



Microlaimidae (Microlaimoidea: Nematoda) from the Indian Ocean: description of nine new and known species

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Abstract

Nine species are described from the genera *Aponema* Jensen, 1978, *Bolbolaimus* Cobb, 1920, *Calomicrolaimus* Lorenzen, 1976, *Ixonema* Lorenzen, 1976 and *Microlaimus* de Man, 1880. *Aponema decraemerae* sp. n. is characterised by sexual dimorphism in the size of the amphids, short cephalic sensilla, spicules with a poorly developed capitulum and conical cylindrical tail with a pointed tip. *Aponema mnazi* sp.n. is characterised by short cephalic sensilla, head set off from the rest of the body by a fine constriction, spicules with a pointed anterior tip, one precloacal supplement located at 7 μm from the cloaca opening and a short tail with a blunt tip. *Bolbolaimus bahari* sp. n. is characterised by cuticular annules with fine interannular spaces, papilliform labial sensilla and short setiform cephalic ones, curved spicules with a poorly developed capitulum. *Bolbolaimus abebei* sp.n. is characterised by setiform outer labial and cephalic sensilla and spicules with a well-developed beak shaped capitulum. *Calomicrolaimus jenseni* sp. n. is characterised by an elongate cervical region, small (2 μm wide) amphids located at 44–54% of the pharyngeal length from the anterior and a conical tail with a pointed tip. *Ixonema deleyi* sp. n. is characterised by a small body (<400 μm long) an elongate cervical region, small (1–2 μm wide) circular amphids with rod-like corpus gelatum located at 30–45% of the pharyngeal length from the anterior. *Microlaimus texianus* Chitwood, 1951 is characterised by sexual dimorphism in the size of the amphids and presence of five pre-cloacal supplements. *Microlaimus minutus* sp. n. is characterised by a small body (< 300 μm long) that is often curved or coiled, amphids that are 55–60% cbd and located at 11–15 μm away from the anterior end and short (12–15 μm long) simple spicules. *Microlaimus pwani* sp.n. is characterised by prominent cuticular annules, long cephalic sensilla, amphids that are 50–55% cbd and located at 11–13 μm from the anterior end and long sausage-shaped striated sperms.

Introduction

This work is part of the Netherlands Indian Ocean Programme of 1992 [cruise A1 (June to July 1992) and A2 (November to December 1992) of the R. V. Tyro], which was aimed at assessing the monsoon effects on the Kenyan coastal ecosystems where both pelagic and benthic systems were studied. Benthic deep-sea sampling was carried out to assess nematode community structure.

The family Microlaimidae is often encountered in deep-sea studies, especially the genus *Microlaimus*. In the deep sea off North Carolina, Tietjen, 1976 found different species of the genus *Microlaimus* at different depths from 50–1750 m. In the Norwegian Sea, *Microlaimus* had a relative abundance of >10% at a depth of 3000 m (Jensen, 1988). In our study, Microlaimidae were represented by five different genera (*Aponema* Jensen, 1978, *Bolbolaimus* Cobb, 1920, *Calomicrolaimus* Lorenzen, 1976, *Ixonema* Lorenzen 1976 and

Microilaimus De Man, 1880) which were found at all depths, from 50–2000 m.

The genus *Aponema* was erected by Jensen (1978) and placed in the family Molgolaimeidae on the basis of having single anterior testis in the males. Lorenzen (1980) transferred this genus to the family Microilaimidae, on the argument that most holophyletic families of free-living nematodes have one type of ovary whereas there are several holophyletic families with two or one testis. We agree with Lorenzen and described *Aponema* in the family Microilaimidae. Besides, the two species of *Aponema* described here have two outstretched and opposed testes.

Materials and methods

Samples were taken off the Kenyan coast from four transects. From North to South; Kiwayu, Tana, Sabaki and Gazi (refer to Muthumbi et al., (1997) for the study area and Muthumbi & Vincx, (1998) for the location of the stations and their depths;) the stations 550 and 552 were taken during a training programme. **Note** that the stations are denoted by 1– for the first cruise and the equivalent are denoted by 5– for second cruise. Sampling was done using a box corer from which two sub-samples were taken to a depth of 5 cm using a plastic core of diameter 2.6 cm.

Nematodes were transferred slowly to glycerine. Drawings were made with the aid of a camera lucida on a Leitz Dialux 20 EB microscope. Scanning electron pictures were taken from formalin fixed animals, transferred to OsO₄ dehydrated, dried and coated with 20–25 μm of gold (SEM: JEOL JSM 840).

Type specimens are deposited in the collection of Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN) of Brussels, slide numbers RI573–RI589 and the Marine Biology section of the University of Ghent (MBRUG) slide numbers 10435–10508.

The abbreviations used in the text and tables are: a: body length divided by maximum body diameter, b: body length divided by pharyngeal length, c: body length divided by tail length, c': tail length divided by anal body diameter abd: anal body diameter, cbd: corresponding body diameter, hd: head diameter at the level of the cephalic setae or the widest part of the head, L: total body length, M: maximum body diameter, spic: spicule length, V: position of vulva as a percentage of total body length, v: vulva distance from the anterior

Formula:

distance from the anterior to:

$$\frac{\text{head (nerve ring) end of the pharynx} \\ \text{M (vulva) anus}}{\text{cbd}} \text{ total length}$$

All measurements (not ratios) are in micrometers and all curved structures are measured along the arc.

Results

Eight new species of Microilaimidae are described and additional information is given for one known species.

APONEMA Jensen, 1978

Two new species of *Aponema* are described, *Aponema decraemerae* sp. n. and *Aponema manzi* sp. n.

Aponema decraemerae sp.n. (Figure 1A–H)

Type material

Eight males and three females on slide numbers RI573–RI574 and 10435–10443

Etymology

The species is dedicated to Dr W. Decraemer of Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN) of Brussels.

Type locality

Males are from sts. 106, 117, 119, 136, 505, 506 (♂₁), 533 (2). Females are from sts. 105 (♀₁), 119 and 131.

Measurements

$$\begin{array}{r} - 47 \quad 75 \quad M \quad 286 \\ \sigma_1 \frac{\quad}{5 \quad 12 \quad 13 \quad 13 \quad 10} 356 \end{array}$$

a: 27.4; b: 5.0; c: 5.1; c': 7.0; spic: 20

$$\begin{array}{r} - 42 \quad 68 \quad 155 \quad 260 \\ \text{♀}_1 \frac{\quad}{6 \quad 12 \quad 13 \quad 16 \quad 9} 323 \end{array}$$

a: 20.2; b: 4.8; c: 5.1; c': 7.0; V: 48%

Other ♂♂s L: 296–378; a: 24.2–28.6; b: 4.7–5.3; c: 5.1–6.0; c': 4.9–6.7; spic: 17–19

Other ♀♀s L: 259–328; a: 17.3–19.3; b: 4.4–4.6; c: 5.5–6.1; c': 5.2–6.0; V: 47–50%

Description

Males: Cylindrical body attenuating on both anterior and posterior ends (Figure 1A). The head is slightly set off by a fine constriction. The cuticle has fine annuli

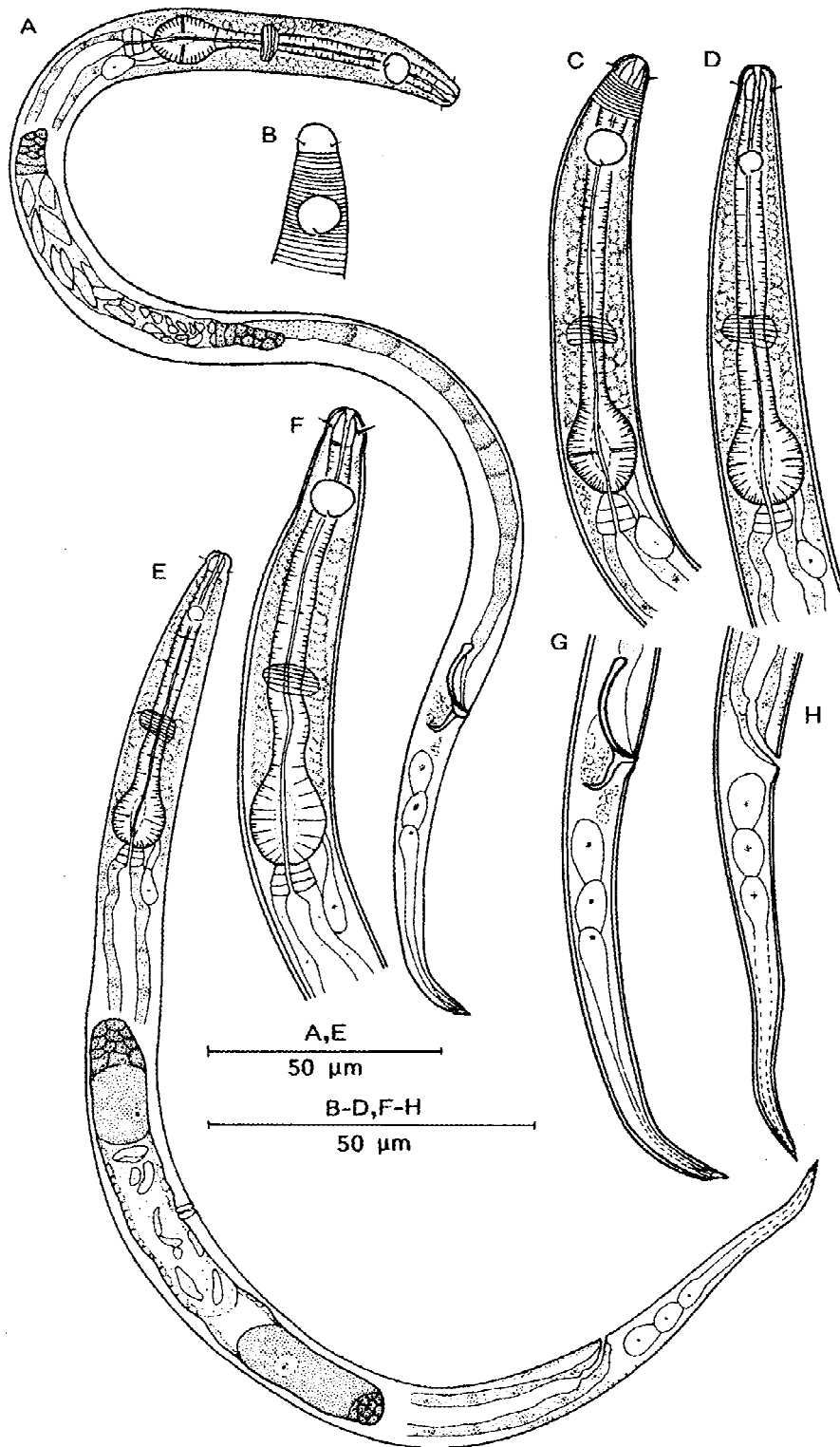


Figure 1. *Aponema decraemerae* sp. n.; A: ♂₁ total body, B: ♂₂ head (superficial), C: ♂₁ pharyngeal region, D: ♀₁ pharyngeal region, E: ♀₁ total body, F: ♂₂ pharyngeal region, G: ♂₁ tail, H: ♀₁ tail.

starting from the level of the constriction (Figure 1B). Somatic setae were not seen.

The amphids are simple spiral and the spiral origin is obvious on the ventral side, they are 5–6 μm , 56–66% of cbd in diameter and located at 12–15 μm from the anterior end. The inner and outer labial sensilla are inconspicuous, while the four cephalic ones are very short (1–2 μm long). The stoma is rather small with one small dorsal tooth and two sub-ventral ones (Figure 1C & F). The pharynx has a well developed pyriform terminal bulb, which is 80–85% of cbd in diameter. The nerve ring is located at 60–65% of the length of the pharynx from the anterior (Figure 1C & F). The ventral gland is small and it is located posterior of the cardia but the gland opening is not obvious.

The reproductive system is diorchic with outstretched testes located anterior to the right or the left of the intestine and posterior one on the opposite side. The sperm cells are large, slightly elongate and pointed on two sides (Figure 1A). The spicules are 1.5–2.0 abd long, slightly curved and with a poorly developed capitulum. The gubernaculum is sclerotized and has a dorsal-caudal apophysis 5–7 μm long (Figure 1G) which is dorsally curved.

The tail is 51–71 μm long, conical and cylindrical on the posterior half and has a pointed tip (Figure 1G).

Females: They are similar to males (Figure 1D, E & H) in most aspects. The amphids are however, smaller (4 μm or 44–50% cbd in diameter) than in males. The reproductive system is amphidelphic with outstretched ovaries, located either anterior to the right or the left and posterior on the other side of the intestine. The ovaries are short and both sides may have ova at the same level of development. In the uterus occur a few sperm cells that may not be clustered together. Vulva and vagina are simple.

Differential diagnosis

Aponema decraemerae sp. n. is characterised by a finely annulated cuticle, sexual dimorphism of the amphids (males have larger amphids), spicules with a poorly developed capitulum and tail with a pointed tip.

So far only the type species *A. torosus* (Lorenzen, 1973) Jensen, 1978 is described. *Aponema decraemerae* sp. n. can be distinguished from *A. torosus* in the size (L= 259–378 μm in the former compared to L=600–700 μm in the latter), sexual dimorphism in the size of the amphids exhibited by *A. decraemerae* sp. n. and the shape of the tail. *Aponema decraemerae* sp. n. can be distinguished from *A. mnazi* sp. n. in the

sexual dimorphism in the amphids and the shape of the tail (short with a blunt tip in *A. mnazi* sp. n.).

Aponema mnazi sp. n. (Figure 2A–G)

Type material

Three males and eight females on slide numbers RI575–RI576 and 10444–10450.

Etymology

The species name is the Kiswahili name for *coconut*.

Type locality

Males are from sts. 111 (2 including σ_1) and 511 and females from sts. 111 and 511 (7 including φ_1).

Measurements

$$\sigma_1 \begin{array}{r} - \quad 42 \quad 69 \quad M \quad 271 \\ 5 \quad 12 \quad 13 \quad 14 \quad 11 \end{array} 308$$

a: 22.0; b: 4.5; c: 8.3; c': 3.4; spic: 19

$$\varphi_1 \begin{array}{r} - \quad 45 \quad 73 \quad 160 \quad 281 \\ 5 \quad 12 \quad 13 \quad 17 \quad 9 \end{array} 311$$

a: 19.5; b: 4.5; c: 6.6; c': 5.6; V: 48%

Other σ 's L: 279–328; a: 21.5–27.3; b: 4.5–4.7; c: 7.5–8.6; c': 3.1–3.2; spic: 19–21.

Other φ 's L: 253–297; a: 17.0–20.9; b: 4.0–4.7; c: 6.6–7.5; c': 4.2–5.6; V: 48–52%.

Description

Males: Cylindrical body often curved (Figure 2F). The head is set off from the rest of the body by a fine constriction. The cuticle is finely annulated (Figure 2C). Somatic setae are very short and were only seen at the tail region (Figure 2D).

The amphids are a simple spiral, (4 μm) 44–55% cbd in diameter and located at 10–15 μm from the anterior end (Figure 2C). The inner and outer labial sensilla were not seen but the four cephalic ones are 1–2 μm long and inserted at the head constriction. The stoma is small with a small dorsal and two sub-ventral teeth (Figure 2B). Pharynx with a well developed terminal bulb which is 75–85% of cbd in diameter. The nerve ring is located at 60–65% of the length of the pharynx from the anterior (Figure 2F). Ventral gland is small and located posterior of the cardia but the gland opening was not seen. The cardia is 4–5 μm long and prominent.

The reproductive system is diorchic with outstretched testes located anterior either to the right or

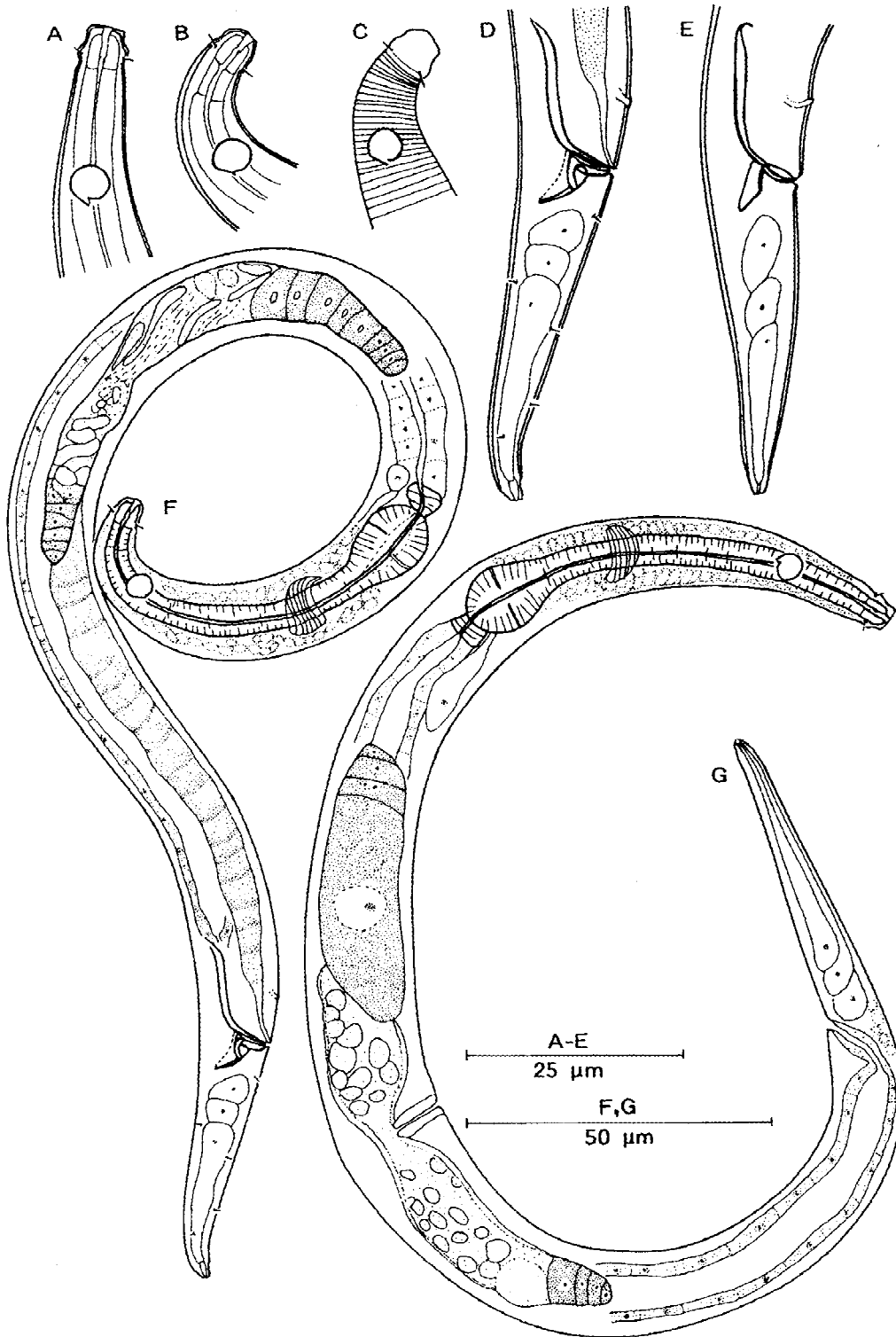


Figure 2. *Aponema mazi* sp. n.: A: ♀₁ stoma, B: ♂₁ stoma, C: ♀₂ head (superficial), D: ♂₁ tail, E: ♀₂ tail, F: ♂₁ total body, G: ♀₁ total body.

the left of the intestine and the posterior one on the opposite side. The sperm cells are elongate or rounded. The spicules are 1.6–1.8 abd long and almost straight except for the anterior one fourth that is dorsally or ventrally bent, and the anterior tip is pointed (Figure 2D). The gubernaculum has sclerotized dorsal caudal apophysis which is 6–7 μm long. There is one pre-cloacal supplement located at 10–11 μm in front of the cloaca (Figure 2F).

The tail is short, conical cylindrical with a blunt terminal tip.

Females: They are similar to males (Figure 2A, C & G). The reproductive system is amphidelphic with outstretched ovaries located, anterior either on the left or right of the intestine and posterior on the other side. The uterus is often filled with spermatozoa. Vulva is simple and vagina is long and heavily sclerotized.

Differential diagnosis

Aponema mnazi sp.n. has a head that is set off from the rest of the body by a fine constriction, spicules that are almost straight and dorsally bent at the anterior tip and one pre-cloacal supplement and a short cylindrical tail with a blunt tip.

Aponema mnazi sp. n. can be distinguished from the other two, *A. torosus* (Lorenzen, 1973) Jensen 1978 and *A. decraemerae* sp. n., by the set off head, spicules with a pointed anterior tip, pre-cloacal supplement and the short tail with a blunt tip in *A. mnazi* sp. n.. Besides, *A. torosus* is much longer (L=600–700 μm long) and *A. decraemerae* sp. n. has sexual dimorphism in the size of the amphids.

Bolbolaimus Cobb, 1920

Two species of *Bolbolaimus*, *Bolbolaimus bahari* sp. n. and *Bolbolaimus abebai* sp. n. are described.

Bolbolaimus bahari sp. n. (Figure 3 A–D)

Type material

Three males on slide numbers RI577 and 10451–10452.

Etymology

The species name ‘bahari’ means *Sea* in Kiswahili.

Type locality

Specimens from sts. 119 (σ_1), 506 and 533.

Measurements

σ_1	–	53	88	M	344	411
	9	21	22	23	18	

a: 16.0; b: 4.7; c: 6.1; c': 3.9; spic: 35

Other $\sigma\sigma$'s L: 382–386; a: 16.8–19.1; b: 4.8; c: 6.9; c': 3.3–3.9; spic: 34.

Description

The body is cylindrical with a blunt anterior end and an attenuating tail end. The head is continuous with the rest of the body (Figure 3C). The cuticle is annulated with annuli starting posteriorly of the cephalic setae and having small inter-annular spaces. Somatic setae are in four longitudinal rows, small papilliform and the cuticle appears to be depressed around them.

The amphids are 6 μm (50% cbd) in diameter, simple spiral and located at 4–6 μm from the anterior end. The six inner and the six outer labial sensilla are papilliform while the four cephalic ones are short setiform (Figure 3A). The stoma is sclerotized and has a large dorsal tooth and two pairs of smaller sub-ventral ones. The pharynx is 80–88 μm long and cylindrical with a well developed posterior bulb which is 65–75% cbd. The nerve ring is located at 55–60% of the length of the pharynx from the anterior (Figure 3B). The ventral gland is small and located posterior of the cardia and the gland opening is at the level of the nerve ring.

The reproductive system is diorchic with outstretched testes located, anterior to the left and posterior to the right of the intestine (Figure 3C). The spicules are 1.9–2.0 abd in length arcuate and with a poorly developed capitulum (Figure 3D). The gubernaculum is 13–14 μm long with a dorso-anteriad pointing tip.

The tail is conical, 55–67 μm long with a pointed tip.

Differential diagnosis

Bolbolaimus bahari sp. n. is characterised by cuticular annuli with fine inter-annular spaces, papilliform labial sensilla and setiform cephalic sensilla, curved spicules with poorly developed capitulum and elongate conical tail.

Bolbolaimus bahari sp. n. closely resembles *B. crassiceps* (Gerlach, 1953) Jensen, 1978 and *B. chitwoodi* (Gerlach, 1950) Jensen 1978 and *B. abebai* sp. n. in the absence of denticles and cuticular ornamentations. *Bolbolaimus bahari* sp.n. however differs from *B. crassiceps* in measurements, de Man's ratios (L=1095–1120, a=35–47, b=7.0–7.5 and c=10.6–12.2

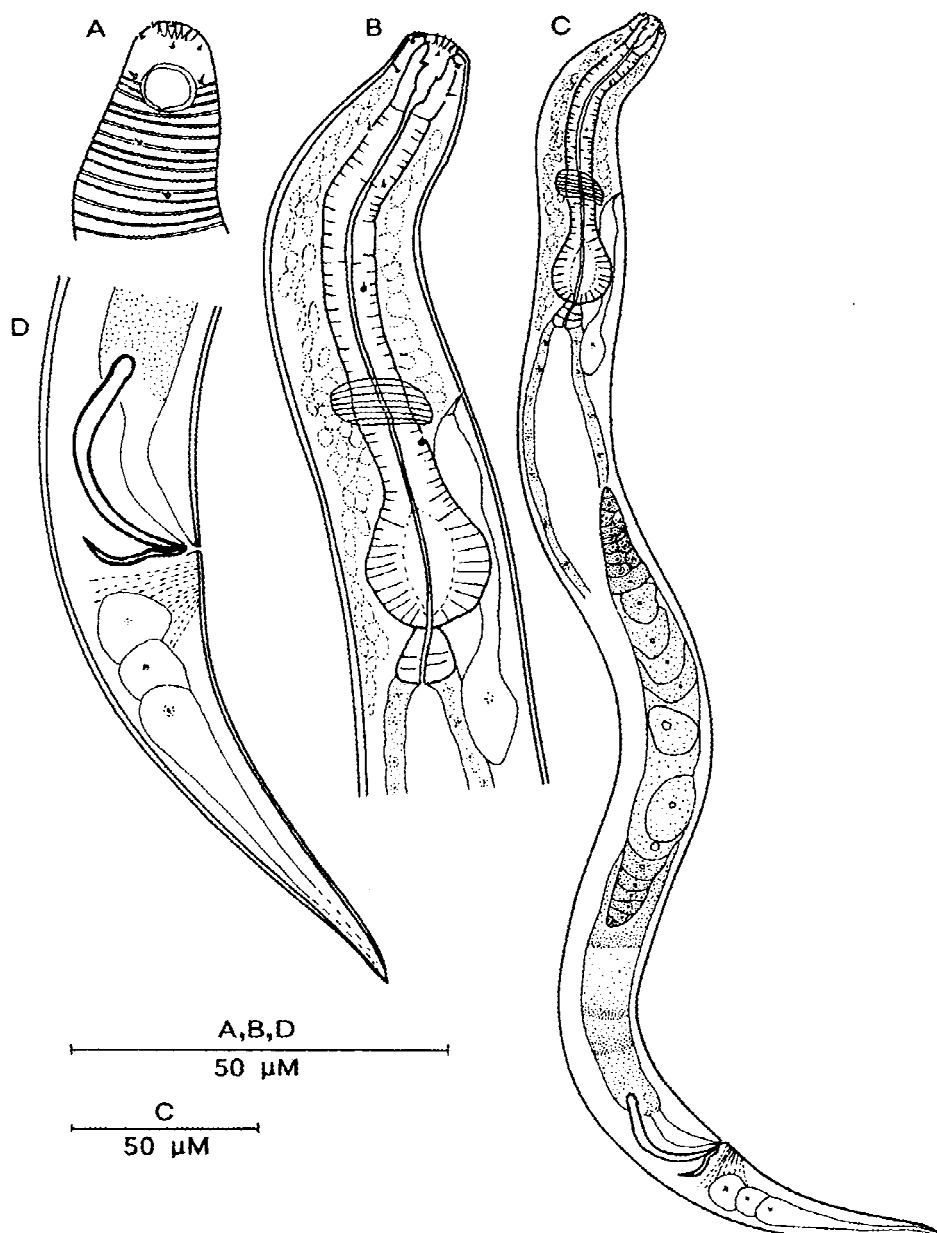


Figure 3. *Bolbolaimus bahari* sp. n.; A: ♂₁ head (superficial), B: ♂₁ pharyngeal region, C: ♂₁ total body, D: ♂₁ tail.

in *B. crassiceps*) and anterior sensilla which are much longer in the latter. *Bolbolaimus bahari* sp. n. differs from *B. chitwoodi* in the position of the amphids (amphids located between the cephalic setae and in front of the level of the dorsal tooth). *B. bahari* sp. n. differs from *B. abebei* sp. n. in the length of the anterior sensilla (both outer labial and cephalic sensilla are setiform, 2–3 μm long in the latter species) and the shape of the spicules.

Bolbolaimus abebei sp.n. (Figure 4A–H)

Type material

Five males and two females on slide numbers RI578–RI579 and 10453–10458.

Etymology

The name of the species is given for Dr Eyuaem Abebe of Ethiopia.

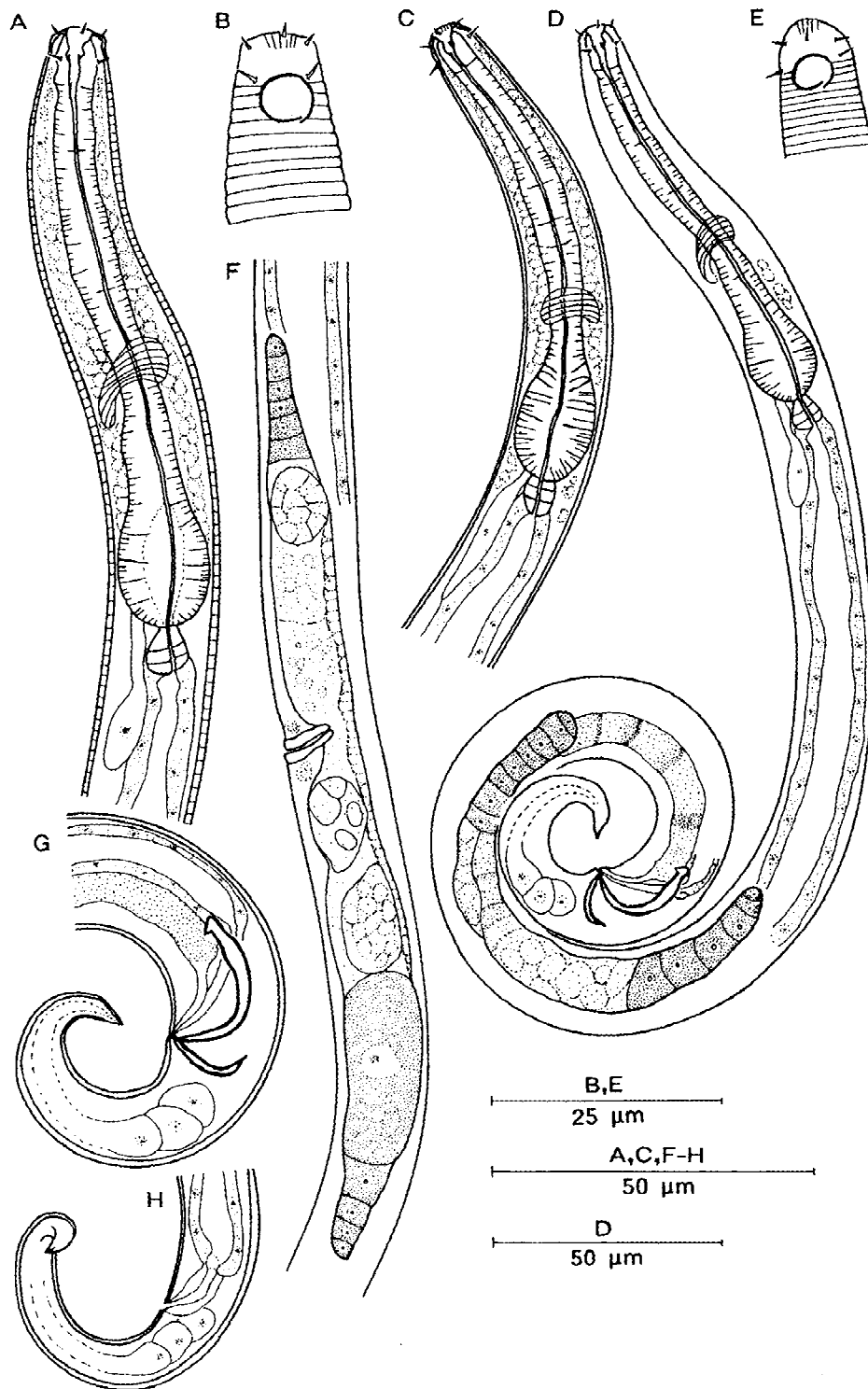


Figure 4. *Bolbolaimus abebai* sp. n.; A: ♂₁ pharyngeal region, B: ♂₁ head (superficial), C: ♀₁ pharyngeal region, D: ♂₁ total body, E: ♀₁ head (superficial), F: ♀₁ reproductive system, G: ♂₁ tail, H: ♀₁ tail.

Type locality

Males are from sts. 505 (3 including ♂₁), 507 (2) and females are from sts. 119 (♀₁) and 505.

Measurements

$$\sigma_1 \frac{- \quad 49 \quad 92 \quad M \quad 427}{8 \quad 17 \quad 16 \quad 18 \quad 16} 488$$

a: 27.1; b: 5.3; c: 8.0; c': 3.8; spic: 29

$$\text{♀}_1 \frac{- \quad 39 \quad 73 \quad 246 \quad 356}{7 \quad 13 \quad 14 \quad 14 \quad 10} 411$$

a: 29.4; b: 5.6; c: 7.5; c': 5.5; V: 60%

Other ♂♂s L: 387–493; a: 25.8–35.2; b: 5.6–6.3; c: 7.3–7.9; c': 4.1–5.7; spic: 24–29

Other ♀♀s L: 527; a: 27.2; b: 6.2; c: 7.6; c': 5.3; V: 59%

Description

Males: The body is cylindrical with a blunt anterior end and an attenuating posterior end (Figure 4D). The cuticular annulation start from posterior of the cephalic setae (Figure 4B). The somatic setae were not seen.

Amphids are large, simple spiral, (4–6 μm) 50–60% cbd in diameter and located at 4–6 μm from the anterior end (Figure 4B). The inner labial sensilla are not conspicuous while the six outer labial and the four cephalic ones are setiform, 2–3 μm long. The stoma is highly sclerotized and has one large dorsal tooth and two pairs of smaller sub-ventral ones. The pharynx is 61–92 μm long, with a terminal pyriform bulb which is 80–93% of cbd in diameter (Figure 4A). The nerve ring surrounds the pharynx at 50–55% of the pharyngeal length from the anterior end. The ventral gland is small and located posterior of the cardia, gland opening not obvious. The cardia is long and conspicuous.

The reproductive system is diorchic with outstretched testes located anterior to the left and posterior to the right or the left (rare) of the intestine. The spicules are 2.0–2.3 abd in length and curved, they have well-developed beak-shaped capitulum. The gubernaculum is 10–12 μm long, curved with a sharp pointed dorsal anterior tip (Figure 4G).

The tail is conical with a short (49–69 μm long) cylindrical posterior part.

Females: They are similar to males (Figure 4C, E & H). The reproductive system is amphidelphic with outstretched ovaries located like in the males, anterior

to the left and posterior to the right or the left of the intestine. The uterus is long and may contain sperm cells that are in clusters. The vulva is simple and the vagina is long (Figure 4F).

Differential diagnosis

Bolbolaimus abebei sp. n. is characterised by setiform labial and cephalic sensilla, amphids located posterior of the cephalic setae and spicules with a well developed beak-shaped capitulum.

Bolbolaimus abebei sp. n. resembles *B. chitwoodi* (Gerlach, 1950) Jensen, 1978, *B. crassiceps* (Gerlach, 1953) Jensen, 1978 and *Bolbolaimus abebei* sp. n. in the absence of denticles in the stoma, the lack of cuticular ornamentation and the level of annulation in the head region. *Bolbolaimus abebei* sp. n. differs from *B. crassiceps* in measurements and de Man's ratios (L=1095–1120, a=35–47, b=7.0–7.5 and c=10.6–12.2 in *B. crassiceps*) and it differs from *B. chitwoodi* in the position of the amphids (amphids located between the cephalic setae and in front of the level of the dorsal tooth). *Bolbolaimus abebei* sp. n. differs from *B. bahari* sp. n. in the length of the anterior sensilla (labial sensilla are papilliform and cephalic are short setiform in *B. bahari* sp.n.) and the shape of the spicules (spicules have a well-developed beak-shaped capitulum in *B. bahari* sp. n.).

Calomicrolaimus Lorenzen, 1976

Calomicrolaimus jenseni sp. n. (Figure 5 A–E)

Type material

Seven males and eight females on slide numbers RI580–RI581 and 10459–10470

Etymology

The species name is given in honour of the late Dr Preben Jensen.

Type locality

Males are from sts. 503, 505 (5 including ♂₁) and 533 and females are from 505 (6 including ♀₁) 518 and 533.

Measurements

$$\sigma_1 \frac{- \quad 53 \quad 79 \quad M \quad 251}{6 \quad 15 \quad 16 \quad 19 \quad 12} 304$$

a: 16.0; b: 3.9; c: 5.7; c': 4.4; spic: 21

$$\text{♀}_1 \frac{- \quad 56 \quad 81 \quad 167 \quad 266}{6 \quad 15 \quad 16 \quad 22 \quad 12} 304$$

a: 13.8; b: 3.8; c: 8.0; c': 3.2; V: 55%

Other ♂♂s L: 319–340; a: 17.5–21.3; b: 4.1–4.7; c: 6.1–7.2; c': 3.5–4.4; spic: 21–25.

Other ♀♀s L: 301–356; a: 12.8–16.8; b: 4.0–6.5; c: 6.4–7.0; c': 4.1–4.8; V: 46–53%.

Description

Males: The body is cylindrical, attenuating on both anterior and posterior end and has a narrow cervical region (Figure 5C). The mid-body is wider than the rest of the body. The cuticle is finely striated starting from posterior of the cephalic setae (Figure 5E). Somatic setae are 3–4 μm long and in four longitudinal rows.

The amphids are small (2–3 μm wide) and located at 44–54% of the length of the pharyngeal region from the anterior and they have corpus gelatum which is longer in the males than in the females (Figure 5D). The inner labial sensilla are inconspicuous, the six outer labial are papilliform while the four cephalic ones are 3–4 μm long. The stoma is sclerotized and has a large dorsal tooth and two sub-ventral ones. The pharynx is (60–81 μm long) cylindrical with a pyriform terminal bulb which is 70–85% of the cbd in diameter. The nerve ring is located at 65–69% of the length of the pharyngeal region from the anterior. The ventral gland is small and located posterior of the cardia but the gland opening is not obvious. Cardia is prominent.

The reproductive system is diorchic with outstretched, opposed testes located anterior to the left and posterior either to the left or the right of the intestine. The spicules are 1.8–1.9 abd long, curved and with a poorly developed capitulum (Figure 5B). The gubernaculum is 12–15 μm long, parallel to the spicules but curved anteriorly on the dorsal tip. There are two pre-cloacal setae 2–3 μm long, located at 7–10 μm and 23–29 μm away from the cloaca opening (Figure 5A & B).

The tail is 45–52 μm long, conical with a cylindrical tip.

Females: They are similar to males (Figure 5C). The reproductive system is amphidelphic with outstretched ovaries located anterior to the left and posterior to the right or the left of the intestine. Vulva is simple and vagina is long. The uterus contains sperms that are dispersed singly.

Differential diagnosis

Calomicrolaimus jenseni sp. n. is characterised by a small body tapering on both ends and an elongate cervical region, small amphids located at 44–54% of the pharyngeal length from the anterior, short cephalic and somatic setae and a tail with a pointed tip.

Calomicrolaimus jenseni sp. n. resembles *C. rugatus* Lorenzen, 1976 in the shape of the anterior region, the elongate cervical region and the size and location of the amphids. *Calomicrolaimus jenseni* sp. n. differs from *C. rugatus* in that, the latter has prominent thorn-like cervical setae, sexual dimorphism in the size of the amphids and body length (L=585–630 μm in *C. rugatus* compared to 304–356 μm in *C. jenseni* sp. n.).

Ixonema Lorenzen, 1971

Ixonema deleyi sp. n. (Figures 6A–F and 7A–G)

Type material

Eight males and eight females in slide numbers RI582–RI583 and 10471–10479.

Etymology

The species name is given for Dr Paul Deley of the University of Ghent.

Type locality

Males are from sts. 117, 120, 503, 506, 511 (2) and 550 (2 including ♂₁) and females are from sts. 119, 503 (2), 505, 511 (2 including ♀₁), 514 and 550.

Measurements

$$\sigma_1 \frac{- \begin{array}{cccc} 47 & 75 & M & 286 \\ 7 & 16 & 17 & 21 & 14 \end{array}}{321}$$

a: 15.3; b: 4.3; c: 9.2; c': 2.5; spic: 27

$$\varphi_1 \frac{- \begin{array}{cccc} 57 & 85 & 177 & 319 \\ 7 & 14 & 15 & 26 & 11 \end{array}}{367}$$

a: 14.1; b: 4.3; c: 7.7; c': 4.4; V: 48%

Other ♂♂s L: 250–405; a: 14.7–22.5; b: 4.0–4.9; c: 7.9–9.1; c': 2.5–3.8; spic: 22–27

Other ♀♀s L: 245–385; a: 12.3–15.1; b: 3.6–4.7; c: 7.3–8.6; c': 2.6–4.5; V: 48–52%

Description

Males: The body is cylindrical, short and plump, attenuating on both ends and thick in the middle (Figure 6C). The cuticle is very finely striated (Figure 7D).

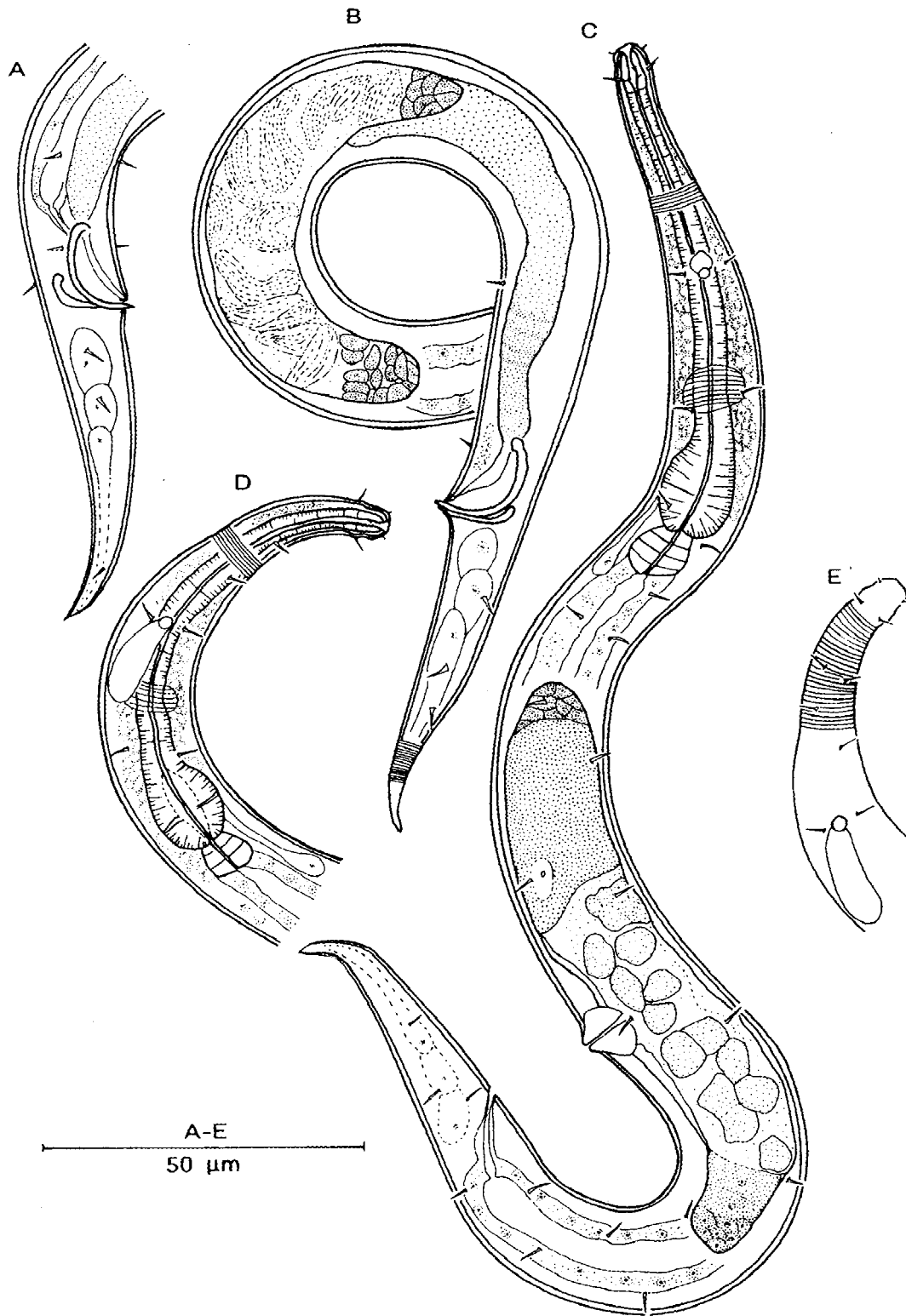


Figure 5. *Calomicrolaimus jenseni* sp. n.; A: ♂₁ tail, B: ♂₂ reproductive system and tail region, C: ♀₁ total body, D: ♂₁ pharyngeal region, E: cervical region (superficial) ♂₁

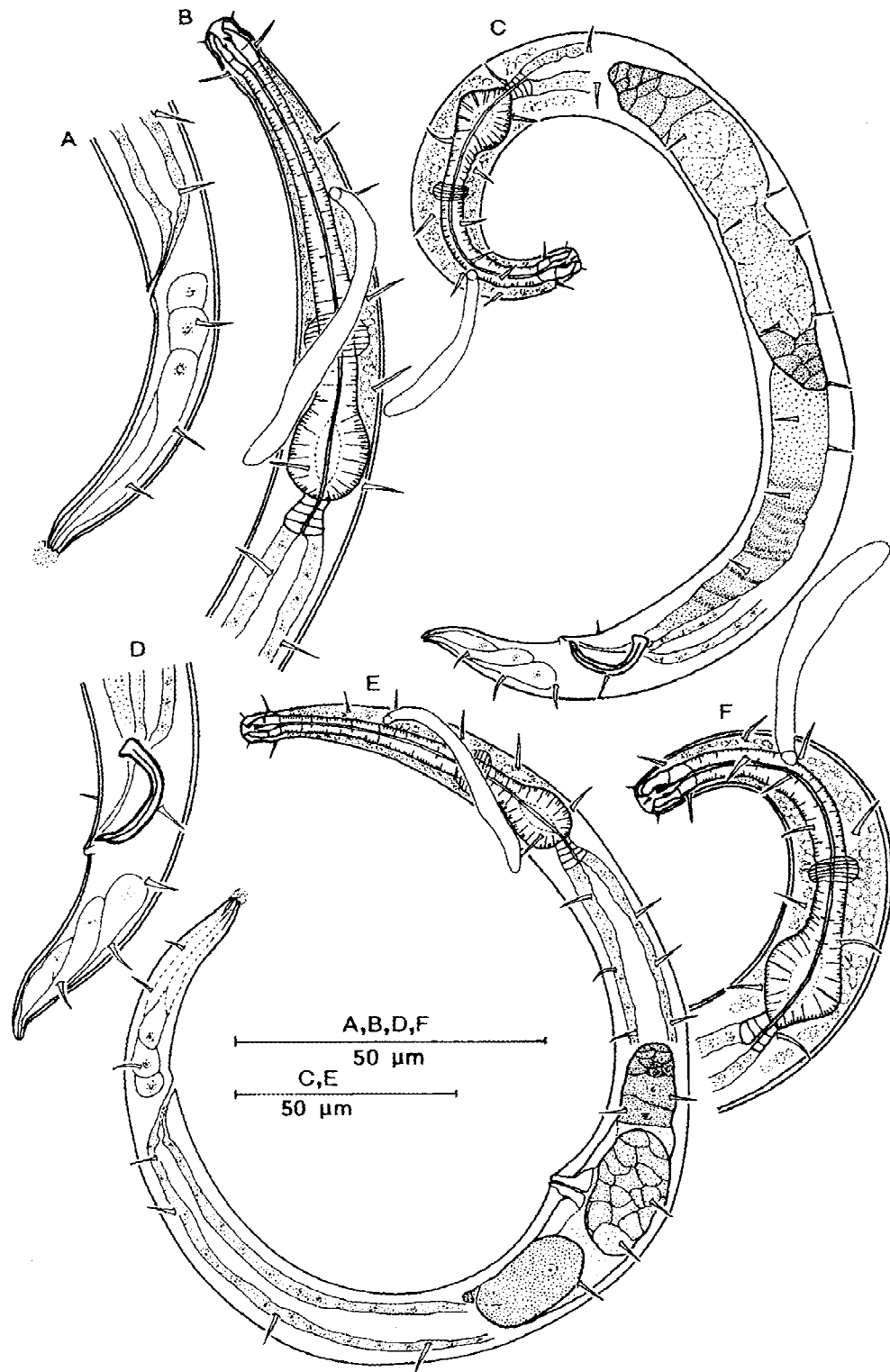


Figure 6. *Ixonema deleyi* sp. n.; A: ♀₁ tail, B: ♀₁ pharyngeal region, C: ♂₁ tail, D: ♂₁ tail, E: ♀₁ total body, F: ♂₁ pharyngeal region.

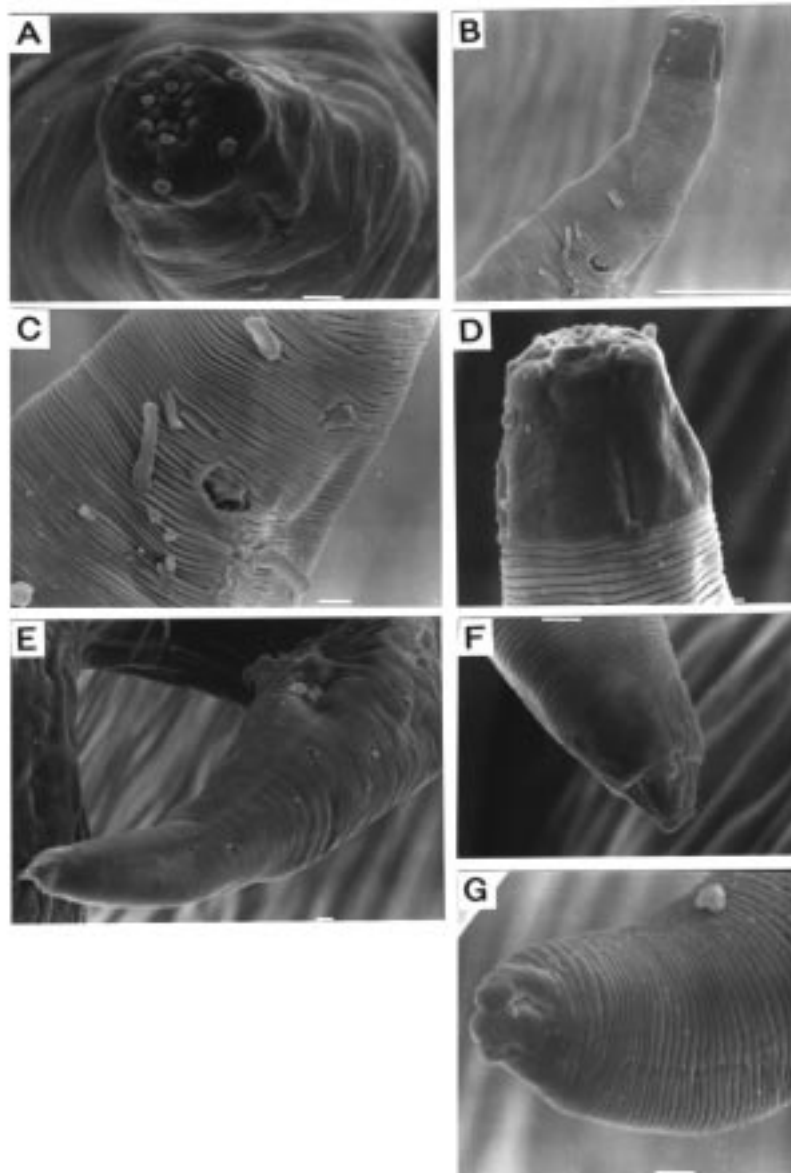


Figure 7. *Ixonema deleyi* sp. n.; A: ♂₂ anterior view, B: ♂₂ cervical region showing position of amphids, C: ♂₂ amphids, D: ♂₂ head region (lateral), E: ♂₂ tail region, F: ♂₂ tail tip, G: ♀₂ tail tip, (Scale bars = 1 μm in A, C–G and 10 μm in B).

only seen by SEM. Somatic setae are 5–6 μm long, thick and in four longitudinal rows (Figure 6C).

The amphids are circular (Figure 7C), 1–2 μm in diameter and located at 30–45% of the length of the pharyngeal region from the anterior and has a long rod-like corpus gelatum (Figure 6F). The inner and outer labial sensilla are papilliform (Figure 7A) and the four cephalic ones are setiform, 4–5 μm long. The stoma is sclerotized and has a big dorsal tooth and two sub-ventral ones. The pharynx has a well developed

terminal bulb which is 70–85% of the cbd in width. The nerve ring surrounds the pharynx at 60–70% of the length of the pharyngeal region from the anterior (Figure 6F). The ventral gland and its outlet were not seen. Cardia is prominent (5–6 μm long).

The reproductive system is dioecious with outstretched testes located (most) anterior to the left and posterior to the right of the intestine or (rare) both anterior and posterior testes to the right or the left of the intestine (Figure 6C). The spicules are 1.7–2.3

abd long, massive and curved (Figure 6D). There is one ventral seta located at 7 μm anterior of the cloaca opening.

The tail is short (36–46 μm long), cylindrical with a blunt tip (Figure 6D & Figure 7E) where the three caudal glands open through separate outlets (Figure 7F).

Females: They are similar to males (Figure 6A, B, E & Figure 7G). The reproductive system is amphidelphic with outstretched ovaries located anterior to the left and posterior to the right of the intestine or both anterior and posterior to the right or the left of the intestine. Vulva is simple and vagina is long.

Differential diagnosis

Ixonema deleyi sp. n. is characterised by short (< 400 μm long) stout body with a narrow elongate cervical region, small (1–2 μm) circular amphids located at 30–45% of the pharyngeal length from the anterior, strong spicules with a poorly developed capitulum.

Two other *Ixonema* species described are: *I. powelli* Jensen, 1985 and *I. sordidum* Lorenzen, 1971. *Ixonema deleyi* sp. n. can be distinguished from them in the body size which is <400 μm long while the other species (*I. powelli* and *I. sordidum*) are longer 500 μm and the shape of the spicules which are arcuate and with a capitulum. It also differs from *I. powelli* in the shape of the amphids (circular in *Ixonema deleyi* sp. n. and pocket-shaped in *I. powelli*).

Remarks

Smooth cuticle is used as a generic character for *Ixonema*, (Lorenzen, 1971), however scanning pictures reveal that the cuticle actually has fine annuli or striations.

Microlaimus de Man, 1880

Additional description of *Microlaimus texianus* Chitwood, 1951 is given and two new species, *Microlaimus minutus* sp. n. and *Microlaimus pwani* sp. n. are described.

Microlaimus texianus Chitwood, 1951 (Figure 8A–H)

Material studied

Ten males and six females on slide numbers RI584–RI585 and 10480–10492.

Locality

Males from sts. 108 (3 including σ_1), 111, 114, 514 (4) and 528, females from sts. 108 (2 including φ_1), 506, 514, 528 and 550.

Measurements

$$\sigma_1 \frac{- \quad 48 \quad 78 \quad M \quad 560}{7 \quad 15 \quad 15 \quad 19 \quad 17} 619$$

a: 32.6; b: 7.9; c: 10.9; c': 3.4; spic: 25

$$\varphi_1 \frac{- \quad 43 \quad 76 \quad 321 \quad 605}{7 \quad 15 \quad 18 \quad 23 \quad 12} 675$$

a: 29.3; b: 8.9; c: 9.6; c': 5.8; V: 48%

Other σ 's L: 559–736; a: 31.0–39.4; b: 7.2–9.1; c: 9.7–12.7; c': 3.2–3.9; spic: 24–30.

Other φ 's L: 491–675; a: 27.3–34.9; b: 7.7–8.5; c: 8.5–9.9; c': 5.1–6.3; V: 47–51%.

Additional description

Males: The body is cylindrical, attenuating more at the posterior end than at the anterior end (Figure 8F). There is a slight constriction posterior of the head, thereby giving the impression of a slightly set off head. Cuticle is annulated with annuli beginning at the constriction. Each annule is ornamented with a fine striation at the middle (Figure 8B). Somatic setae were not seen except at the tail where there are two rows on each sub-lateral side of the body. Hypodermal glands were not seen.

The amphids are simple spiral with the spiral origin obvious on the ventral side; they are 60–75% of the cbd in diameter and located at 8–11 μm from the anterior end. In some individuals there is corpus gelatum from the amphids (Figure 8C). The labial sensilla are inconspicuous. The four cephalic ones are 3–4 μm long and located at the level of the constriction. The stoma is small with a dorsal tooth and two smaller sub-ventral ones (Figure 8B). The pharynx (75–89 μm long) has a well-developed terminal bulb which is 71–76% of the cbd. The nerve ring is located at 47–50% of the length of the pharynx from the anterior. The ventral gland is large, and located posterior of the cardia and the gland opening is at the level of the nerve ring. Cardia is prominent (Figure 8D).

The reproductive system is monorchic with an outstretched anterior testis located to the right or left of the intestine (Figure 8F). The sperm cells are large, elongate and striated. The spicules are 1.5–1.7 abd in length, curved and they have a poorly developed capitulum (Figure 8E). The gubernaculum is 11–13 μm

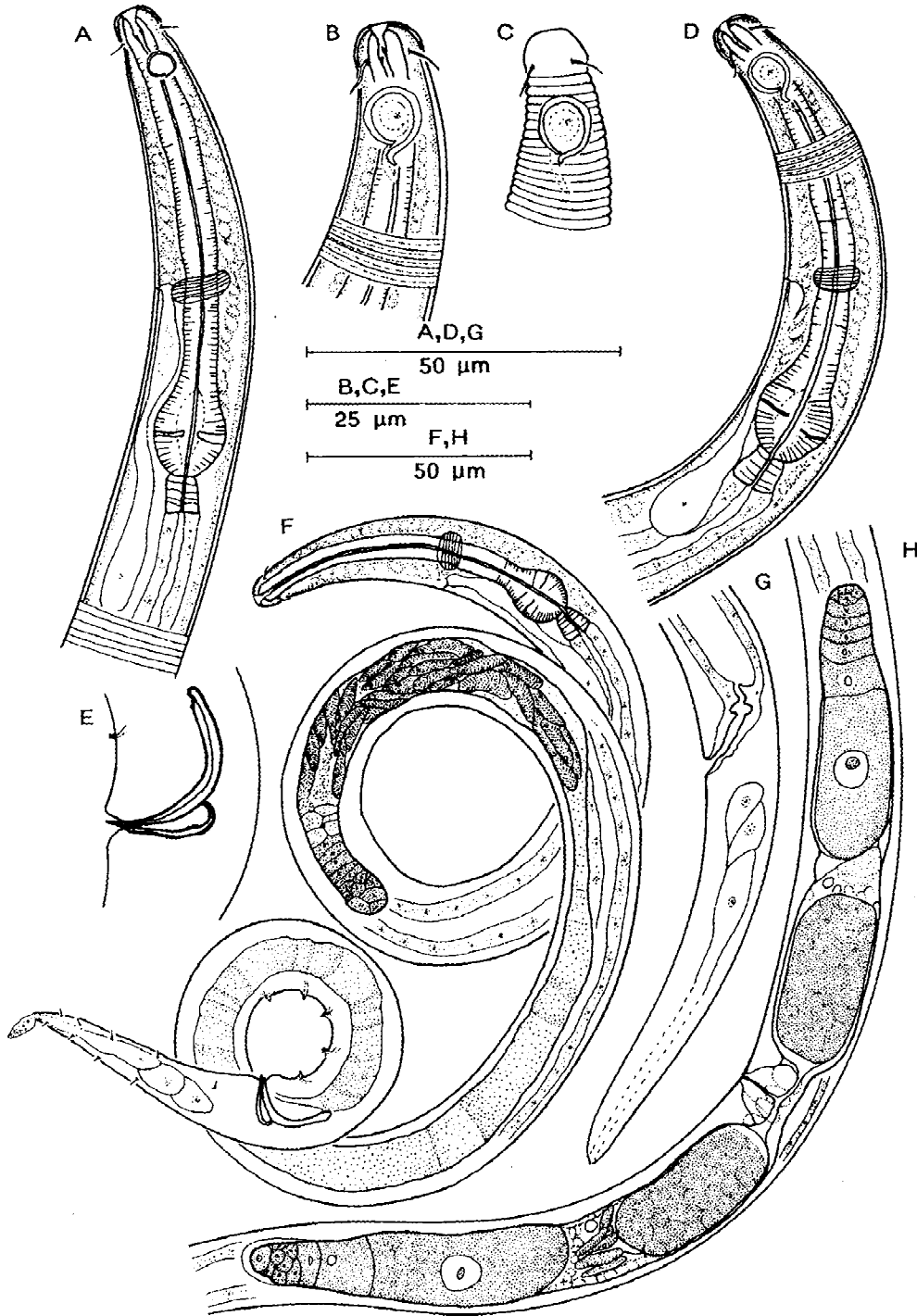


Figure 8. *Microlaimus texianus* Chitwood, 1951; A: ♀₁ pharyngeal region, B: ♂₁ stoma, C: ♂₁ head (superficial), D: ♂₁ pharyngeal region, E: ♂₁ spicules, F: ♂₁ total body, G: ♀₁ tail, H: ♀₁ reproductive system.

long and curved ventrally on the anterior end. There are five pre-cloacal supplements located between 7–13 μm and 44–81 μm from the cloaca opening.

Tail is conical with an elongate cylindrical end. The three caudal glands are arranged in tandem (Figure 8F).

Females: They are similar to males in most aspects (Figure 8A & H). The amphids are however, smaller, 44–55% of cbd and located at 8–12 μm from the anterior end (Figure 8A). The reproductive system is amphidelphic with outstretched ovaries located anterior one either to the right (often) or left of the intestine and the posterior one on the opposite side. There are large eggs (39 \times 17 μm in dimensions) on each side of the uterus suggesting that ovulation takes place simultaneously from both ovaries. Vulva and vagina are simple (Figure 8H). The tail is also longer (Figure 8G) (see c' and c-ratio values).

Discussion

Microloaimus texianus was first described by Chitwood, 1951 with only females. Wieser, 1954 described another population with males. The present population has been identified as *M. texianus* because of the general body shape, measurements and ratios which are similar to the original population. There are, however, slight differences between the present population and that of Wieser:

- There is no sexual dimorphism in the amphids size in the population of Wieser
- The size of the gubernaculum differs markedly (22–24 μm compared to 11–13 μm in the present population).
- Although Wieser depicts presence of pre-cloacal supplements in males (Figure 133b), he does not mention the number in total and we can only assume that they are five like in our population.
- Finally, our population has males that possess only an anterior testis and since there is no mention of the reproductive system in Wieser's population, so we cannot know the condition in that population.

So far this is the only *Microloaimus* species described with only one testis. Single anterior testis is a character found in *Molgolaimus* (and partly in *Aponema*) Jensen, 1978. However, this species has outstretched ovaries while in *Molgolaimus* the females have reflexed ovaries. Lorenzen (1980) argues that it is more likely that the posterior testis is lost independently (in the case of *Aponema*) than that the ovaries have become reflexed independently. And *Aponema* is char-

acterised mainly by the highly sclerotized copulatory apparatus especially the gubernaculum which possesses a dorso-caudal apophysis (Jensen, 1978) which is not the case in this species.

In conclusion, therefore, we shall leave this population as *Microloaimus texianus* because it resembles the original population morphologically. Although, *Microloaimus texianus* and *M. cyatholaimoides* de Man, 1922 resemble closely, we agree with Hopper and Meyer, 1967, to keep the two species separately since there are no hypodermal glands in *M. texianus*.

Microloaimus minutus sp. n. (Figure 9A–F)

Type material

Six males and nine females on slide numbers RI586–RI587 and 10493–10503.

Etymology

Species named because of the small size.

Type locality

Males from sts. 133 (3 including σ_1), 503, 505 and 518. Females from sts. 133 (5), 105, 531 (φ_1) and 550 (2).

Measurements

$$\sigma_1 \frac{-69 \quad M \quad 244}{6 \quad 13 \quad 15 \quad 12} 294$$

a: 19.6; b: 4.3; c: 5.7; c' : 4.3; spic: 12

$$\varphi_1 \frac{-49 \quad 103 \quad 163}{5 \quad 12 \quad 12 \quad 8} 202$$

a: 16.8; b: 4.1; c: 5.2; c' : 4.9; V: 51%

Other $\sigma\sigma$ s L: 211–296; a: 18.9–20.7; b: 4.3–4.8; c: 4.9–7.0; c' : 3.5–4.7; spic: 12–15.

Other $\varphi\varphi$ s L: 217–291; a: 13.6–17.7; b: 3.8–4.3; c: 5.2–7.2; c' : 3.0–6.0; V: 47–52%.

Description

Males: The body is cylindrical and narrows on both ends. Head is not set off (Figure 9F). The cuticle is annulated with annuli starting posterior of the cephalic setae (Figure 9A). Somatic setae were not seen.

The amphids are (4–5 μm) 56–62% of cbd in diameter, simple spiral, with the spiral origin sometimes being obvious on the ventral side. They are located at 11–15 μm from the anterior end (Figure 9A). The inner and outer labial sensilla are inconspicuous and the four cephalic ones are very short and located just anterior of the first annule. The pharynx is cylindrical

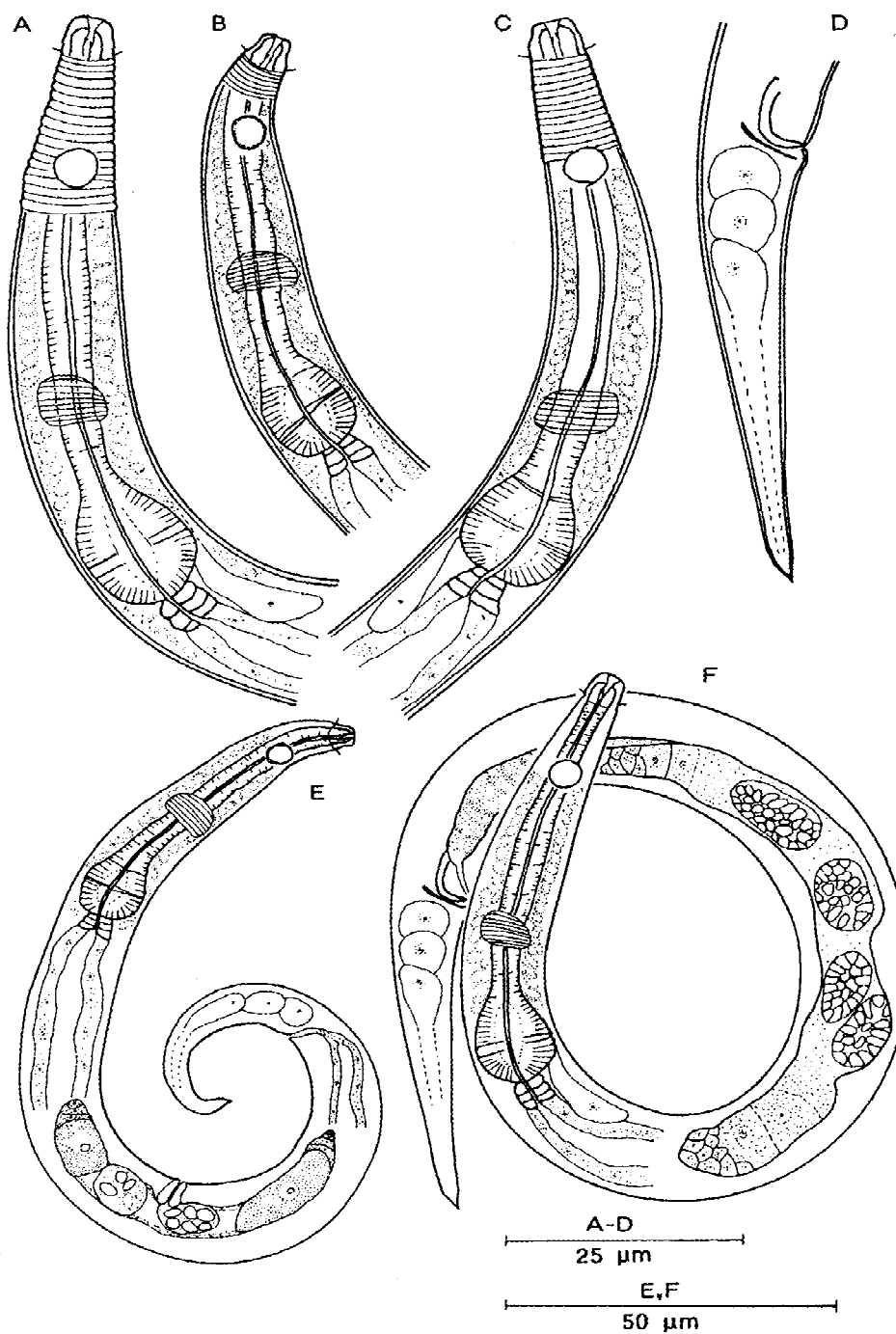


Figure 9. *Microlaimus minutus* sp. n.; A: σ_1 pharyngeal region, B: φ_1 pharyngeal region, C: φ_2 pharyngeal region, D: σ_1 tail, E: φ_1 total body, F: σ_1 total body.

(46–69 μm long) with a well developed, pyriform bulb, which is 80–85% of cbd in diameter (Figure 9A). The nerve ring is located at 58–65% of the length of

the pharynx from the anterior. The ventral gland is small and located posterior of the cardia, but the gland opening was not seen.

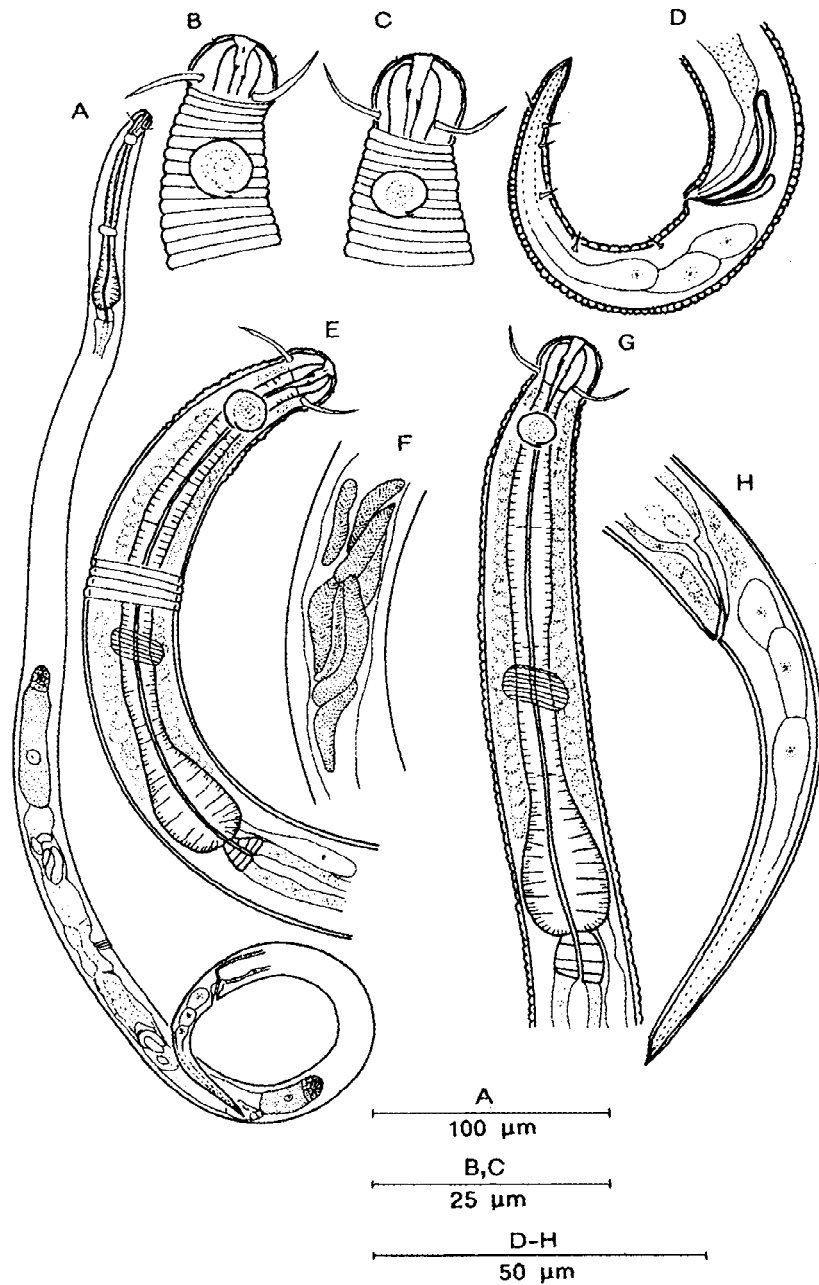


Figure 10. *Microlaimus pwani* sp. n.; A: ♀₁ total body, B: ♂₁ head (superficial), C: ♀₁ head (superficial), D: ♂₁ total body (left side), E: ♂₁ pharyngeal region (right side), F: ♂₁ spermatozoa, G: ♀₁ pharyngeal region, H: ♀₁ tail.

The reproductive system is dioecious with outstretched testes often located to the left of the intestine. The sperms are oval to rounded clusters, which enclose several sperms. The spicules are 1.0–1.7 abd long, slightly curved and with a poorly developed ca-

pitulum (Figure 9D). The gubernaculum is simple, 5–6 μm long.

The tail is 43–52 μm long, conical cylindrical in shape. The caudal glands are arranged in tandem.

Females: They are similar to males (Figure 9B, C & E). The reproductive system is amphidelphic with outstretched ovaries, located like in the males to the left of the intestine. The uterus may contain one or two clusters of sperms. The vulva is simple and the vagina is long.

Differential diagnosis

Microlaimus minutus sp. n. is characterised by a small (<300 μm long) body that is often curved or coiled; an elongate cervical region, amphids located at 11–15 μm from the anterior end sperms that are in oval to round clusters and short simple spicules.

Microlaimus minutus sp. n. resembles *M. copulatus* Jensen, 1988 in general body shape and de Mans ratios. The two species, however, differs in the shape and the size of the spicules (in *M. copulatus* the spicules have a peculiar shape and they are twice abd), gubernaculum which has a highly sclerotized piece in front of the cloaca and the presence of a single pre-cloacal supplement in *M. copulatus*; besides, *M. minutus* sp. n. is shorter (L=211–296 μm in males and 202–291 μm in females) than *M. copulatus* (L=320–330 μm in males 340–350 μm in females).

Microlaimus pwani sp. n. (Figure 10 A–H)

Type material

Four males and four females on slide numbers RI588–RI589 and 10504–10508.

Etymology

The species name is the Kiswahili word for Coast.

Type locality

All the specimens are from st. 503 except one male that is from st. 550.

Measurements

$$\sigma_1 \frac{- \quad 56 \quad 93 \quad M \quad 735}{9 \quad 14 \quad 14 \quad 15 \quad 14} 799$$

a: 53.3; b: 8.6; c: 12.5; c': 4.6; spic: 22

$$\varphi_1 \frac{- \quad 56 \quad 95 \quad 391 \quad 640}{10 \quad 16 \quad 16 \quad 20 \quad 13} 710$$

a: 35.5; b: 7.5; c: 10.1; c': 5.4; V: 55%

Other $\sigma\sigma$ s L: 735–792; a: 45.5–50.3; b: 8.3–8.9; c: 11.7–13.0; c': 4.1–5.3; spic: 21–24.

Other $\varphi\varphi$ s L: 719–759; a: 38.0–42.3; b: 7.5–8.4; c: 10.0–10.1; c': 5.1–5.9; V: 52–55%.

Description

Males: The body is cylindrical, long and slender. The head is slightly set off and the posterior end is attenuating. The cuticular annulations are quite conspicuous and starts posterior of the cephalic sensilla (Figure 10B). The somatic setae were not seen except at the tail region which has a sub-ventral row and probably a sub-dorsal one on each side.

The inner labial sensilla are inconspicuous, the six outer ones are papilliform and the four cephalics are 7–9 μm long (Figure 10B). The amphids are 50–55% of cbd (5–6 μm) in diameter, simple spiral, with the spiral origin being obvious and located at 11–13 μm away from the anterior end. The stoma is sclerotized and has one dorsal and two sub-ventral teeth. The pharynx is 89–93 μm long, cylindrical with a poorly developed pyriform bulb, which is 75–80% of cbd in diameter (Figure 10E). The nerve ring is located at 59–60% of the length of the pharynx from the anterior. The ventral gland is located posterior of the cardia and the gland opening was not seen. Cardia is 6–7 μm long and prominent.

The reproductive system is diorchic with opposed and outstretched testes located anterior either to the left or the right and posterior to the opposite side of the intestine. The sperms are elongate sausage-shaped and striated (Figure 10F). The spicules are 1.6–1.8 abd in length slightly curved and with a poorly developed capitulum. The gubernaculum is simple, 10–12 μm long, and parallel to the spicules (Figure 10D).

The tail is 58–64 μm long, slightly conical anteriorly and cylindrical on the posterior end. The caudal glands are in tandem.

Females: They are similar to males (Figure 10A, C, G & H). However, the amphids are slightly smaller 42–50% cbd in diameter. The reproductive system is amphidelphic with outstretched ovaries, located like in the males, anterior to the right or the left and the posterior to the opposite side of the intestine. Vulva and vagina are simple. The tail is also longer (70–76 μm long) than in males although the L is higher in males than in females.

Differential diagnosis

Microlaimus pwani sp. n. is characterised by cuticle with prominent annuli, papilliform outer labial and long (one hd in length) setiform cephalic ones, long sausage-shaped striated sperms and simple curved spicules.

Microloaimus pwani sp. n. resembles *M. acinaces* Warwick & Platt, 1973, *M. borealis* Steiner, 1916, *M. ostracion* Schuurmans Stekhoven, (1964) 1966 and *M. sensus* Wieser, 1954 in the length of the cephalic setae in relation to hd. *M. pwani* sp. n. can be distinguished from *M. acinaces* in the shape (sickle-shaped) of the spicules and the presence of pre-cloacal supplements in *M. acinaces*. *Microloaimus pwani* sp. n. differs from *M. borealis* in the large dorsal tooth and long slender spicules present in *M. borealis*. *M. pwani* differs from the other two (*M. ostracion* and *M. sensus*) in the nature of the cuticle (*M. ostracion* has cuticular ornamentation while *M. sensus* has fine annuli).

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