

*Females* (n = 3) : L = 92 & 107 mm (1 damaged); mid-body width =  $366.3 \,\mu m (306-452)$ ; head width (at level of cephalic papillae) =  $99 \,\mu m (95-104) (at neck) =$  $104 \,\mu m \,(100-110);$  body width at nerve ring = 161.6  $\mu m$ (158-165); cuticle width (at nerve ring) =  $32.3 \ \mu m$ (25-40) (at mid-body) = 42.3 µm (27-60) (at terminus) =  $45 \& 110 \ \mu m$  (1 damaged); hypodermis width  $(\text{mid-body}) = 19 \,\mu\text{m} (12-25); \text{ amphid aperture} = 3 \,\mu\text{m}$ (nil range); amphid pouch =  $15 \times 13$  (nil range); distance of nerve ring from mouth = 404 um (377-452); position of vulva = 51.89 & 52.8 per cent (1 damaged);

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length of vagina (from vulva to junction with uterus) = 409.3  $\mu$ m (392-427); diameter of vagina = 172  $\mu$ m (135-201); width of lateral hypodermal chord = 43  $\mu$ m (39-47); distance of vestigial anus from tail = 377 & 427 (1 damaged); tail width at vestigial anus = 256 & 306 (1 damaged); diameter of egg in uterus = 50-52  $\mu$ m.

Males (n = 7): L = 44.42 mm (32-52); width mid-body =  $222.14 \,\mu m (202-242)$ ; head width (at level of cephalic papillae) =  $88.25 \,\mu m (83-92.8) (at neck) =$ 98.85  $\mu$ m (98-101); body width at nerve ring = 133.71  $\mu$ m (125-137); cuticle thickness at nerve ring = 10.4  $\mu$ m (7.5-15), mid-body = 12.14  $\mu$ m (8-20); hypodermis mid-body =  $16 \mu m (12-20)$ ; amphid aperture =  $3 \times 3 - 5 \mu m$ ; amphid pouch = 21.1 × 20.28  $\mu m$  $(20-22 \times 18-22)$ ; distance of nerve ring from mouth = 304.7  $\mu$ m (285-325); spicule length = 240.7  $\mu$ m (218-261); spicule head width = 28.58 µm (22.5-32); mid-shaft width = 22.7  $\mu$ m (19-25); tail length = 312.57  $\mu$ m (266-334); tail width at cloaca = 221.57  $\mu$ m (196-245); position of proximal genital papillae anterior to cloaca =  $373 \ \mu m$  (310-450); number of genital papillae = 114.7 (89-143).

*Juvenile, st. 2* (early parasitic : 1 day) (n = 10) : L = 291.7  $\mu$ m (271-311); width mid-body = 11.6  $\mu$ m (11-12); head width = 7  $\mu$ m (nil range); position of node (junction of stichosome and trophosome) as a proportion of body length = 52.8 % (50-56); stylet length = 16.4  $\mu$ m (16-18); distance of nerve ring from mouth = 28.2  $\mu$ m (26-32).

## DESCRIPTION

General : Long nematodes; females  $1.7-3.3 \times \text{length}$ of males. Cuticle with cross fibres subtending intersecting angles of 104 and 76 degrees. Head rounded. Mouth with ventral shift. Head protoplasm slightly broader on lateral axis than dorso-ventral axis; more pronounced in female than in male. Paired lateral lip papillae, cylindrical, short, in female width equal to height  $(12 \times 11 \ \mu m)$  and in male width greater than height (12  $\times$  5  $\mu$ m), connected by a dorsal ridge. Four sub-medial head papillae, circular; duct attenuated towards opening, terminal area of duct compressed by thickened collar of cuticle; duct opening on a small nipple of thickened cuticle. Amphids large, prominent, larger in male than female, in female pearshaped with forward pointing duct, in male retort-shaped with lateral pointing duct. Six hypodermal chords; lateral hypodermal chords broad (8 % of circumference); located between 15 and 22 per cent of circumference from dorsal hypodermal chord; subventral hypodermal chords equidistant (13.5 % of circumference) from ventral and lateral hypodermal chords, cuticle of variable thickness depending on age (thicker in older specimens).

Females : Vulva with narrow longitudinal opening. Vulval chamber oblique, at 15° to long axis of body; cuticle surrounding vulva unmodified; muscular vagina short, U shape; dorsal loop bent anteriorly until horizontally aligned in mid-body plane; junction of vagina with uterus contiguous with posterior uterus and in transverse alignment with junction of vagina and vulva. Pigment clusters in neck region present but indistinct. Tail conoid flattened ventrally, convex dorsally. Vestigial anus well developed.

Eggs : Embryonated in uterus; round; lacking polarknobs and byssus; dorso-ventrally compressed, colourless; chorion composed of two layers : outer layer thick rough, consisting of " scab-like " plates (= " Oberfläche ", Steiner 1921) and ridges, intervening troughs with pore-like structures, inner layer thin and smooth. Unembryonated eggs with single layer of smooth chorion.

*Males* : Tail tightly curled, terminus conoid. Spicules paired, separate, curved; head slightly flared on ventral wall, walls thick (5-7  $\mu$ m); length equal to (× 0.97-1.2) body width at cloaca; length less than (× 0.65-0.84) tail length; spicule tip conoid, plain, dorsal edge tending to straight, ventral edge convex; canal contricted before terminal expansion; genital papillae arranged in three rows each bificate for posterior two thirds of length, median row marginally longer than submedian rows, distance of proximal genital papillae from cloaca × 1.5 (1.22-1.91) length of spicule and equal or greater than (× 0.96-1.38) tail length. Structure of head conforming to general description. Lateral lip papillae shorter and amphids larger than in female.

*Juvenile st. 2* (early parasitic) Short; body broad cephalad, tapered caudad; tail curled; stylet sigmoid; ring-like thickening of stylet at 60 % of length from anterior end.

## TYPE MATERIAL

A female, one male, eggs and parasitic juveniles have been deposited in the South Australian Museum, Adelaide, Australia (Nos.) and the Department of Nematology, University of California, Davis, USA. Two males have been deposited in the Muséum national d'Histoire naturelle, Laboratoire des Vers, Paris, France.

## DIAGNOSIS AND RELATIONSHIPS

The ventral shift in the mouth differentiates both male and female *M. athysanota* from all described species of *Mermis sensu stricto* except *M. quirindiensis* Baker & Poinar 1986 and *M. changodudus* Poinar, Remillet & Van Waerebeke, 1978.

Female *M. athysanota* differ from *M. quirindiensis* in the form of the egg (plain in *M. athysanota vs* polar knobs and byssus in *M. quirindiensis*); shape and height of lateral lip papillae [cylindrical, short (11  $\mu$ m) vs conical and tall (18  $\mu$ m)] and shape and length of vagina



 $\overline{F}$ ig. 1. Mermis athysanota, female. A : Head, ventral views; B : Head, lateral view; C : Tail, lateral view; D : Vagina, ventral view; E : Vagina, lateral view; F : Egg, dorsal view; G : Egg, side view.

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Fig. 2. Mermis athysanota, male. A : Head, en face view; B : Head, ventral view; C : Head, lateral view; D : Cross section, mid-boddy; E : Tail, ventral view showing arrangement of genital papillae; F : Schematic arrangement of genital papillae; G : Tail, lateral view.

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(U shaped, 392-427  $\mu$ m vs S shapped, 465-1 043  $\mu$ m) and  $\overline{M}$ . *changodudus* in regard to development of eggs at oviposition (fully embryonated in M. *athysanota vs* partially embryonated in M. *changodudus*), form of eggs (scab-like outer coating vs rough chorion (equivalent to inner shell of M. *athysanota*), size of lateral lip papillae (short vs tall).

Round eggs are also found in *M. paranigrescens* Rubstov 1976 and *M. keyensis* Baylis, 1944. In addition to the ventrally shifted mouth, *M. athysanota* females differ from the former in shape of the amphids (round in *M. athysanota vs* triangular in *M. paranigrescens*) and length of the vagina (409 vs ca. 750  $\mu$ m) and *M. keyensis* in regard to height and shape of lateral lip papillae (short cylindrical vs tall conical) and position of amphid opening in relation to sub-medial head papillae (posterior vs anterior).

Male M. athysanota differ from M. quirindiensis in the prominence, shape and size of amphids (very pronounced, retort shaped,  $21 \times 20 \ \mu m$  in M. athysanota vs obscure, hook shaped,  $10 \times 8 \,\mu m$  in M. quirindiensis); height of lateral lip papillae (5 µm vs 15 µm); spicule length in relation to tail length ( $\times 0.7$  vs  $\times$  1.02); number of genital papillae (89-143 vs 71-76) and arrangement of genital papillae (three rows bificated over two thirds of length vs three single rows), and M. changodudus in their spicule length (240 µm in M. athysanota vs 184 µm in M. changodudus); tail length (312 um vs 275 um); length of spicule in relation to body width at cloaca ( $\times$  1.1 vs  $\times$  0.87) and arrangement and number of genital papillae (three bificate rows; 89-143 genital papillae vs three single rows; ca 52 genital papillae).

An unusual feature of *M. athysanota* is the dorsal ridge between the paired lateral lip papillae in both sexes. This feature is also found in *M. papillus* Gafurov, 1982 from which *M. athysanota* differs in having a ventrally shifted mouth.

Stage 2 juveniles of M. athysanota (ovic and early parasitic) are 50 % larger than the juveniles of M. nigrescens and M. quirindiensis (Baylis 1947; Baker & Poinar, 1986). The transitional zone between stichosome and trophosome is also more distinct in M. athysanota than M. nigrescens and M. quirindiensis.

## HOST RANGE

Congeneric parasitic juveniles have been dissected from field collected hosts at the Hernani site. As *M. athysanota* was the sole representative of this genus in specimens sampled from the soil at this site, the parasitic juveniles are assumed to be conspecific. On this basis the following hosts are recorded :

Praxibulus sp. (Acrididae) Bobilla victoriae Otte & Alexander (Gryllidae)

In the laboratory, *M. athysanota* eggs were fed to third instar *Chortoicetes terminifera* (Walker) (Acrididae) and

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Stage 2 juveniles were dissected from the host's haemocoel 1 and 2 days later. The distribution of *C. terminifera* does not include coastal and tableland regions except as secondary invasion areas during plagues. It is therefore unlikely that *C. terminifera* is a natural host of *M. athysanota*.



Fig. 3. *Mermis athysanota*, Male amphids. A : Head, lateral view with amphid arrowed; B : Dorsal view; C : Lateral view (Bars : 10 um).

### DISTRIBUTION

In addition to the type locality (New Ireland, Papua New Guinea), *M. athysanota* has only been recorded from Hernani, Northern Tablelands, New South Wales, Australia.

## DISCUSSION

*M. athysanota* was identified principally on the basis of egg morphology. Complimentary features were the



Fig. 4. *Mermis athysanota*, Male. A : Tail, lateral view (Bar : 100  $\mu$ m); B : Spicule, lateral view (Bar : 50  $\mu$ m); C : Spicule head (Bar : 10  $\mu$ m); D : Spicule, mid body (Bar : 10  $\mu$ m); E : Spicule tip (Bar : 10  $\mu$ m); F : Genital papillae, lateral view (Bar : 10  $\mu$ m).



Fig. 5. *Mermis athysanota*, Eggs and parasitic juveniles. A : Uterine eggs *in situ* (showing unembryonated eggs without cuticular thickening and embryonated eggs with rough outercoating); B-C : SEMs of outer coating of eggs; D : Parasitic juvenile st. 2 (early parasitic : day 2); E : Head of parasitic juvenile st. 2. (Bars : 10 µm. SEMs by M. Horwood).

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unique prominence of the amphids and the geographical proximity of collection site and type location. Slight differences in egg size from the type specimen could be due to variation in female length. Apparent discrepancies in head morphology (position of mouth and relative position of the opening of amphids and sub-medial head papillae) can be attributed to the oblique orientation of the head depicted in the illustration of the type specimen.

Steiner (1921) described the amphids of *M. athysanota* as "stark-betont": very prominent. This feature, shared by the material described in this paper, contrasts sharply with other species of *Mermis* in the south-west Pacific Region (*M. savaiiensis* Orton Williams, 1984; *M. quirindiensis* Baker & Poinar 1986) which have shallow, indistinct amphids.

In the diagnosis of *M. athysanota* no comparison was made with *M. quakensis* Gafurov, 1982, *M. kirgisica* Kiryanova, Karavaeva & Romanenko, 1959 and *M. gigantea* Artyukovsky & Lisikova, 1977. *M. quakensis* is considered *species inquirenda* on the grounds that the description is inadequate (a single female and the egg diameter only given). *M. kirgisica* is considered a synonym of *M. nigrescens* Dujardin, 1842 given the similarity of adult female morphology and egg colour and structure. The description of *M. gigantea* was unavailable for comparison.

A dorsal ridge connecting the paired lateral lip papillae in both *M. athysanota* and *M. papillus* suggests a close affinity between these two species. Unfortunately, lack of knowledge regarding the morphology of the egg of *M. papillus* precludes further comparison. Interestingly, both *M. athysanota* and *M. papillus* are parasites of Acrididae (Orthoptera).

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