Journal of Nematology 38(4):411–417. 2006.

Description and SEM Observations of *Stegelletina coprophila* sp.n. (Nematoda: Rhabditida) from Caves of Andalucía Oriental, Spain

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Abstract: A new species of the genus *Stegelletina* is described from caves of Andalucía Oriental (SE Iberian Peninsula). *Stegelletina coprophila* sp. n. is characterized by its body 386 to 536 µm long in females and 391 and 521 µm in males, lateral field with three incisures, lips bearing four tines, labial probolae 4 to 6 µm long and bifurcate, pharyngeal corpus 1.5 to 2.9 times isthmus length, spermatheca 18 to 43 µm long, postvulvar sac 0.5 to 1.6 times the corresponding body diameter long, female tail conical (24–34 µm, $c = 14.2–17.2$, $c' = 1.7–2.3$), male tail conical (26–35 µm, $c = 12.1–17.1$, $c' = 1.4–1.8$), spicules 20 to 25 µm long, and gubernaculum 10 to 13 µm long. Descriptions, measurements and illustrations, including SEM photographs, are provided for the species.

Key words: Caves, Cephalobidae, description, Iberian Peninsula, morphology, new species, *Stegelletina*, SEM, taxonomy.

Subterranean ecosystems have long been considered to be extreme environments, inhabited by only a few specialized species. However, cave fauna consist of an interesting variety of taxa; some of them are obligate cave dwellers (troglobites), edaphic (edaphobites) and aquatic (stygobites), meanwhile, others are either facultative cave dwellers (troglophiles), indifferent cave-soil dwellers (trogloxenes), or even accidentals (Welbourn, 1999; Culver and Sket, 2000).

Zoological studies carried out in these kinds of habitats are usually focused on arthropods (Welbourn, 1999; Culver and Sket, 2000; Reeves et al., 2000; Gibert and Deharveng, 2002), where nematodes are mentioned as "undetermined material" or "unidentified taxa." Nevertheless, there are a few monographic contributions on cave nematodes (Joseph, 1879; Dudich, 1932; Altherr, 1938; Andrássy, 1959a, 1959b; Cayrol, 1967; Altherr, 1969, 1971; Eder, 1979; Abolafia, 2005) or that include some cavernicolous species (e.g., Andrássy, 1967; Eder, 1975; Sturhan, 1975).

Several species belonging to the genus *Stegelletina* Andrássy, 1984 have been recorded previously from the Iberian Peninsula (Abolafia and Peña-Santiago, 2003). This paper, part of a series on cephalobs from Andalucía Oriental (Abolafia et al., 2002), deals with a new species collected in caves.

Materials and Methods

Nematodes were extracted from soil samples (organic or guano material) that were collected from caves from the province of Jaén, Andalucía Oriental (see Abolafia, 2005) by Flegg's (1967) method and a somewhat modified Baermann's (1917) funnel technique. Nematodes obtained were later relaxed and killed by heat, fixed in 4% formaldehyde, and processed to anhydrous glycerine according to Siddiqi (1964). Measurements were taken using an ocular micrometer; drawings were made using a drawing tube attached to a Leica microscope, while LM pictures were made using a Nikon microscope provided with a videocamera. For SEM studies, fixed specimens were hydrated in distilled water, dehydrated in a graded ethanol and acetone series, critical point dried and coated with gold (Abolafia and Peña-Santiago, 2005), and observed with a JEOL JSM-5800 microscope. The terminology used for morphology of stoma and spicules follows the proposal by De Ley et al. (1995) and Abolafia and Peña-Santiago (2006), respectively.

Description

Stegelletina coprophila sp. n.

(Figs. 1–3)

Measurements: Are listed in Table 1 and are in micrometers excluding ratios.

Female (n = 10): Body 412–536 µm long. Habitus ventrally curved, "C"-shaped. Body cylindrical, tapering gradually towards both ends, but more so towards the posterior one. Cuticle distinctly annulated; annuli 2 µm wide at midbody. Lateral field occupying 16–23% of midbody diameter, with three incisures fading out near tail terminus. Lips amalgamated two by two, slightly divided at labial papilla level, each one having straight margin at primary axil and dentate margin at secondary axil; this with four tines, the tine closer at primary axil being more elevated, bigger and slightly lobed (two minute lobes). Primary axils "U"-shaped, with one guarding process (lacking refractive elements). Secondary axils "V"-shaped, without guarding process (without refractive element). Three slender labial probolae 4–6 µm long, bifurcate, "Y"-shaped, with curved prongs (bull horn-like), frequently bent after fixation. Stoma cephaloboid. Cheilostom with spheroid rhabdia. Gymnostom narrower than cheilostom, and as wide as stegostom. Pharyngeal corpus slightly fusiform, 2.0–2.9 times isthmus length; metacorpus longer than procorpus. Isthmus slender. Basal bulb ovoid, bearing well developed valves. Nerve ring at 66–76% of neck length, at isthmus level. Excretory pore at 38–42 annuli

Received for publication August 9, 2006.

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The authors acknowledge Grupo Espeleológico de Villacarrillo (GEV), especially Toni Pérez Fernández, who collected the samples from the different caves examined; the assistance of Research Technical Services of University of Jaén (Spain) for the SEM study; and the financial support received from the project entitled "Fauna Ibérica VIII" (CGL2004–04680-C10–09/BOS).

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This paper was edited by Zafar Handoo

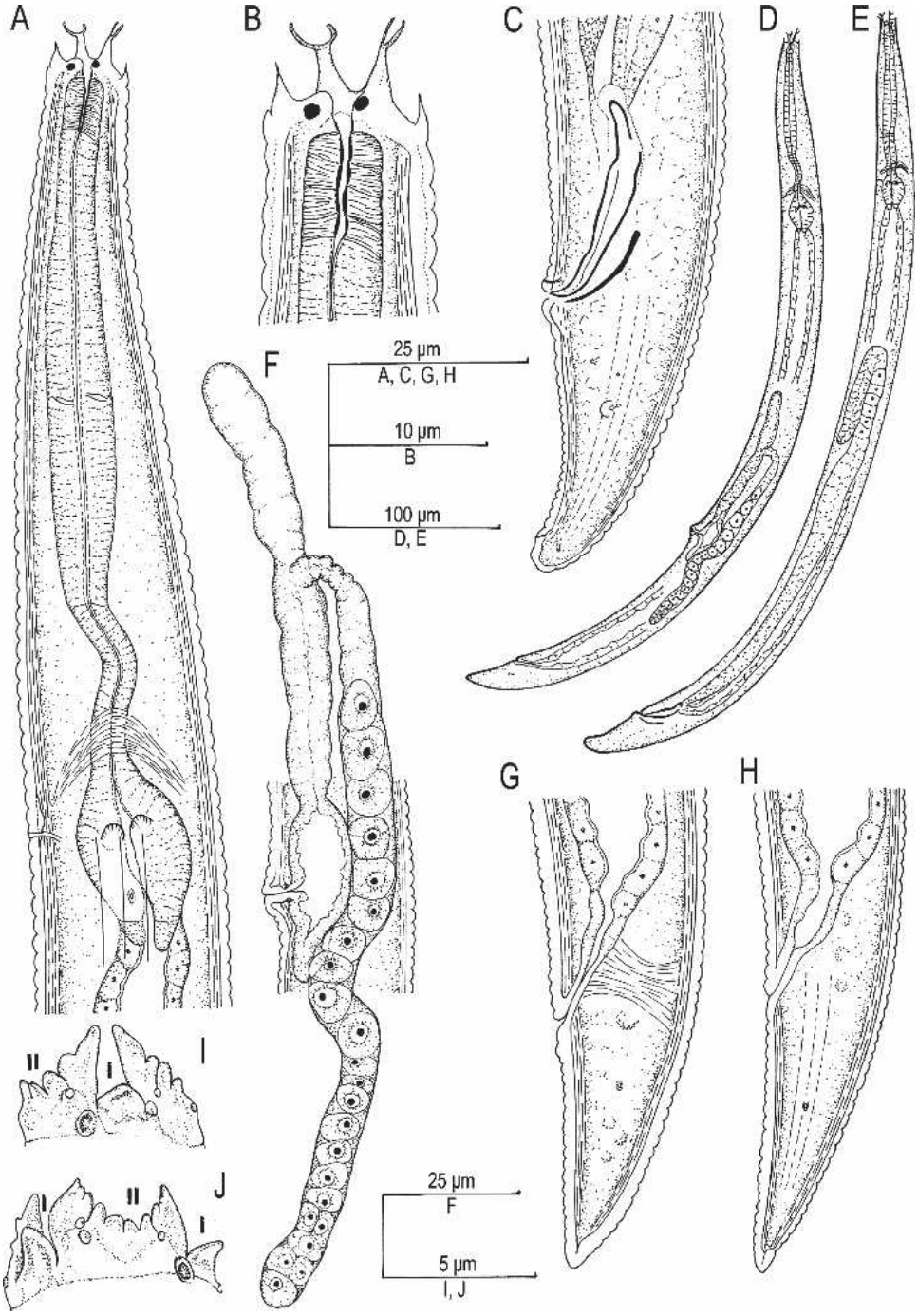

FIG. 1. *Stegelletina coprophila* sp. n. A: Neck region. B: Anterior end. C: Male posterior end. D: Entire female. E: Entire male. F: Female reproductive system. G-H: Female posterior end. I-J: Lip region (I: primary axil; II: secondary axil).

from anterior end, at 77–89% of neck length, at basal bulb level, and in front of hemizonid. Deirid 45–47 annuli from anterior end, at 81–99% of neck length, at basal bulb or intestine level. Cardia conoid, surrounded by intestinal tissue. Intestine lacking major specializations. Rectum 0.9–1.3 times anal body width long. Reproductive system monodelphic-prodelphic, dextral to intestine. Ovary with flexures posterior to vulva. Oviduct short. Spermatheca well developed, 1.0–2.0 times the corresponding body diameter long, filled with spermatozoa. Uterus about two times body diameter long. Postvulvar sac 0.5–1.6 times the corresponding body diameter long, differentiated in a distal tubular part and a proximal swollen part. Vagina with thick walls at its distal part. Tail conical, ventrally straight, with 18–21 ventral annuli, with more or less rounded terminus. Phasmid located at 28–38% of tail length.

Male (n = 10): Body 425–521 µm long. Habitus ventrad curved, adopting "J" shape. Reproductive system

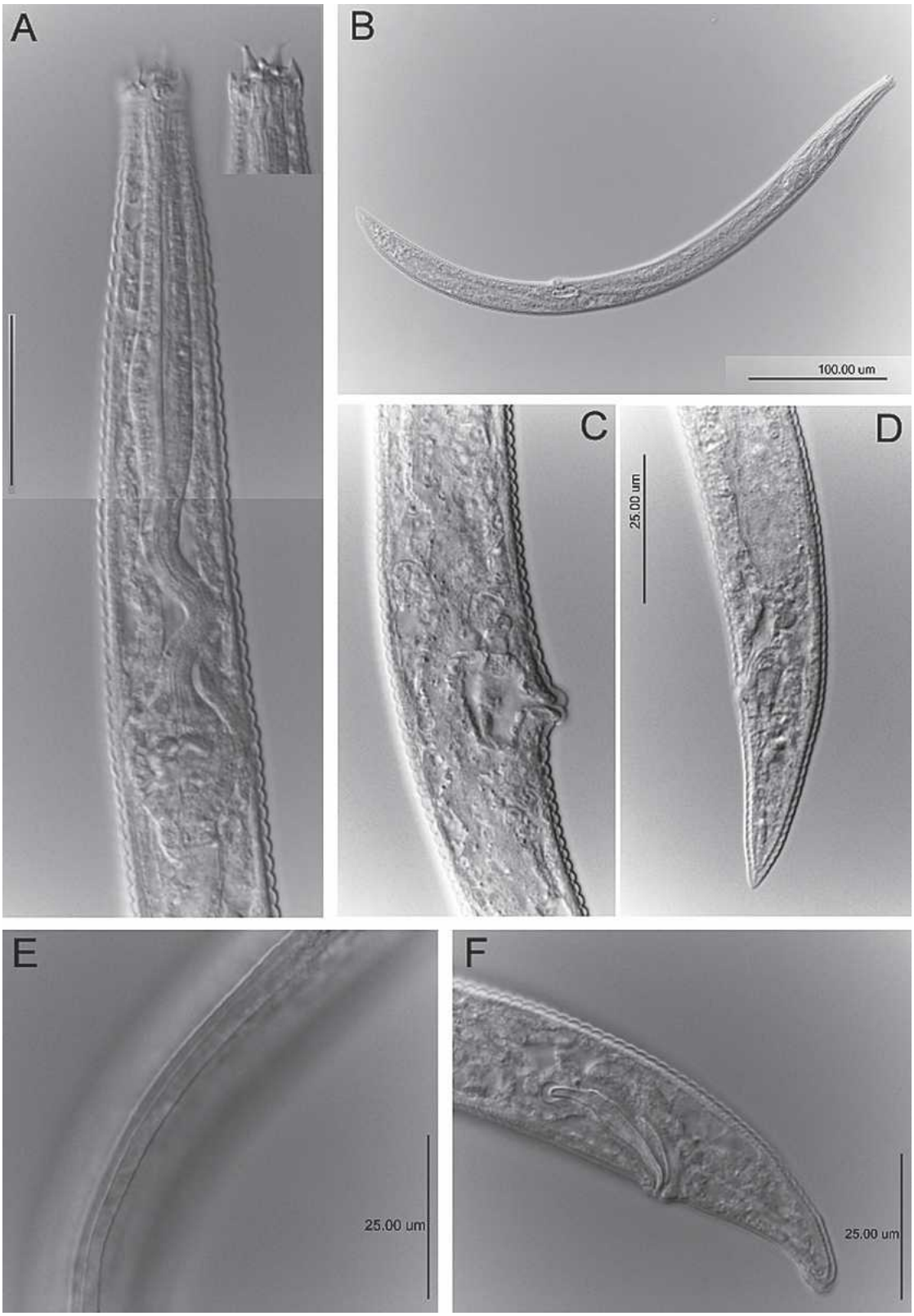

FIG. 2. *Stegelletina coprophila* sp. n. (LM). A: Anterior end. B: Entire female. C: Vulva region. D: Female posterior end. E: Lateral field. F: Male posterior end.

monorchic. Testis reflexed ventrally anteriorly. Tail ventrad curved with more or less rounded terminus. Spicules consisting of elongated manubrium, conoid calamus, and ventrally curved lamina, with dorsal tip and ventral velum, and terminus more ventrally bent. Gubernaculum ventrally curved.

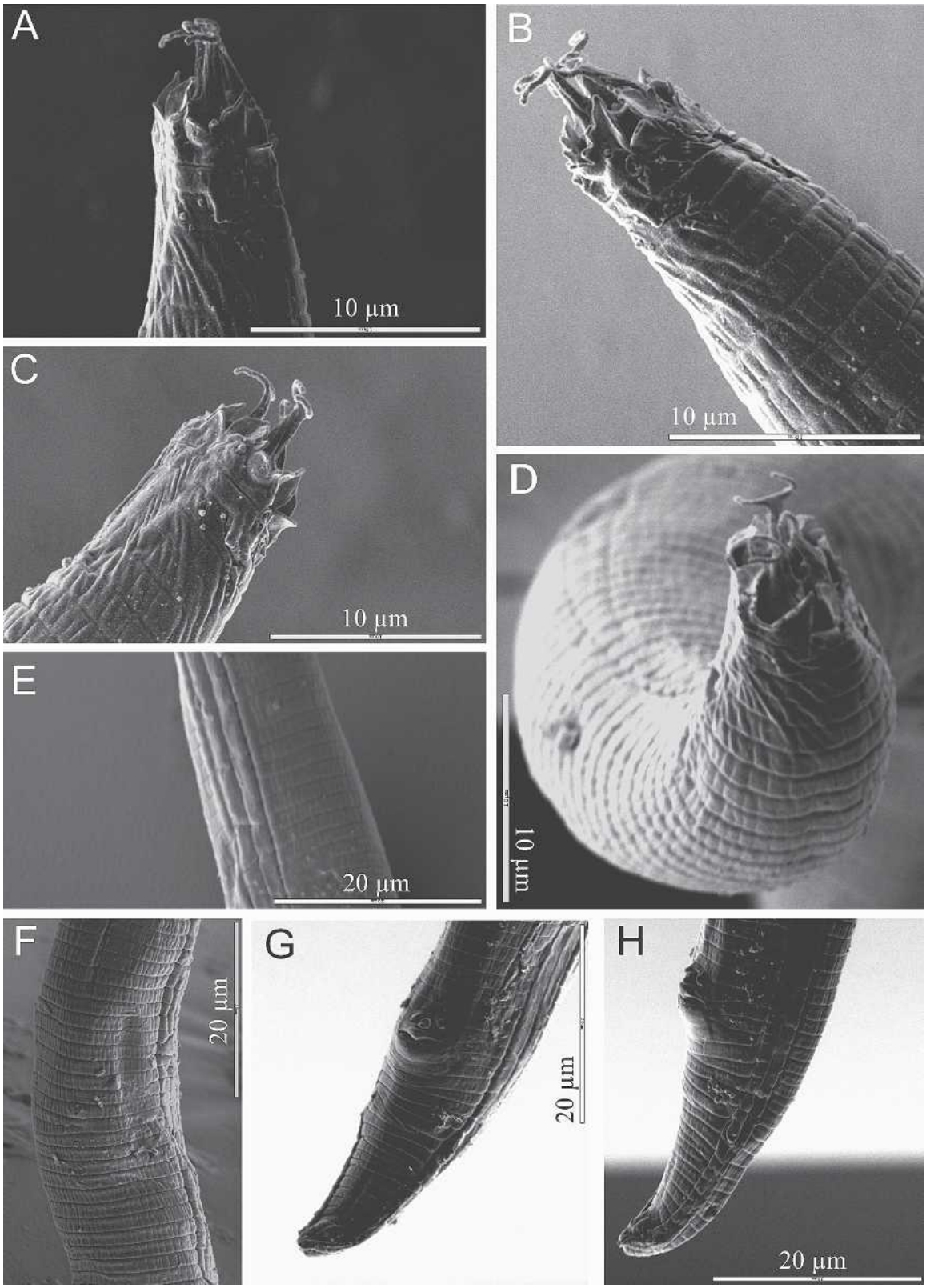

FIG. 3. *Stegelletina coprophila* sp. n. (SEM). A-D: Anterior end (A,C: subventral left view; B: lateral left view; D: ventral view). E: Lateral field. F: Excretory pore region. G-H: Male tail.

Population from Sima de los Murciélagos (see Table 1)

Very similar to type population, but having shorter body and little more anterior position of nerve ring, excretory pore and deirid.

Diagnosis

Stegelletina coprophila sp. n. is characterized by its body 386–536 µm long in females and 391–521 µm in males, lateral field with three incisures, lips bearing four

TABLE 1. Measurements (in µm) of females (n = 15) and males (n = 14) of *Stegelletina coprophila* sp. n.

Locality	Sima de la Fuente Negra (Villanueva del Arzobispo)			Sima de los Murciélagos (Hornos)	
Province	Jaén			Jaén	
Habitat	Bat guano			Organic material	
n	Holotype E	Paratypes 9EE	Paratypes 10ГГ	5EE	4ГГ
Body length	473	488.3 ± 41.7 (412–536)	487.4 ± 28.8 (425–521)	409.8 ± 21.9 (386–433)	427.0 ± 27.6 (391–458)
a	19.7	20.5 ± 1.9 (18.2–24.4)	20.9 ± 1.2 (19.3–23.3)	18.5 ± 1.2 (17.3–19.7)	20.6 ± 1.0 (19.6–21.6)
b	4.3	4.4 ± 0.2 (4.0–4.7)	4.5 ± 0.2 (4.1–4.7)	3.6 ± 0.1 (3.5–3.8)	3.8 ± 0.1 (3.7–4.0)
c	15.3	16.2 ± 0.8 (14.7–17.2)	15.4 ± 1.4 (12.1–17.1)	15.1 ± 0.9 (14.2–16.1)	14.7 ± 1.3 (13.5–16.6)
c′	1.8	2.0 ± 0.2 (1.7–2.3)	1.6 ± 0.1 (1.5–1.8)	2.0 ± 0.2 (1.8–2.2)	1.6 ± 0.2 (1.4–1.8)
V/T	64	64.3 ± 1.3 (62–66)	—	65.1 ± 0.5 (65–66)	—
Labial probolae	4	4.7 ± 0.7 (4–6)	4.2 ± 0.4 (4–5)	5.3 ± 0.5 (5–6)	5.3 ± 0.5 (5–6)
Lip region width	10	9.9 ± 0.8 (8–11)	10.0 ± 0.0 (10–10)	8.8 ± 2.5 (5–10)	9.8 ± 0.5 (9–10)
Stoma	9	8.3 ± 1.0 (7–10)	8.2 ± 0.8 (7–10)	9.5 ± 0.6 (9–10)	9.0 ± 0.8 (8–10)
Pharyngeal corpus	54	57.1 ± 3.7 (52–64)	55.7 ± 3.0 (51–62)	53.0 ± 1.2 (52–54)	54.0 ± 2.2 (51–56)
Isthmus	22	24.8 ± 3.2 (20–30)	24.0 ± 1.6 (22–26)	28.8 ± 3.6 (26–34)	26.8 ± 1.0 (26–28)
Bulb	18	17.7 ± 0.9 (16–19)	16.4 ± 1.0 (15–18)	17.0 ± 1.2 (16–18)	18.3 ± 1.9 (17–21)
Pharynx length	109	111.3 ± 7.8 (103–127)	108.4 ± 3.1 (103–112)	112.5 ± 3.8 (107–115)	111.0 ± 7.3 (103–119)
Nerve ring—ant. end	82	78.9 ± 5.4 (71–86)	77.7 ± 4.0 (71–86)	76.0 ± 4.3 (70–80)	80.5 ± 5.7 (76–88)
Excretory pore—ant. end	88	93.0 ± 6.3 (82–102)	93.2 ± 4.9 (82–98)	83.0 ± 6.1 (77–90)	88.0 ± 4.4 (83–91)
Deirid—ant. end	100	107.4 ± 5.2 (103–114)	107.3 ± 4.7 (100–114)	96.8 ± 7.4 (90–105)	102.0 ± 9.5 (96–113)
Annuli width	2	2.1 ± 0.2 (2–3)	2.1 ± 0.2 (2–3)	2.1 ± 0.2 (2–2)	1.7 ± 0.2 (2–2)
Cuticle thickness	1	1.0 ± 0.0 (1)	1.0 ± 0.0 (1)	1.4 ± 0.3 (1–2)	1.4 ± 0.3 (1–2)
Body width					
Neck base	23	22.3 ± 1.7 (19–25)	22.2 ± 0.9 (21–24)	20.0 ± 1.4 (18–21)	20.3 ± 1.5 (19–22)
Midbody	24	24.0 ± 2.5 (19–27)	23.4 ± 1.1 (22–25)	22.3 ± 1.7 (20–24)	20.8 ± 1.5 (20–23)
Anus	17	15.2 ± 1.2 (13–17)	19.1 ± 0.6 (18–23)	13.5 ± 1.3 (12–15)	18.5 ± 0.6 (18–19)
Lateral field	5	4.6 ± 1.1 (3–6)	5.5 ± 0.5 (5–6)	4.8 ± 0.5 (4–5)	4.0 ± 1.0 (3–5)
Vagina	10	9.1 ± 1.9 (7–12)	—	9.5 ± 1.3 (8–11)	—
Ovary/testis	213	118.5 ± 24.3 (88–154)	72.2 ± 16.5 (46–104)	91.0 ± 7.0 (86–99)	61.5 ± 6.0 (56–70)
Spermatheca	35	29.8 ± 8.1 (18–43)	—	29.5 ± 4.9 (26–33)	—
Uterus	60	60.2 ± 9.3 (48–71)	245.6 ± 18.2 (212–270)	46.5 ± 10.6 (39–54)	193.0 ± 9.3 (179–198)
Postvulvar sac	18	20.6 ± 7.8 (10–36)	—	15.0 ± 3.6 (12–19)	—

tines, labial probolae 4–6 µm long and bifurcate, pharyngeal corpus 1.5–2.9 times isthmus length, spermatheca 18–43 µm long, postvulvar sac 0.5–1.6 times the corresponding body diameter long, female tail conical (24–34 µm, c = 14.2–17.2, c' = 1.7–2.3), male tail conical (26–35 µm, c = 12.1–17.1, c' = 1.4–1.8), spicules 20–25 µm long, and gubernaculum 10–13 µm long.

Relationships

The new species resembles *S. ankyra* (Thorne, 1925) Boström and De Ley, 1996, *S. insubrica* (Steiner, 1914) Boström and De Ley, 1996, *S. kheirii* Karegar, De Ley and Geraert, 1998, and *S. pygmaea* Abolafia and Peña-Santiago, 2003. It differs from all of them in the more posterior location of nerve ring, excretory pore and deirid (between basal part of isthmus and cardia-intestine junction vs. between medium part of isthmus and basal bulb). It can be distinguished from *S. ankyra* by the shape of its labial probolae (with "Y" or bull horn prongs vs. "T" shape), lips with shallow incisures (vs. lips with deep incisures [cf. Andrássy, 1984] resembling those found in the genus *Teratocephalus* de Man, 1876), and shorter female tail (1.7–2.3 times anal body width vs. 2.9 times). It differs from *S. insubrica* by having lip region with secondary axils bearing four pairs of tines (vs. secondary axils with two pairs of tines), and shorter female tail (c' = 1.7–2.3 vs. c' = 2.7, according with Steiner's drawing [1914: Fig. 4]) with rounded terminus (vs. acute), and different numbers of ventral annuli on the tail (18–21 vs. 24 according with Steiner (1914) and 25 according with Thorne (1925)). The material from Senegal described by De Ley et al. (1994) as *Ypsylonellus cf. insubricus* (Steiner, 1914) Andrássy, 1984 is also similar to the material described here, but it has less ventral annuli (18–21 vs. 13). It differs from *S. kheirii* by having longer body (386–536 vs. 295–370 µm in females) and different tail shape (conical with rounded terminus vs. conical with acute terminus). It can be distinguished from *S. pygmaea* by having longer body (386–536 µm in females and 391–521 µm in males vs. 364–401 µm in females and 376–415 µm in males), different labial axils morphology ("U"-shaped and lacking refractive elements vs. two "U"-shaped refractive elements at primary axils), and tail terminus shape (rounded vs. acute).

In the key to species identification published by Abolafia and Peña-Santiago (2003), this species is located at step 7 together with *S. kheirii.*

Type locality and habitat

Type population collected from a cave: Sima de la Fuente Negra, Villanueva del Arzobispo (province of Jaén), in soil with guano of *Rhinolophus* sp. (Mammalia, Chiroptera) obtained 15 m deep.

Other locality

Another isolate of the new species was collected from another cave: Sima de la Murcielaguina, Hornos (province of Jaén), in soil with organic material obtained 60 m deep.

Type material

Seven females (holotype and paratypes) and 18 males (paratypes) deposited in Departamento de Biología Animal, Universidad de Jaén, Spain. One paratype female and one paratype male deposited in the nematode collection of the Swedish Museum of Natural History, Stockholm (Sweden), and in the nematode collection of the Department of Nematology, University of California, Riverside (USA).

Etymology

The specific epithet refers to the habitat where the species was found.

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