

Eight new Afrotropical *Spinitectus* spp. (Nematoda: Cystidicolidae) from freshwater fishes with a key to the members of the genus in the Region

J. BOOMKER¹ and F.A. PUYLAERT²

ABSTRACT

BOOMKER, J. & PUYLAERT, F.A. 1994. Eight new Afrotropical *Spinitectus* spp. (Nematoda: Cystidicolidae) from freshwater fishes with a key to the members of the genus in the Region. *Onderstepoort Journal of Veterinary Research*, 61:127–142

Seven new species of the genus *Spinitectus* Fourment, 1883, recovered from several species of freshwater fishes from West and Central Africa, are described. The eighth species, *Spinitectus allaeri* Campana-Rouget, 1961 recorded by Moravec (1974) in Egypt, is assigned to *Spinitectus moraveci* n. sp.

The new and known species have been divided into three groups according to the number of spines in the first row behind the anterior end. The *Spinitectus* spp. in Group A have fewer than 20 spines in the first row and the group contains *Spinitectus mormyri* Campana-Rouget, 1961, *Spinitectus thurstonae* Ogden, 1967 and *Spinitectus micropectus* n. sp. Those in Group B have between 20 and 40 spines in the first row and comprise the species *S. allaeri*, *Spinitectus menzalei* Hugot, 1979, *Spinitectus maleficus* n. sp., *Spinitectus macilentus* n. sp., *Spinitectus minusculus* n. sp., *Spinitectus macherius* n. sp., *Spinitectus mucronatus* n. sp. and *Spinitectus moraveci* n. sp. Group C species have more than 45 spines in the first row and consist of *Spinitectus polli* Campana-Rouget, 1961, *Spinitectus petterae* Boomker, 1993, *Spinitectus zambezensis* Boomker, 1993, and *Spinitectus monstrosus* n. sp.

The species that are quite distinctive are *S. mucronatus*, which has characteristic spinulation and lateral floats on the eggs; *S. monstrosus*, which has characteristic spinulation and an exceptionally long left spicule; *S. micropectus*, which has approximately 80 rows of large spines and six post-cloacal papillae and *S. maleficus*, that has approximately 20 rows of large spines and seven post-cloacal papillae. The remaining species can be differentiated by the number of spines in the first row, the number of post-cloacal papillae, the number of labial papillae and, in the females, the distance between the anus and the vulva and the position of the gravid uterine coils in relation to the anterior end.

S. moraveci differs from *S. allaeri* in that the first six rows of spines are raised, giving the anterior end an inflated appearance, in the number of post-cloacal papillae, and in that the distance between the anus and the vulva is considerably shorter.

There are distinct morphological similarities between the *Spinitectus* species recovered from *Heterobranchus isopterus* and/or *Clarias vanderhorsti* (Clariidae) in Liberia, Ivory Coast and Sierra Leone, those recovered from *Mormyrus* spp. (Mormyridae) in western Zaire, Angola and Cameroon, and those recovered from *Mastacembelus* spp. (Mastacembelidae) in eastern Zaire. The differences lie mainly in the spinulation and the position at which the excretory pore opens, and they may be the result of host influence or represent adaptive radiation in the various regions.

The affinities of the different species are discussed and a key to the members of the genus in Africa is provided.

INTRODUCTION

The genus *Spinitectus* Fourment, 1883 consists of a large number of species that have been described from the digestive tracts of both marine and freshwater fishes, especially in the northern hemisphere and South

¹ Department of Veterinary Pathology, Medical University of Southern Africa, P.O. Box 176, Medunsa, 0204 South Africa

² Musée Royal de l'Afrique Centrale, Section Invertébrata, B-3080 Tervuren, Belgium

America. The genus is poorly known in Africa and only eight species have been described to date. These are *Spinitectus allaeri* Campana-Rouget, 1961, *Spinitectus mormyri* Campana-Rouget, 1961, *Spinitectus polli* Campana-Rouget, 1961, *Spinitectus thurstonae* Ogden, 1967, *Spinitectus petterae* Boomker, 1993 and *Spinitectus zambezensis* Boomker, 1993, all from freshwater fishes. *Spinitectus camerunensis* Vaucher & Durette-Desset, 1980 was described from the frog, *Pedropedetes newtoni* (Bocage) and *Spinitectus menzalei* Hugot, 1979 from the otter shrew, *Potamogale velox* du Chaillu.

Material collected from a number of freshwater fishes of the families Clariidae, Mastacembelidae and Mormyridae in several African countries, is described here. *S. allaeri* recovered from *Bagrus bayad*, *Bagrus docmac*, *Synodontis schall*, and *Lates lates* in Egypt (Moravec 1974) is considered a distinct species for reasons given below. This brings the number of *Spinitectus* species described from the continent to 16.

MATERIALS AND METHODS

The specimens examined during this study originated from the collection of the Musée Royal de l'Afrique Central (MRAC), Belgium. All the specimens have been returned and deposited under their respective MRAC access numbers.

The nematodes were initially examined in water and, if necessary, cleared in lactophenol. Measurements were made by measuring drawings of the material; these were made with a Wild compound microscope and a drawing tube. Measurements given are those of the holotype or allotype and, where available, followed by those of the paratypes (in parentheses). All measurements are given in micron (μm).

Temporary en face preparations were made by hand-cutting sections of the anterior end and mounting these in water or lactophenol. The anterior end was not removed from the holotype and/or allotype specimens and those of the paratype and other specimens examined were returned to the tubes in which the particular worms are stored.

The species have been divided into three groups, depending on the number of spines in the first row. Group A has fewer than 20 spines, Group B has between 20 and 40 spines and group C has more than 40 spines in the first row, and they are described accordingly.

FAMILY CYSTIDICOLIDAE SKRJABIN, 1946

Characterization of the genus *Spinitectus* Fourment, 1883

Spirurida: anterior end retractile, pseudolabia relatively large, without teeth, and with enlarged anterior border covering the greater part of the oral opening; papillae

usually reduced to four (eight in some species) at the base of the pseudolabia. Pharynx cylindrical, relatively short; oesophagus clearly divided into anterior muscular and posterior glandular parts. Cuticle with transverse rows of posteriorly directed spines, often on a swollen base. Anteriorly, the spines are close together and are interrupted laterally to form two semi-circles; spines decreasing in size and number posteriorly. Males with spirally coiled tail, narrow caudal alae; usually four pairs of pre-cloacal papillae, but these may be absent or there may be more than four pairs; usually six to seven pairs of post-cloacal papillae, more in some South American species. Spicules unequal in length, lightly sclerotized. Females usually straight; vulva in posterior third of the body (pre-equatorial in some Indian species); oviparous. Eggs small with a thick shell, sometimes with polar plugs or filaments, or lateral floats (amended from Baylis & Daubney 1926; Skrjabin 1949; Chabaud 1975).

DESCRIPTION OF THE SPECIES

Group A

Spinitectus micropectus n. sp. (Fig. 1)

Body relatively long and slender; first row with 16 spines, eight in each semi-circle; first two rows of spines on large, lightly sclerotized bases, giving the anterior end in that region an inflated appearance; bases become unapparent after about row five and spines only gradually diminish in size, those in the 80th row being almost the same length as those in the third row. Pseudolabia each with two lateral papillae and a median amphid, all relatively large. Anterior end of oesophagus slightly in front of the first row of spines. Nerve ring between second and third rows of spines; excretory pore opens ventrally at the level of the fifth row.

MALES

Anterior rows of spines contiguous, becoming dissociated from about row ten onwards; approximately 165 rows of spines discernable, after which they become widely dispersed and difficult to see. Body 4 005 (4 362–4 812) long, 49 (62–66) wide; nerve ring 40 (46–50), excretory pore 95 (79–114) from end of pharynx; pharynx 38 (36–45), muscular oesophagus 155 (179–188), glandular oesophagus 930 (1 072–1 465), total oesophagus length 1 085 (1 251–1 653). Right spicule 60 (52–62), left spicule 337 (373–470) long, ratio of right:left spicule 1:5.62 (1:7, 17–7.58), tail 84 (98–104) with a fairly long finger-like terminal process. Right spicule stout, left spicule slender. Four pair pre-cloacal papillae, six pairs post-cloacal papillae, arranged as three pairs of fairly large papillae close together near the cloaca, a single pair separated some distance from those nearer the cloaca and two small pairs near the tip of the tail. Area rugosa extends for 198 anterior of the cloaca.

FEMALES

Unknown.

males, MRAC 35.818 from the same host and locality.

TYPE HOST

Mastacembelus micropectum (Mastacembelidae).

ETYMOLOGY

The species is named after its host.

HABITAT

Mucosa of stomach.

COMMENTS

S. micropectus differs from *S. mormyri* and *S. thurstonae*, the other two species in this group, in having fewer and smaller spines in the first row, in being thinner with a minimum of 80 rows of large spines. *S. mormyri* has 11 complete rows of spines that are

TYPE MATERIAL

Holotype male, MRAC 35.818, Makobola, Zaire (Lake Tanganyika), date unknown; paratypes, two

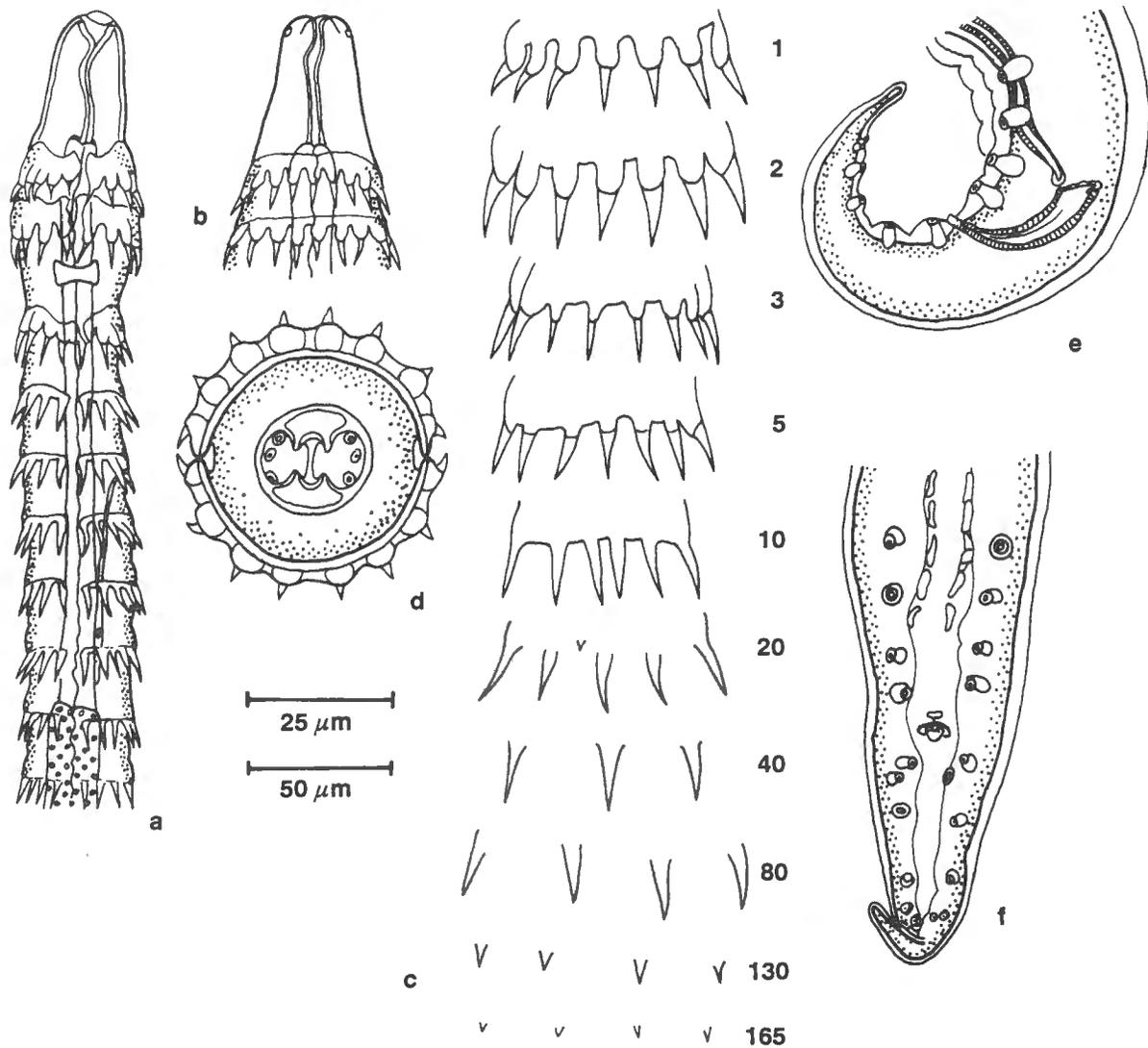


FIG. 1 *Spinitectus micropectus*: a. Anterior end of a paratype male, lateral view. b. Head, holotype male, dorsal view. c. Spines, holotype male, row number indicated. d. Apical structures and cross-section of first row of spines. e. Posterior end, holotype male. f. Posterior end, ventral view, paratype male

Scale bars: c, d, 25 μm; a, b, e, f, 50 μm

easily visible and there are 18 complete rows in *S. thurstonae* (Campana-Rouget 1961; Ogden 1967).

Group B

Spinitectus maleficus n. sp. (Fig. 2)

First row of spines rather small; subsequent rows becoming increasingly larger until about row ten, then gradually decreasing in size; 28–36 spines in the first row; anterior spines seated on distinct, inflated bases. Anterior part of body narrow but increasing gradually in width posteriorly; anterior region not inflated. Apical structures not seen. Anterior end of oesophagus in front of the first row of spines. Nerve ring at the level of the second row of spines or between the second and the third rows. Excretory pore opens ventrally at the level of the fifth row of spines.

MALES

Twenty-eight spines in the first row. About 76 rows of spines discernable; those in the first ten rows increase in size, those in the next ten gradually become smaller and those following row 20 rapidly become smaller. Only the anterior quarter is covered by visible spines. Body 4 131 (3 220–3 739) long, 167 (80–104) wide; nerve ring 45 (45–52), excretory pore 119 (111) from posterior end of pharynx; pharynx 50 (45–59), muscular oesophagus 237 (191–247), glandular oesophagus 1 041 (847–1 131), total oesophagus length 1 278 (1 038–1 378). Right spicule 59 (59–72), left spicule 508 (425–449), ratio of right:left spicule 1:8,61 (1:5,90–7,61). Right spicule broadly boat-shaped with a rounded tip which is covered by a transparent membrane. Left spicule curves ventrally, ends in a rounded tip which is covered by a membrane; a spur is visible in lateral view.

There are four pairs of pre-cloacal and seven pairs of post-cloacal papillae; the latter arranged as three pairs nearer the cloaca and four pairs nearer the tip of the tail, all in a more or less straight line.

FEMALES

Anterior rows of spines as in the males; first 80 rows of spines easily visible, spines decreasing gradually in length. From row 100 the spines become irregularly scattered prickles that in turn decrease in size until they are no longer visible on the cuticle, 215 behind the glandular oesophagus. Body 6 793 (3 912) long, 153 (94) wide; nerve ring 48 (21), excretory pore 133 (115) from end of pharynx; pharynx 52 (56), muscular oesophagus 250 (178), glandular oesophagus 1 392 (548), total oesophagus length 1 642 (726). Vulva situated 6 086 (3 526) from anterior end, 486 (309) from anus; tail 167 (77). Eggs thick-shelled, 33 x 22, containing a larva when laid. The anterior loops of the gravid uterus end about 550 behind the end of the glandular oesophagus, in the anterior third of the body.

TYPE HOST

Mastacembelus flavidus (Mastacembelidae).

HABITAT

Mucosa of stomach.

TYPE MATERIAL

Holotype male, allotype female, two paratype males and one paratype, an immature female, MRAC 35.813, Makobola, Zaire (Lake Tanganyika), 8.xi.1960.

ETYMOLOGY

The specific name is derived from Latin, meaning 'harmful' and the species is so named after the considerable number of large spines.

COMMENTS

S. maleficus is the only species in group B in which the ten anterior rows of spines gradually increase in size and in which the excretory pore opens at row 5. It is closest to *S. allaeri* but differs from it in the position of the excretory pore and in having seven post-cloacal papillae as opposed to six, and in the females the distance between the vulva and the anus is slightly longer.

Spinitectus macilentus n. sp. (Fig. 3)

Body thin and slender; first four rows of spines noticeably larger than those following, giving the region a distinct inflated appearance in relaxed specimens, less so in contracted ones; first row of spines smaller than those of second row; 32–34 spines in first row, 15–17 in one semi-circle, 17 in the other; loose spines appearing as early as between the sixth and seventh row. Anterior spines seated on inflated, lightly sclerotized bases, which become unapparent from about the eighth row onwards. Pseudolabia each with two large lateral papillae and a smaller median amphid; ornamentation on the lips may resemble additional papillae. Oesophagus starts in front of the first row of spines in relaxed specimens, but in contracted ones it starts at the level of the second row. Nerve ring at second row of spines, between second and third or at third row of spines, depending on state of contraction of the worms; excretory pore at level of fourth row of spines.

MALES

The first four rows of spines are contiguous; spines in fifth row smaller and become separated; approximately 88 discernable rows of spines in anterior half of the body, thereafter spines are reduced to irregularly scattered prickles, few of which are present in the posterior half.

Body 3 605 (2 804–5 770) long, 66 (41–63) wide; nerve ring 20 (26–38), excretory pore 46 (64–88) from end of

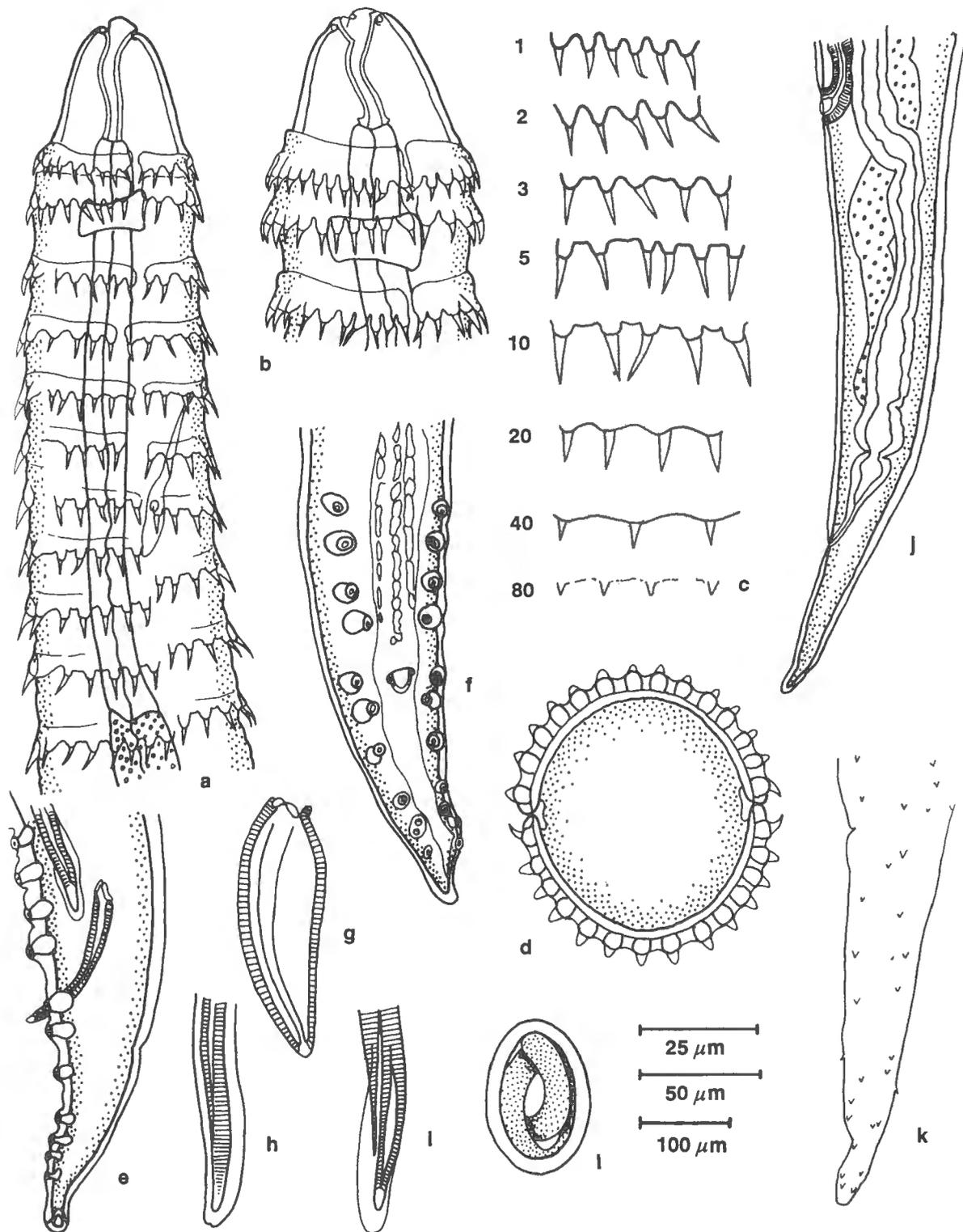


FIG. 2. *Spinitectus maleficus*: a. Anterior end of the holotype male, lateral view. B. Head, lateral view, allotype female. c. Spines, holotype male, row number indicated. d. Anterior row of spines of a male in cross-section. e, f. Lateral and ventral views, male posterior end. g. Right spicule, ventral view. h, i. Left spicule in ventral and lateral views. j. Female posterior end, lateral view. k. Female tail, showing the spinulation. l. Egg.

Scale bars: c, d, g, h, i, l, 25 μ m; j, 100 μ m

pharynx; pharynx 44 (45–65), muscular oesophagus 216 (139–157) long, glandular oesophagus 492 (421–557) long, total oesophagus length 708 (564–710). Right spicule 61 (50–62), left spicule 265 (304–363), ratio of right:left spicule 1:4,34 (1:5,27–6,60); tail 67 (40–69). Tip of right spicule rounded; left spicule en-

closed in a thin membrane which is expanded terminally but does not enclose the tip of the spicule which ends in a fine point.

There are four pairs of pre-cloacal and seven pairs post-cloacal papillae; the latter are arranged in a group

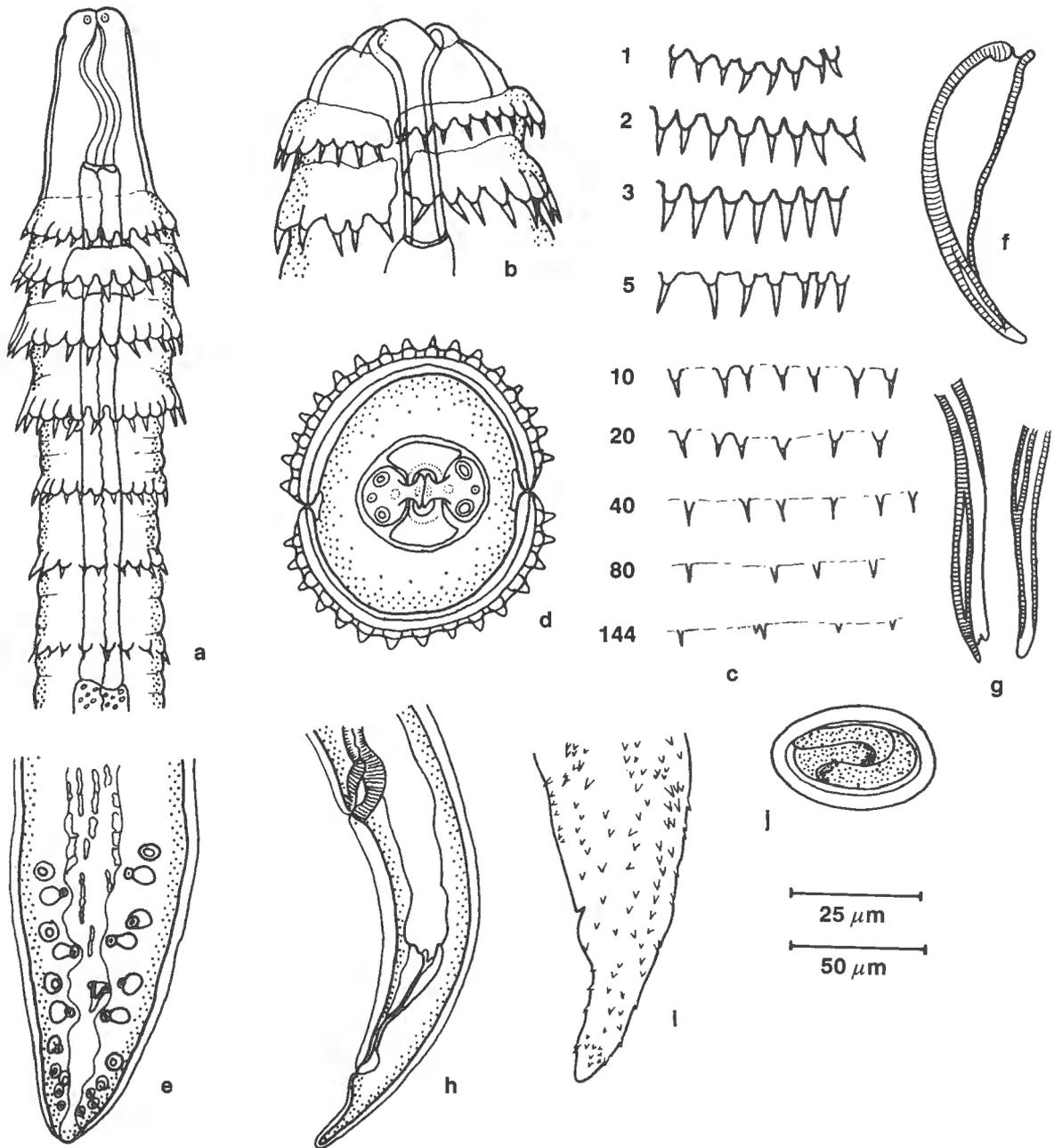


FIG. 3 *Spinitectus macilentus*: a. Dorsal view of anterior end of the allotype female. b. Head, lateral view, holotype male. c. Spines of holotype male, row number indicated. d. Apical structures and cross-section of first row of spines. e. Posterior end, holotype male, ventral view. f. Right spicule, ventrolateral view. g. Left spicule in lateral (left) and ventral (right) views. h. Lateral view of female posterior end. i. Lateral view of female tail, showing spinulation. j. Egg

Scale bars: b, c, d, f, g, i, j, 25 µm; a, e, h, 50 µm

of three pairs of stout papillae nearer the cloaca and four smaller pairs nearer the tip of the tail. Area rugosa 278, not measured in paratype males.

FEMALES

First seven rows of spines contiguous, thereafter becoming single; 115 rows discernable, rows becoming incomplete posteriorly; from row 173 spines become prickles that are visible with difficulty and are scattered across the body; prickles becoming more numerous, but still irregularly scattered, from the vulva to the tip of the tail.

Body 5 459 (3 262–6 726) long, 89 (52–84) wide; nerve ring 45 (29–45), excretory pore 95 (79–84) from end of pharynx; pharynx 64 (46–67), muscular oesophagus 206 (157–187) long, glandular oesophagus 696 (477–642) long, total oesophagus length 902 (634–801). Vulva situated 5 182 (3 104–6 486) from anterior end, 237 (120–203) from anus; tail 40 (38–48). Eggs thick-shelled, 32 x 18 (31–48 x 17–21), containing a larva when laid. Anterior branch of uterus does not extend further cranially than the middle of the body.

TYPE HOST

Heterobranchus isopterus (Clariidae).

HABITAT

Mucosa of stomach.

TYPE MATERIAL

Holotype male, MRAC 34.682, Kombo-Kwaso, Liberia, 8.v.1963; allotype female, MRAC 34.673, Pendetum, Sierra Leone, 20.iv.1963; paratypes, MRAC 34.673, Pendetum, Sierra Leone, 20.iv.1963, six males, three females.

OTHER MATERIAL

Several males and females from *Heterobranchus isopterus* from Zoquin, Ivory Coast, MRAC 34.674.

ETYMOLOGY

The name "macilentus" is derived from the Latin, meaning "thin" or "slender".

COMMENTS

S. macilentus resembles *S. allaeri* only as far as the number of spines in the first row is concerned. The former species has a more slender appearance, there are four anterior rows of raised spines and the spines on the anterior rows are bigger, the left spicule is considerably shorter and the vulva is nearer the anus.

S. macilentus is also near the males of *S. macherius* but differ in the following respects: the former species is more slender, has an oesophagus that is approximately half as long as that of the latter species, the

spicules are considerably shorter and there are seven instead of six papillae behind the cloaca.

S. macilentus differs from *S. moravecii* in having four rows of raised spines, seven post-cloacal papillae as opposed to six rows of raised spines, and six post-cloacal papillae.

Spinitectus minusculus n. sp. (Fig. 4)

Body fairly stout, less than three mm long; 28–39 spines in the first row; first five rows of spines noticeably large, but spines of first row smaller than those of subsequent four rows; spines of sixth row noticeably smaller than those of the preceding rows; spines of anterior rows situated on swollen, semi-circular to elliptical bases. Pseudolabia with two papillae and a median amphid, all rather small. Anterior end of oesophagus at level of second row of spines. Nerve ring situated between rows two and three, excretory pore opens at level of the fourth row.

MALES

First row with 28 spines. Approximately 45 discernable rows of spines, thereafter becoming irregularly dispersed over the posterior third of the body. Body 2 585 (2 239–2 608) long, 79 (80–87) wide; nerve ring 21 (5–7), excretory pore 60 (45–52) from end of pharynx; pharynx 55 (52–55), muscular oesophagus 144 (150–179), glandular oesophagus 628 (505), total oesophagus length 772 (655–684). Right spicule 68 (69–74), left spicule 298 (277–322), ratio of right:left spicule 1:4,38 (1:4,02–5,10), tail 86 (84–90). Tip of right spicule is rounded and covered by a membrane following the contour of the spicule; that of left spicule ends acutely and is covered by a bulbous membrane.

There are four pairs pre-cloacal and six pairs of post-cloacal papillae, the latter grouped into three large pairs nearest the cloaca, and one large and two smaller pairs nearest the tip of the tail. One or two sessile papillae are present immediately in front of the cloaca.

FEMALES

First row with 39 spines. Approximately 94 discernable rows of spines; from row six the spines become discontinuous and after row 94 only a few scattered prickles remain, even on the tail. Body 2 504 (2 493–2 504) long, 79 (118–125) wide; nerve ring and excretory pore not seen in the allotype but 12–22 and 52–72, respectively, in the two paratype females; pharynx 29 (48–60), muscular oesophagus 174 (172–198), glandular oesophagus 569 (532–539), total oesophagus length 743 (711–730). Vulva 2 421 (2 364–2 371) from anterior end, 45 (67–77) from anus, tail 38 (55–63). Eggs 33 x 21 (31–33 x 20–22), with a shell that appears thicker than that of the other species, containing a larva when laid. Anterior branch of the vulva reflects approximately 120 (3&0–485) from the anterior extremity.

TYPE HOST

Heterobranchus isopterus (Clariidae).

HABITAT

Mucosa of stomach.

TYPE MATERIAL

Holotype and allotype female, MRAC 34.679, Zoquin, Ivory Coast, date not given. Paratypes, two males and

two females, MRAC 34.784, from *Clarias vanderhorsti*, Zoquin, Ivory Coast, 20.iii.69.

ETYMOLOGY

The species is named for its size.

COMMENTS

S. minusculus differs from *S. macilentus* and *S. maleficus* in having six post-cloacal papillae instead

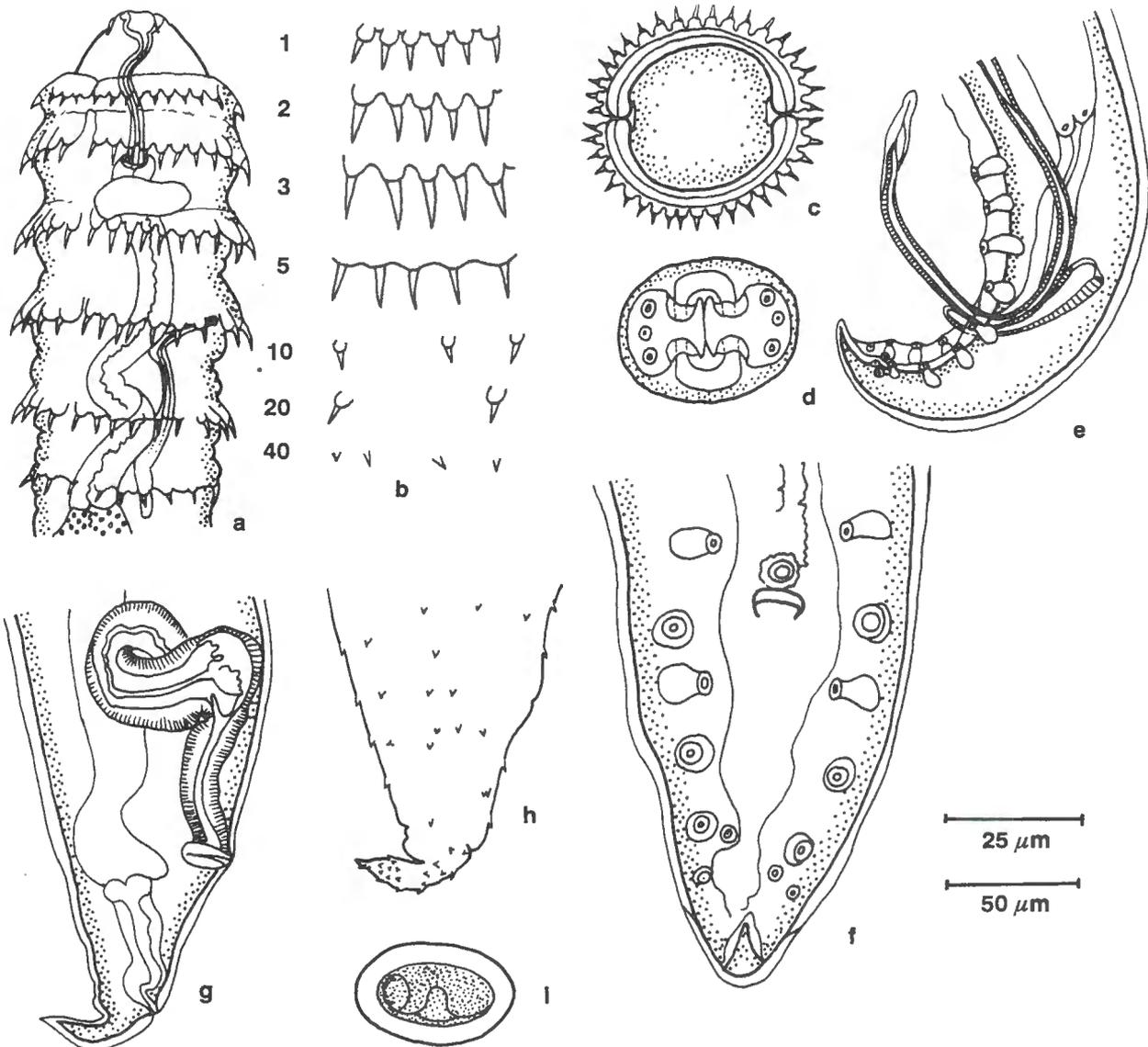


FIG. 4 *Spinitectus minusculus*: a. Lateroventral view of anterior end of the holotype male. b. Spines of holotype male, row number indicated. c. Cross-section of first row of spines of a female. d. Apical structures. e. Posterior end, holotype male, lateral view. f. Ventral view, male posterior end. Note papilla immediately in front of cloaca. g. Female posterior end, lateral view. h. Spinulation of posterior end of a female. i. Egg

Scale bars: b, d, f, g, h, i, 25 µm; a, c, e, 50 µm

of seven. The males of *S. allaeri* and *S. moravecii* differ from *S. minusculus* in having more spines in the first row, longer oesophagi, longer left spicules and slightly longer tails. With the exception of *S. macherius*, of which the females are unknown, the females of *S.*

minusculus differ from the other species mentioned above, in that they have the most spines in the first row, and in the close proximity of the vulva to the anus (45–77 as opposed to 312 in *S. allaeri*, 82–144 in *S. moravecii*, 120–237 in *S. macilentus* and 309–486 in *S. maleficius*).

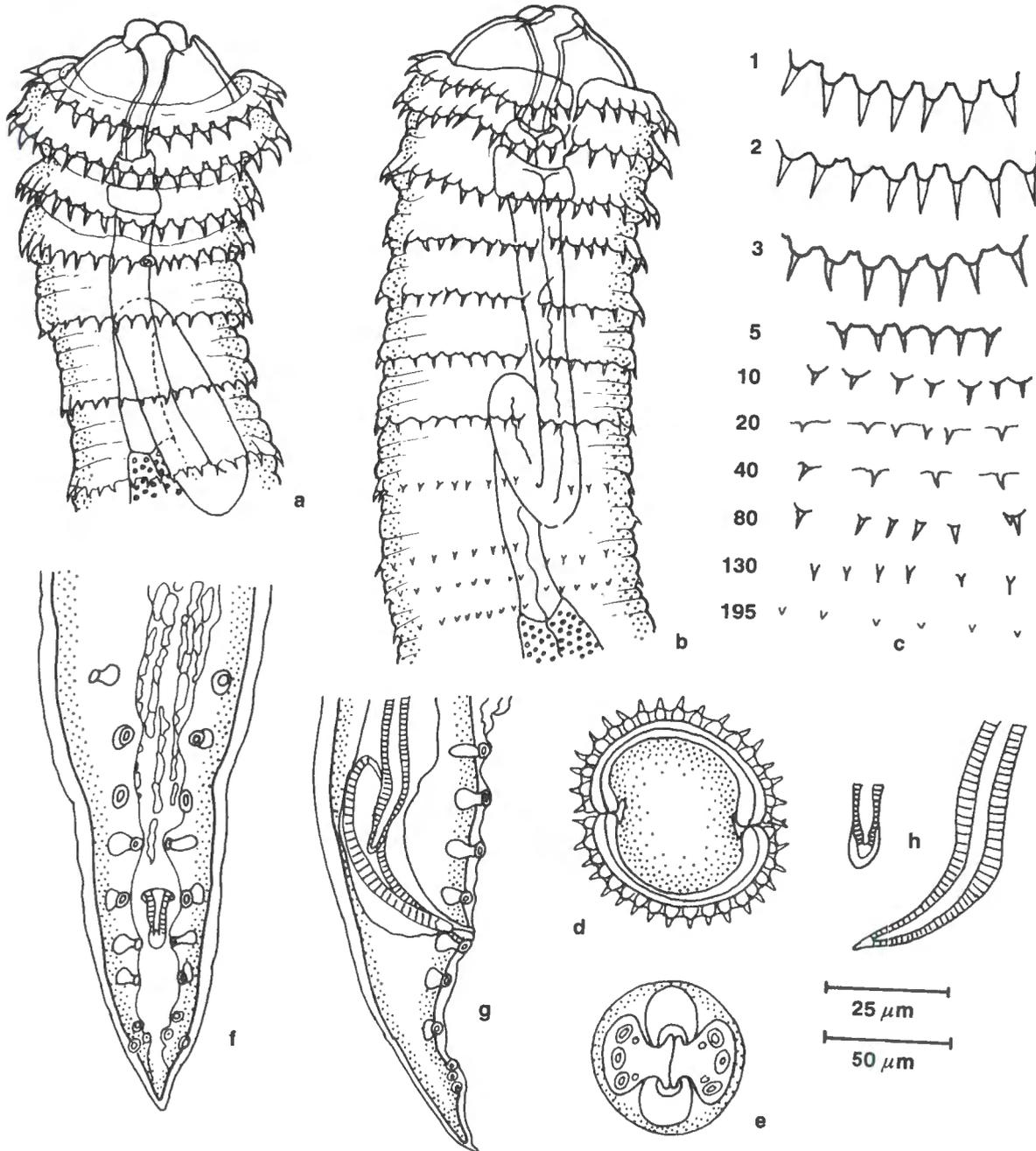


FIG. 5. *Spinitectus macherius*: a. Ventral view of anterior end of the holotype male. b. Lateral view of the anterior part of a paratype male. c. Spines of holotype male, row number indicated. d. Cross-section of the first row of spines of a male. e. Apical structures. f, g. Male posterior end, ventral and lateral views, respectively. h. Tip of the right spicule, dorsal view (left) and left spicule, lateral view (right). Scale bars: c, e, h, 25 μm ; a, b, d, f, g, 50 μm .

In addition, the anterior part of the uterus reflects closer to the anterior end than any of the other species and, as is the case with the males, the spinulation of the four species is entirely different.

***Spinitectus macherius* n. sp.** (Fig. 5)

First two rows of spines fairly large; 36 spines in the first row, 18 in each semi-circle; spines of third row approximately the same length as those of the first row, thereafter rapidly diminishing in size; those in row ten already difficult to see; anterior spines seated on a slightly inflated base, the latter becoming unapparent from about row 15. Pseudolabia with two large lateral and two small median papillae, amphids large and distinct. Oesophagus starts at level of the second row of spines. Nerve ring between second and third rows of spines, very close to the junction of the pharynx and the oesophagus; excretory pore at the level of the fourth row.

MALES

Approximately 205 rows of visible spines, last row 666 from tip of tail. Body 3 508 (3 751–3 785) long, 129 (122–132) wide; nerve ring 22 (14–26), excretory pore 41 (52) from end of pharynx; pharynx 64 (53–60), muscular oesophagus 286 (289–345) long, glandular oesophagus 909 (992–1 076) long, total oesophagus length 1 195 (1 281–1 421). Right spicule 100 (100–105), left spicule 616 (757–776), ratio of right:left spicule 1:6,16 (1:7,39–7,57). Right spicule with rounded tip covered by a transparent membrane; left spicule curves ventrally, ends acutely.

There are four pairs of pre-cloacal and six pairs of post-cloacal papillae. The latter are arranged in two groups of 3, those nearer the cloaca being regularly spaced, those nearer the tip of the tail clustered in a triangle. Area rugosa 687 (557–784) long.

FEMALES

Unknown.

TYPE HOST

Clarias vanderhorsti (Clariidae).

HABITAT

Mucosa of stomach.

TYPE MATERIAL

Holotype male and two paratype males, MRAC 34.785, Zoquin, Ivory Coast, 20.iii.1969.

ETYMOLOGY

The name is derived from the Latin, meaning “little sabre” or “sword”.

COMMENTS

S. macherius resembles *S. allaeri* in having 36 spines in the first row and six papillae posterior to the cloaca, but differs from it in having an additional pair of papillae on the pseudolabia, a longer pharynx, a longer oesophagus and a longer left spicule. *S. macherius* differs from *S. moraveci* in not having raised anterior rows of spines, in the longer oesophagus and longer left spicule; from *S. maleficus* in the number of post-cloacal papillae (six in the former species and seven in the latter); from *S. macilentus* in not having raised rows of spines anteriorly; from *S. mucronatus* in the distinct spinulation of the last names species.

The spinulation of *S. macherius* somewhat resembles that of *S. minusculus*. The two species can be differentiated by the number of labial papillae (eight in the former and four in the latter), the number of spines in the first row (36 in the former and 28 in the latter) and the ratio of the spicules (1:6,16–7,57 in the former and 1:4,02–5,10 in the latter).

***Spinitectus mucronatus* n. sp.** (Fig. 6)

The first two rows of spines are very large, those in the third row considerably smaller but increasing gradually in size until about row 30, thereafter gradually becoming smaller again; 27–28 spines in the first row. Pseudolabia with an accessory pair of papillae. Anterior end of oesophagus in front of first row of spines. Pharynx rather short, nerve ring between second and third rows, excretory pore at level of sixth rows of spines.

MALES

Twenty-seven spines in the first row. There are 85–90 discernable rows of spines on the anterior two-thirds of the body, becoming progressively smaller caudally; posterior third with hardly any prickles. Rows remain contiguous until about row 90.

Body 3 647 (3 058–4 316) long, 174 (132–164) wide; nerve ring 66 (35–80), excretory pore 153 (60–167) from end of pharynx; pharynx 45 (41–42), muscular oesophagus 275 (244–320), glandular oesophagus 1 235 (71–1 339), total oesophagus length 1 510 (959–1 712). Right spicule 87 (83–94), with a small bulbous tip, left spicule 292 (281–304), ratio of right:left spicule 1:3,36 (1:3,39–3,62); area rugosa consisting of three to five rows of plates that end some distance from the cloaca; a small bilobed structure is present immediately anterior to the cloaca; four pairs of pre-cloacal papillae; post-cloacal papillae arranged as four large pairs, approximately equidistant, and three small pairs, grouped in a triangle; tail 115 (107–119).

FEMALES

Number of spines in the first row and number of rows of spines not counted, but visible rows cover almost

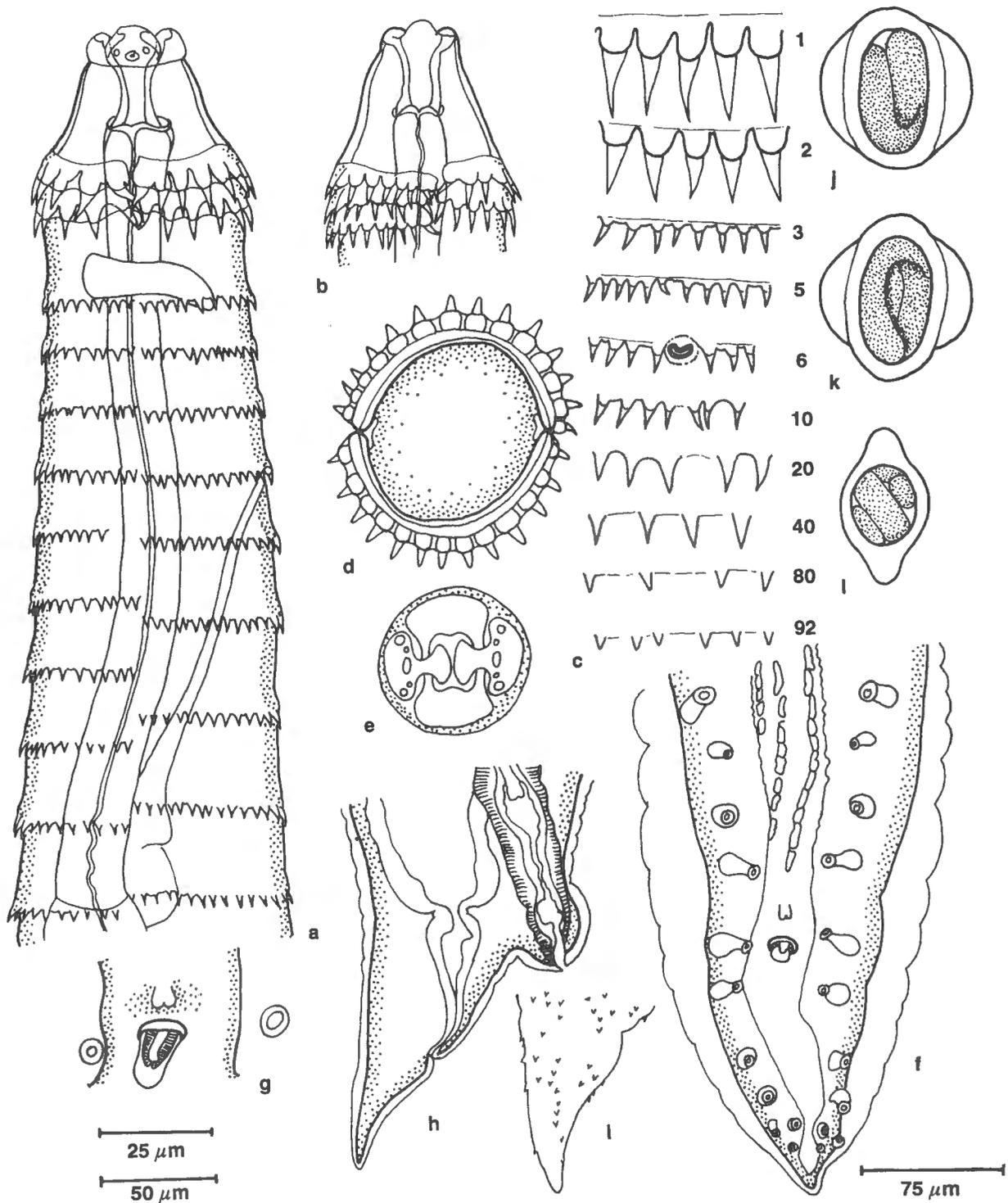


FIG. 6 *Spinitectus mucronatus*: a. Lateral view of anterior end of a paratype male. b. Lateral view of a male showing additional semi-circle of spines. c. Spines of holotype male with row number indicated. d. Cross-section at level of first row of spines. e. Apical structures. f. Male posterior end, ventral view. g. Cloacal region of male, showing the bilobed structure in front of the cloaca. h. Female posterior end. i. Female tail showing spinulation. j, k. Eggs in lateral view. l. Egg in optical cross-section. b and g from specimens from *Mormyrops zanclostris*, all others from specimens from *Mormyrops deliciosus*

Scale bars: c, e, g, j, k, l, 25 μm ; a, b, d, f, i, 50 μm ; h, 75 μm

the entire anterior part of the body, leaving the posterior one-fifteenth with prickles that are difficult to see.

Body 3 901 (3 797–5 274) long, 174 (167–268) wide; pharynx 44 (42–52) long; nerve ring 80 (35–70), excretory pore 181 (66–164) from end of pharynx; muscular oesophagus 338 (265–383); glandular oesophagus 1 173 (1 173–1 596), total oesophagus length 1 511 (1 479–1 945). Vulva a transverse slit situated on a prominent swelling, 3 765 (3 675–5 057) from anterior end; vulva 77 (64–122) from anus; tail 59 (58–77). Eggs 36 x 34 (34–38 x 34–38), characteristic in that large lateral floats are present; relatively thick-shelled, containing a larva when laid. Anterior branch of gravid uterus does not extend further cranially than 140 in front of end of muscular oesophagus.

TYPE HOST

Mormyrops deliciosus (Mormyridae).

HABITAT

Mucosa of stomach.

TYPE MATERIAL

Holotype male and allotype female, MRAC 35.731, Lucoge river, Angola, no date given. Paratypes, two males, MRAC 35.731, Lucoge river, Angola, no date given; one male, three females, MRAC 35.733, Lucoge river, Angola, no date given; two males from *Mormyrops zanclostris*, MRAC 35.740, Libange, Zaire, no date given.

OTHER MATERIAL

Several males and females from *Mormyrops deliciosus*, MRAC 35.759, Dokoa, Cameroon, 3–6.iv.1970; one male, one female from *Mormyrops boulengeri*, MRAC 35.804, Kinshasa vicinity, Zaire, no date given.

ETYMOLOGY

The species name is given after the large, curved spines in the first two rows that resemble the thorns of the African buffalo thorn tree, *Ziziphus mucronata*.

COMMENTS

This species cannot be confused with any other species in Africa, as the first two rows of spines are very large, the excretory pore is situated at the sixth row of spines, and in the females, on the proximity of the anus to the vulva, the vulva that opens on a distinct prominence and that lateral floats are present on the eggs.

One of the paratype males has an additional semi-circle of which the spines on the one lateral aspect are large and those on the other are small. This should be considered as abnormal, as members of the genus generally do not have incomplete rows of spines so near to the anterior end.

Spinitectus moravecii n. sp.

(= *Spinitectus allaeri* Campana-Rouget, 1961 *sensu* Moravec 1974: misidentification).

Moravec (1974) recovered what he considered to be *S. allaeri* from *Clarias lazera* (Clariidae), *Bagrus bayad* and *Bagrus docmac* (Bagridae), *Synodontis schall* (Mochokidae) and *Lates niloticus* (Centropomidae) in Egypt. These specimens differ from those of *S. allaeri* in a number of respects and the description of Moravec (1974) is repeated here. For the sake of continuity, the various measurements have been changed to micron.

Small nematodes with cuticle-bearing rings of minute spines; first six rings conspicuous, raised, the first two close to each other. Annulation starting at the level of the anterior end of the muscular oesophagus or close below it. Spines biggest on the anterior part of the body, considerably smaller and irregular on posterior part. Female tail with either two rings of spines or these may be completely lacking. On lateral view always 12–18 spines visible in one anterior ring; on apical view of female 35 spines in the first ring and 37 in the second. Mouth with two small, lobular, lateral lips, each bearing two oral papillae and an amphid at its base. Vestibule relatively long, anteriorly widened to form a small prostom. Muscular oesophagus slender, somewhat shorter than the glandular one.

MALES

Length of body 3 330–4 840, maximum width 95–122. Maximum length of spines 6–9. Vestibule measuring 45–78, muscular oesophagus 168–237, glandular oesophagus 600–702. Nerve ring at 99–168 from anterior extremity. Posterior end of body provided with narrow alae ending a short distance from the tip of the tail. Of a total of nine subventral, pedunculate pairs of papillae, four are pre-anal, five post-anal; first post-anal papillae located at almost cloaca level. An additional pair of small, ventral, sessile papilla present in the space between the fourth and the fifth post-anal pedunculate pair. Several longitudinal cuticular ridges are developed on the ventral pre-cloacal surface. Spicules unequal. Larger spicule slender, 405–471, with a sharp tip; smaller spicule wider, 69–87 long. Length of conical tail 90–105.

FEMALES

Length of female containing eggs 4 200–6 580, maximum width at posterior half, 163–204. Maximum length of spines 9. Vestibule measuring 63–75, muscular oesophagus 177–255, glandular oesophagus 600–840. Nerve ring at 123–144 from anterior extremity. Tail conical, 63–78, ending in a sharp cuticular spike. Vulva considerably shifted to posterior end of body (located a short distance in front of the anus), at 159–207 from the posterior extremity. Thick-walled eggs

smooth, without filaments, embryonated when laid; size of eggs 36–38 x 21–24.

COMMENTS

Upon comparison of the measurements and drawings of Campana-Rouget (1961) and Moravec (1974), the following differences were noted: the specimens examined by Moravec (1974) have a slightly longer pharynx (45–78 as opposed to 35), the nerve ring is more posterior (99–168 as opposed to 80), the left spicule is shorter and the right:left spicule ratio is 1:4,66–6,83 as opposed to 1:7,79, six pairs of post-cloacal papillae are present, as opposed to seven. The female tail is slightly longer and the vulva considerably closer to the anus than seen in the material examined by Campana-Rouget (1961). The excretory pore is situated at the fourth row of spines in *S. allaeri* but is not recorded for *S. moraveci*. Furthermore, from the drawings of Campana-Rouget (1961) and Moravec (1974) it appears that the anterior spines of *S. allaeri* are of almost equal size and the first rows are not raised. The spines in the first row of *S. moraveci* are small, those in the next five rows slightly larger, and from the seventh row onwards the spines abruptly become smaller. The spinulation of *S. moraveci* differs from all the other species in the group in that the spines of the first six rows are raised, giving the region an inflated appearance.

S. moraveci differs from *S. macherius* in having shorter spicules, a slightly shorter tail and a shorter oesophagus; from *S. maleficius* in the shorter oesophagus, the number of post-cloacal papillae, the shorter tail of the female, and the considerably shorter distance between the anus and the vulva; from *S. macilentus* in having six rows of raised spines instead of four, and in the slightly longer oesophagus, the slightly longer spicules, and the number of post-cloacal papillae; from *S. minusculus* in the slightly longer oesophagus, the longer left spicule and in the females, the longer distance between the anus and the vulva, and the longer tail; from *S. mucronatus* in the number of spines in the first row, the shorter oesophagus, the considerably longer left spicule, and the eggs that are without lateral floats.

These differences are, in our opinion, sufficient to warrant the creation of a new species, named in honour of Dr F. Moravec, in recognition of his extensive contribution to the knowledge of the nematodes of freshwater fishes.

Group C

Spinitectus monstrosus n. sp. (Fig. 7)

The spines in the first rows are not noticeably larger than those of subsequent rows and the spines gradually decrease in size; approximately 46 spines in the

first row, 23 in each semi-circle. Spines become dissociated from about the tenth ring onwards. About 70 rows of spines could be detected, whereafter only a few prickles are dispersed on the cuticle of the rest of the body. Apical structures not seen. Anterior end of oesophagus at the level of the fifth row of spines. Pharynx exceptionally long; nerve ring at level of row seven, excretory pore not seen.

MALES

Spines small when compared with the size of the nematode. Body 7 143 long, 171 wide; nerve ring 47 from the end of the pharynx; pharynx 130, muscular oesophagus 269, glandular oesophagus 1 208, total oesophagus length 1 477. Right spicule 115, massive and thick with a rounded tip covered by a membrane, left spicule 1 733, slender, with a membranaceous triangular tip in lateral view, ratio of right:left spicule 1:15,07. Area rugosa entirely lacking. Pre-cloacal papillae small when compared with the size of the body, close together, numbering four pairs; post-cloacal papillae also relatively small, three pairs close together near the cloaca, another group of three smaller pairs close together near the tip of the tail; tail 174, rounded.

FEMALES

Unknown.

TYPE HOST

Mormyrops boulengeri (Mormyridae).

HABITAT

Mucosa of stomach.

TYPE MATERIAL

Holotype male, MRAC 35.755, Kinshasa, Zaire, ix.1957.

ETYMOLOGY

The specific name is given after the massive right and the long left spicules.

COMMENTS

Only a single male of this species, of which the fourth and fifth post-cloacal papillae on the left side are fused, was available for study. It is quite unlike any other members of the genus from African freshwater fishes in that the caudal papillae occur in two widely separated groups. Furthermore, the tail is rounded, the short right spicule is massive when compared to that of the other members of the genus and the area rugosa in front of the cloaca is lacking. The left spicule and the pharynx are the longest yet recorded for this genus in Africa. The size and number of spines on the anterior part of the body further help to distinguish this species.

DISCUSSION

Baylis & Daubney (1926) have already shown that the anterior end is retractile and that features such as the elongated, conical or rounded shape of the anterior end, and whether the anterior extremity is close to the first row of spines or not, should not be considered when attempting to group the various species of the genus. This will obviously influence measurements such as the distance of the nerve ring and excretory pore from the anterior end, and also the position of the commencement of the muscular oesophagus in relation to the rows of spines. It is illustrated here (Fig. 3 and 5). We have therefore measured the distance of the nerve ring and excretory pore from the end of the

pharynx (or the beginning of the muscular oesophagus). Characteristics such as the size, number and arrangement of the spines in the anterior rows and the position of the excretory pore in relation to the rows of spines are more reliable and constant, as are the number of caudal papillae in the males, and the distance of the vulva from the anus and the degree to which the loops of the gravid uterus extend anteriorly in the females.

There are several possible ways in which the *Spinitectus* species can be grouped on a primary character, such as the number of spines in the first row, the position of the opening of the excretory pore or, in the males, the number of post-cloacal papillae. While the number of

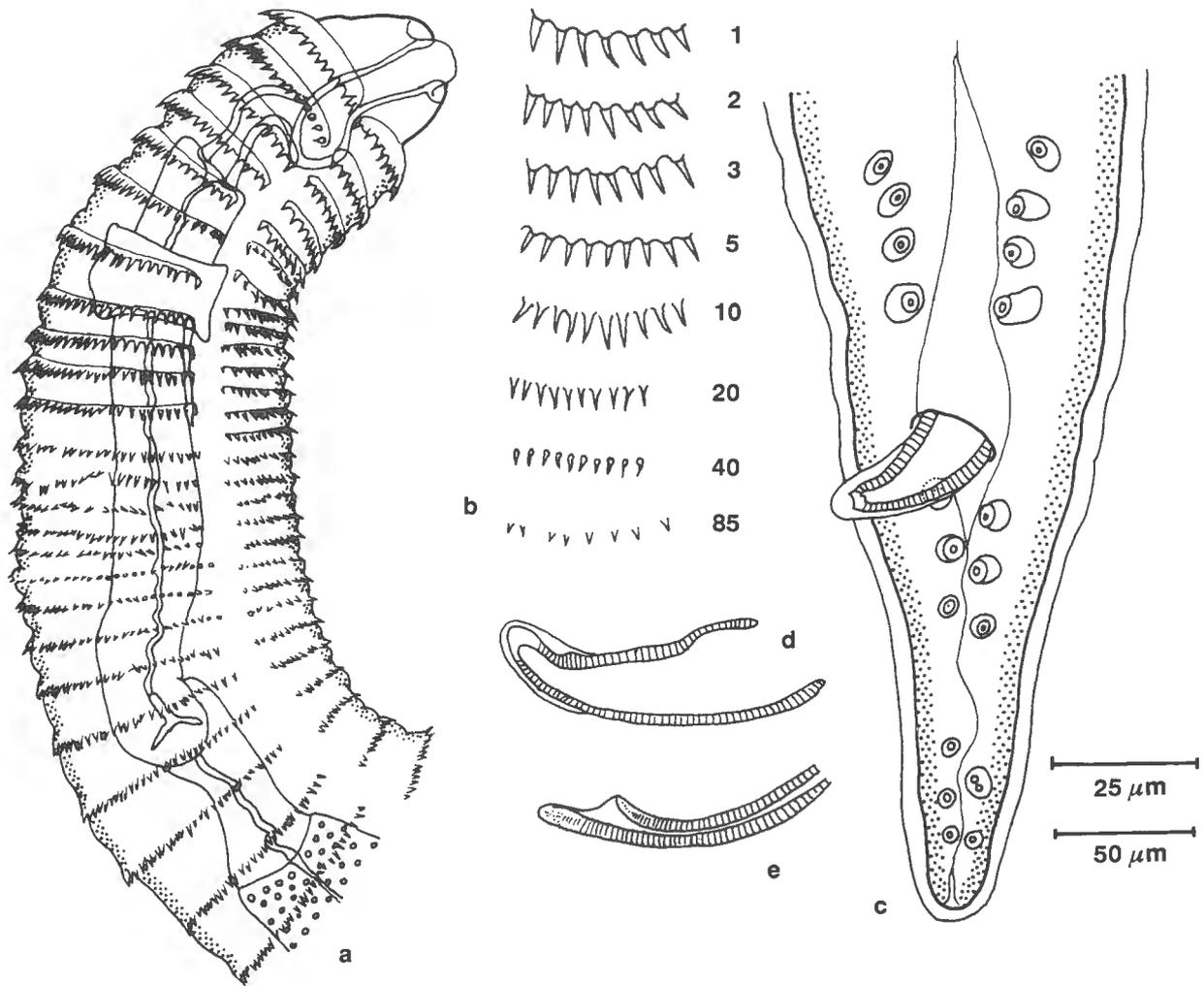


FIG. 7 *Spinitectus monstrosus*: Holotype male. a. Lateral view. b. Spines with row number indicated. c. Ventral view of caudal end. d. Right spicule, lateral view. e. Tip of left spicule, lateral view

Scale bars: b, 25 μ m; a, c, d, e, 50 μ m

spines in the first row probably has no phylogenetic importance, it serves as a useful means of separating the various species groups. We have therefore elected to group the species according to this criterion as the spines are easily counted in both sexes. Thus the 16 known *Spinitectus* species can be divided into three groups. Group A has fewer than 20 spines in the first row and contains *S. micropectus*, *S. mormyri* and *S. thurstonae*. Group B, the largest group, has between 20 and 40 spines in the first row and contains the species *S. allaeri*, *S. maleficus*, *S. macilentus*, *S. menzalei*, *S. minusculus*, *S. macherius*, *S. mucronatus* and *S. moraveci*. Group C has more than 45 spines in the first row and contains the species *S. monstrosus*, *S. petterae*, *S. polli* and *S. zambezensis*. Only *S. camerunensis* could not be placed in one of the groups, because the number of spines in the first ring were not recorded by Vaucher & Durette-Desset (1980).

It is interesting to note that of the species described here, *S. maleficus* and *S. micropectus* were collected from *Mastacembelus* spp. from Lake Tanganyika, eastern Zaire. Both have predominantly large spines on the body, and in both the excretory pore opens on the level of the fifth row. *S. macilentus* was recovered only from *Heterobranchus isopterus*, *S. minusculus* from both *Heterobranchus isopterus* and *Clarias vanderhorsti* and *S. macherius* only from *Clarias vanderhorsti*, in Sierra Leone, Liberia and the Ivory Coast. In these species the anterior five rows have fairly large spines and the excretory pore opens at the level of the fourth row of spines. Both *S. mucronatus* and *S. monstrosus* were collected only from *Mormyrops* spp. and both are quite distinct from the other species in their spinulation, and in that the excretory pore opens further posteriorly than the fourth row, or presumably so. *S. mucronatus* has the widest distribution, occurring in western Zaire (Kinshasa), Cameroon and Angola. The position of the excretory pore is not known in *S. moraveci*, but the spines of the first six rows are raised and their size and arrangement also differs from that of the other species in the group. Whether these characteristics indicate host influence on the spines, which are the primary organs of attachment of the nematodes, or adaptive radiation of the parasites in the respective geographical regions, cannot yet be determined. Similarly, it is at this stage uncertain whether the position of the excretory pore and the number of post-cloacal papillae have any phylogenetic importance, and many more specimens and species from these and other localities in Africa will have to be examined.

KEY TO THE AFRICAN SPECIES OF THE GENUS SPINICTECTUS FOURMONT, 1883

- 1. Parasites of freshwater fishes 2
Parasites of other vertebrate groups 15
- 2. First row with fewer than 20 spines 3

- First row with more than 20 spines 5
- 3. Eighteen spines in the first row 4
Female unknown, male with 16 spines in the first row, first 80 rows of spines of about equal length, excretory pore opens at level of row five, parasites of *Mastacembelus micropectum*, Lake Tanganyika, Zaire
..... *Spinitectus micropectus*
- 4. Left spicule 368–406, combined length of oesophagus of females 2 360–2 480, parasites of *Mormyrus* sp., Lake Victoria, Uganda
..... *Spinitectus thurstonae*
Left spicule 600, combined length of oesophagus of females 1 330, parasites of *Mormyrus cashive*, Lake Edward, now Lake Idi Amin Dada, Zaire *Spinitectus mormyri*
- 5. First row with 20–40 spines 6
First row with more than 40 spines 12
- 6. Excretory pore opens at the level of the fourth row of spines 7
Excretory pore opens at the level of the fifth or later rows of spines 11
- 7. Anterior region appears inflated 8
Anterior region does not appear inflated 9
- 8. Six raised rows of spines gives anterior region an inflated appearance, left spicule 405–471, right spicule 69–87, six pairs of post-cloacal papillae, vulva 82–144 from anus, parasites of *Clarias lazera*, *Bagrus bayad*, *Bagrus docmac*, *Synodontis schall* and *Lates niloticus* in Egypt *Spinitectus moraveci*
Four raised rows of spines gives anterior region an inflated appearance, left spicule 265–363, right spicule 50–62, seven pairs of post-cloacal papillae, vulva 120–237 from anus, parasites of *Heterobranchus isopterus*, Liberia and Sierra Leone
..... *Spinitectus macilentus*
- 9. Male with six post-cloacal papillae 10
Male with seven post-cloacal papillae, left spicule 545, vulva 312 from anus, parasites of *Malapterurus electricus*, *Eutropius niloticus*, *Bagrus bayad*, *Lates albertianus*, *Mormyrus cashive* and *Alestes dentex* in Lake Albert, now Lake Mobutu Sese Seko, Zaire
..... *Spinitectus allaeri*
- 10. Left spicule 277–322, right spicule 68–74, ratio of right:left spicule 1:4, 02–5, 10; 28 spines in the first row, females with 39 spines in the first row, vulva 45–77 from anus, parasites of *Clarias vanderhorsti* and *Heterobranchus isopterus* in Ivory Coast
..... *Spinitectus minusculus*

- Left spicule 616–776, first three rows of spines of equal length, decreasing from row four onwards, female unknown, parasites of *Clarias vanderhorsti* in Ivory Coast *Spinitectus macherius*
11. Excretory pore opens at the level of the fifth row of spines, 28–36 spines in the first row, anterior ten rows of spines of approximately the same length, vulva 309–486 from anus, parasites of *Mastacembelus flavidus* in Zaire *Spinitectus maleficius*
- Excretory pore opens at the level of the sixth row of spines, 27–28 spines in the first row, anterior two rows of spines very large, following seven rows of spines distinctly smaller, vulva 64–122 from anus, eggs with large lateral floats, parasites of *Mormyrops* spp. in Angola, Cameroon and Zaire *Spinitectus mucronatus*
12. Left spicule less than 1 000 13
- Left spicule 1 733, approximately 46 spines in the first row, female unknown, parasites of *Mormyrops boulengeri* in Zaire *Spinitectus monstrosus*
13. Left spicule 500 or longer 14
- Length of left spicule 366–461, with round tip and twisted distal end, the latter S-shaped in lateral view, right spicule 77–90, tail 83–87, vulva 1 087–2 034 from anus, parasites of *Synodontis zambezensis* in South Africa ... *Spinitectus zambezensis*
14. Lateral lips each with four papillae, left spicule 553–790, tip strongly curved ventrally, tip also with ventral spur, right spicule 77–90, vulva 242–423 from anus, parasites of *Clarias gariepinus* in South Africa *Spinitectus petterae*
- Lateral lips each with two papillae, left spicule 500, right spicule 125, vulva 800 from anus, parasites of *Synodontis schall* in Lake Albert, now Lake Mobutu Sese Seko, Zaire *Spinitectus polli*
15. Parasites of amphibians 16
- Parasites of mammals 17
16. Excretory pore at level of fourth row of spines, left spicule 1 015, combined length of oeso-

phagus 2 030–2 900, vulva 700 from anus, parasites of *Pedropedetes newtoni* in Cameroon *Spinitectus camerunensis*

17. Left spicule 218, right spicule 62, ratio of right:left spicule 1:3.5, 26 spines in the first row, female unknown, parasites of *Potamogale velox* in Gabon *Spinitectus menzalei*

ACKNOWLEDGEMENTS

The authors wish to thank Prof. Alain G. Chabaud and Dr Annie J. Petter for their help with and criticism of the manuscript. This work was done at the Muséum National d'Histoire Naturelle, Paris, France, with a study grant to the senior author from the Foundation for Research Development.

REFERENCES

- BAYLIS, H.A. & DAUBNEY, R. 1926. *A synopsis of the families and genera of Nematoda*. London: Taylor & Francis.
- BOOMKER, J. 1993. Parasites of South African freshwater fish. V. Description of two new species of the genus *Spinitectus* Fourment, 1883 (Nematoda: Cystidicolidae). *Onderstepoort Journal of Veterinary Research*, 60:139–145.
- CAMPANA-ROUGET, Y. 1961. Nématodes de poissons. *Exploration hydrobiologique des lacs Kivu, Edouard et Albert (1952–1954)*. *Résultats scientifiques*, 3:1–61.
- CHABAUD, A.G. 1975. Keys to genera of the order Spirurida. Part 2. Spiruroidea, Habronematoidea and Acuarioidea, in *CIH Keys to the Nematode Parasites of Vertebrates*, No. 3, edited by R.C. Anderson, A.G. Chabaud & Sheila Wilmott. Commonwealth Institute of Helminthology, 103 St. Peter's Street, St. Albans, Herts, England.
- HUGOT, J.-P. 1979. Description de cinq nouveaux nématodes d'un Tenrecoidea africain: *Potamogale velox* du Chaillu. *Bulletin du Muséum national d'Histoire Naturelle*, Series 4, 1:1057–1073.
- OGDEN, C. G. 1967. *Spinitectus thurstonae* sp. nov. from a freshwater fish in Lake Victoria, Uganda. *Revue de Zoologie et de Botanique africaine*, 75:77–81.
- MORAVEC, F. 1974. On some nematodes from Egyptian freshwater fishes. *Vestník Československé Společnosti Zoologické*, 38:32–51.
- SKRJABIN, K.I. 1949. *Key to parasitic nematodes*. Volume 1. Spirurata and Filariata. English translation 1991, Leiden, New York, Copenhagen, Köln: E.J. Brill.
- VAUCHER, C. & DURETTE-DESSET, M.-C. 1980. Etude d'une collection de nématodes parasites d'amphibiens et de reptiles du Cameroun. II. *Spinitectus camerunensis* n. sp. (Spiruroidea). *Revue suisse de Zoologie*, 87:125–130.