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DESCRIPTION OF *CERVIDELLUS CAPRICORNIS* SP.N. (NEMATODA: CEPHALOBIDAE) FROM ISRAEL

by

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Summary. *Cervidellus capricornis* sp. n. from Israel is described on the basis of studies by light and scanning electron microscopy. The new species is distinguished by a body length of 0.46-0.68 mm; cuticle with longitudinal incisures; lateral fields with four incisures; labial probolae bifurcated two-thirds of their length with a basal shallow, cup-shaped, abaxial swelling; asymmetrical lips with six tines; two slender, elongate guarding processes in each primary axil; corpus 2.1-3.0 times longer than isthmus; spermatheca 27.5-50.0 µm long; PUS 0.5-1.0 time vulval body width; and conical tail with acute terminus.

The genus *Cervidellus* Thorne, 1937 contains twelve valid species, of which seven have been described in the last 15 years. Species are characterized by highly elaborate lips and labial probolae, which are of basic importance for the taxonomy of the genus. Soil samples from "Evolution Canyon", Israel, revealed a population of a new species of cephalobids, *Cervidellus capricornis* sp.n., differing from all other species of the genus by the organisation of the tines of the lips and the structure of the labial probolae. The new species is described from studies by light and scanning electron microscopy.

Materials and methods

Soil samples containing *C. capricornis* sp. n. were collected in the Lower Nahal Oren and Lower Nahal Keziv, Israel. The samples were moistured and stored for a few days in a cooler. Specimens were extracted by a modified Baermann funnel method, relaxed by gentle heat, fixed in cold TAF, processed to pure glycerine by a slow evaporation method and mounted in glycerine on permanent slides using paraffin as support for the coverslip. After making observations and taking measurements, four females and two males were washed with increasing volume of distilled water, resuspended in TAF and prepared for SEM. The specimens were post-fixed in 1% osmium tetroxide (OsO_4), transferred to pure acetone through an acetone/distilled water series, critical point dried in liquid CO_2, mounted on stubs, gold-plated under vacuum to a thickness of 200 nm in a sputter, and examined in a Zeiss Novascan 30 SEM at an accelerating voltage fo 15 kV.

Description

CERVIDELLUS CAPRICORNIS sp. n.

(Figs 1-2, Table I)

Lower Nahal Oren (type) population

Female. Body slightly arcuate ventrad, gradually narrowing anteriorly from nerve ring and in caudal region. Cuticle 1.9-2.4 µm thick, strongly annulated, annules 2.4-3.0 µm wide just anterior to vulva, more spaced in neck region. Regular longitudinal striation forming two indentations per annule. SEM of a damaged specimen revealed that the annulation is also present on one of the internal cuticular layers, where the longitudinal striation is absent but a pattern of "pores" is present (Fig. 2F). Lateral fields with two wings, separated by an inner smooth area, resulting in four longitudinal lines along most of the body, as observed with LM, originating anterior to nerve ring and reaching almost to tail tip. Lip region with four cephalic and six labial papillae; amphid opening rounded, surrounded by a cuticular ridge, located dorso-laterally on the base of each lateral lip. Three pairs of asymmetrical lips, one dorsal and two ventrolaterals. Pairs of lips separated by U-shaped primary axils with two slender, elongate guarding pieces emerging from the incomplete basal annule. Secondary axils demarcated by narrow incisures separating the two lips of the pair; without guarding pieces. Each lip asymmetrically rectangular (trapezium-shaped) with six tines along its margin. They are (numbered from primary towards secondary axil): two low oval tines directed towards primary axil, one long and slender tine directed anteriorly and reaching the level of the bifurcation of labial probolae, and the remaining three low oval tines directed approximately anteriorly. Thus, three tines are in the sector of the primary axil and three small and rounded tines in the sector of the secondary axils. Labial probolae connected at bases by prominent tangential ridges. Each labial probola with a basal cup-shaped abaxial swelling being the base for a slender apical bifurcation which is bent outwards resembling the horns of a goat. Stoma length 0.8-1.0 times labial region width, with distinct divisions into cheilostom, gymnostom and stegostom. Cheilorhabdia oval in median section, gymnostom short, stegostom with distinct subdivisions. Pharyngeal corpus cylindrical, metacorpus somewhat fusiform, isthmus clearly delineated from and narrower than corpus. Basal bulb with strongly developed valves. Excretory pore 2-5 annules posterior to nerve ring. Deirid located 3-6 annules posterior to excretory pore. Reproductive system monodelphic, prodelphic, dextral in position. Vulva slightly protruding, vagina length 0.3-0.4 times of corresponding body width. Oviduct emerging dorsally from the uterus-spermatheca junction, leading to a generally straight ovary, always extending well posterior to vulva. Postvulval uterine sac shorter than vulval body width. Spermatheca comparatively large, containing spermatozoa in some females. Rectum equal to anal body width, anus an arcuate slit. Phasmid somewhat anterior to middle of tail. Tail conoid, 11-19 prominent ventral annules, posteriorly hardly discernible. Tail tip acute, hyaline.

Male. Similar to female except sexual characters, but differs from the female by smaller measurements in a number of characters. Body strongly curved ventrad in posterior part. Excretory pore 2-4 annules posterior to nerve ring. Deirid 2-3 annules posterior to excretory pore. Reproductive system occupying approximately half body length, monorchic, testis ventrally reflexed. Spicules 1.0-1.3 times as long as anal body width, arcuate ventrad, with a thin velum and hemisphaerical, offset manubrium. Gubernaculum canoe-shaped, more than half spicule length. Phasmid somewhat anterior to middle of tail. Precloacal papillae distributed as: three subventral pairs, a single midventral papilla on anterior cloacal lip. Caudal papillae distributed as: one lateral pair and one subventral pair just posterior to phasmid; one subdorsal pair, one lateral pair, and one subventral pair near tail terminus. Tail curved ventrad, conical, tip acute.

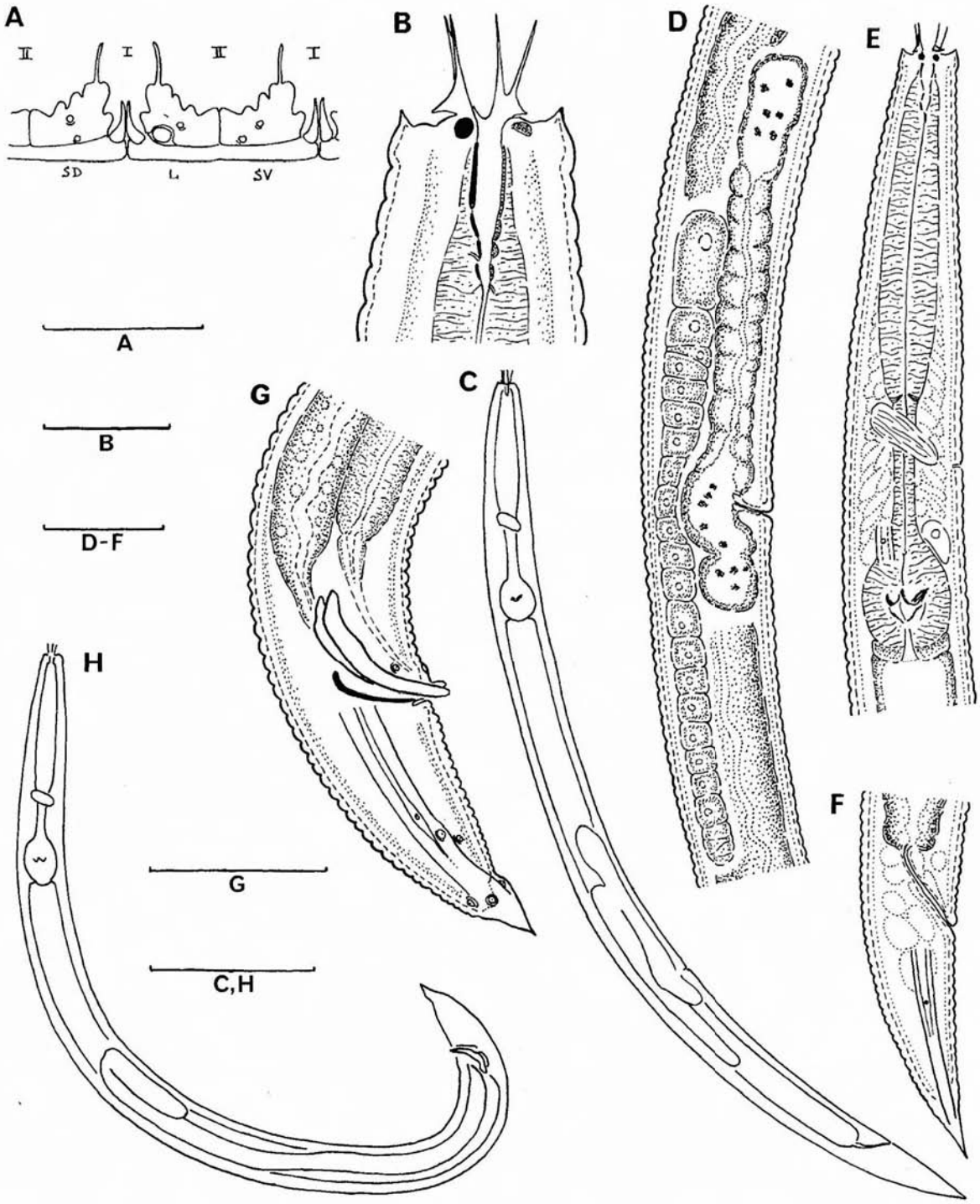

Fig. 1 - *Cervidellus capricornis* sp. n.: holotype female (B-E). A, schematic lip structure (abbreviations: I = primary axil, II = secondary axil; L = lateral lip, SD = subdorsal lip, SV = subventral lip); B, anterior region, lateral median section; C, entire body; D, reproductive system; E, pharyngeal region. Paratype female F, tail region. Allotype male (G-H). G, tail region; H, entire body. Scale bars 10 µm for A-B, 30 µm for D-G and 100 µm for C, H.

TABLE I - *Measurements of (μm)* Cervidellus capricornis *sp. n. The dimensions of paratype females are in the format: mean±standard deviation (range) and of paratype males (Lower Nahal Oren): mean (range).*

Locality	Lower Nahal Oren				Lower Nahal Keziv	
n	Holotype ♀	Allotype ♂	Paratypes 14 ♀♀	Paratypes 4 ♂♂	Paratypes 5 ♀♀	Paratypes 2 ♂♂
L	645	642	565±64 (461-681)	519 (496-558)	579±50 (527-659)	557;592
Body width	33	32	31.8±2.6 (28.0-36.0)	29.9 (27.5-32.5)	30.7±1.4 (28.5-32.0)	30.5; 31.0
Neck length	149	147	141.0±10.7 (127-159)	119.7 (98-145)	146.7±10.3 (132-157)	137; 140
Tail length	64	46	51.4±5.5 (44-64)	44.4 (41-53)	54.4±3.1 (50-57)	52; 53
Anal body width	21.0	23.5	21.2±1.9 (18.0-23.5)	23.2 (21.0-25.5)	20.2±0.7 (19.5-21.0)	26.0; 23.5
a	19.6	20.2	17.8±1.6 (14.7-20.2)	17.4 (16.2-18.8)	18.9±1.9 (17.1-22.1)	18.2; 19.0
b	4.3	4.4	4.0±0.2 (3.5-4.3)	4.4 (4.0-5.7)	4.0±0.4 (3.5-4.5)	4.1; 4.2
c	10.1	14.0	11.0±0.9 (9.6-12.8)	11.8 (10.6-12.2)	10.6±0.5 (10.2-11.6)	10.8; 11.1
c'	3.0	2.0	2.4±0.3 (1.9-3.0)	1.9 (1.6-2.3)	2.7±0.1 (2.5-2.8)	2.0; 2.3
Labial region width	15.0	14.5	15.0±0.8 (14.0-16.0)	13.6 (13.0-14.0)	15.3±0.4 (14.5-15.5)	14.0; 14.0
Labial probolae length	7.5	8.5	7.4±0.9 (6.0-8.5)	7.2 (7.0-7.5)	8.1±1.1 (7.0-9.0)	7.0; 7.0
Stoma length	14.0	13.0	13.4±1.0 (11.5-14.5)	12.5 (12.0-13.5)	12.8±0.3 (12.5-13.5)	13.5; 13.0
Corpus	77	78	75.4±6.6 (64-89)	71.1 (62-84)	80.2±3.7 (75-84)	75; 83
Isthmus	36.5	32.0	32.4±3.5 (25.0-36.5)	27.9 (22.5-31.5)	31.1±3.9 (26.0-36.5)	30.0; 27.5
Bulbus	20.5	23.0	22.8±2.3 (20.0-27.0)	21.9 (21.0-23.0)	23.1±1.7 (21.5-25.0)	20.0; 22.5
Corpus/isthmus ratio	2.1	2.4	2.3±0.3 (2.1-3.0)	2.6 (2.1-3.3)	2.6±0.2 (2.3-2.9)	2.5; 3.0
Nerve ring (nr)	86	104	89.2±9.5 (80-107)	85.3 (83-84)	95.0 (92-99)	86; 99
Excretory pore (ep)	92	115	97.6±11.4 (83-119)	88.6 (88-89)	98.9±4.5 (92-105)	92; 99
Deirid (dei)	100	120	106.1±8.5 (97-124)	98.4 (98-99)	108.8±6.3 (105-120)	104; 112

TABLE I - Continued

Locality	Lower Nahal Oren				Lower Nahal Keziv	
n	Holotype ♀	Allotype ♂	Paratypes 14 ♀♀	Paratypes 4 ♂♂	Paratypes 5 ♀♀	Paratypes 2 ♂♂
Nerve ring (% of neck)	58	71	63.6±3.3 (58-68)	66.0 (65-67)	63.2 (62-64)	63; 70
Excretory pore (% of neck)	61	78	68.6±4.3 (62-75)	70.2 (69-71)	67.7±6.3 (62-78)	67; 70
Deirid (% of neck)	67	81	76.4±4.5 (70-83)	77.3 (77-78)	74.4±5.3 (68-83)	76; 80
V or T (%)	62	50	63.5±1.6 (61-67)	54.5 (45-65)	65.1±3.3 (62-71)	56; 47
Spermatheca	37.5	–	36.4±8.4 (27.5-50.0)	–	42.8 (36.0-50.0)	–
Vagina or spicules	12.5	29.5	11.7±1.1 (9.5-13.5)	26.7 (26.0-27.5)	12.4 (12.0-13.0)	31.0; 30.0
PUS	26.0	–	20.9±2.6 (16.5-26.0)	–	25.7 (22.5-31.5)	–
PUS/BW	0.8	–	0.7±0.1 (0.5-0.8)	–	0.8 (0.7-1.0)	–
Rectum or Gubernaculum	22.0	19.2	20.5±2.1 (16.0-23.5)	17.2 (15.0-19.0)	20.2±1.4 (18.0-22.0)	19.0; 19.5
Rectum/ABW	1.0	–	1.0±0.1 (0.8-1.1)	–	1.0±0.1 (0.9-1.1)	–
Phasmid from anus	20.5	17.5	16.0±2.6 (13.0-21.0)	20.3 (17.0-26.0)	17.5 (16.0-21.0)	20.0; 22.0
Phasmid (% of tail)	32	38	31.3±4.7 (25-41)	45.4 (38-49)	32.0 (28-39)	39; 41
Annule width	2.5	2.5	2.7±0.2 (2.5-3.0)	2.9 (2.5-3.0)	2.5 (2.5-3.0)	2.5; ?
R_{nr}*	32	37	31±2 (28-34)	30 (29-30)	36 (35-37)	31; 39
R_{ep}*	36	41	34±2 (30-38)	32 (31-32)	37±1 (36-39)	33; 39
R_{dei}*	40	43	38±3 (34-43)	35 (34-35)	41±3 (38-45)	37; 44
R_{neck}*	47	52	50±5 (44-63)	46 (43-49)	54±3 (49-58)	50; 54
R_{vulva}*	130	–	125±9 (115-144)	–	129±3 (124-132)	–
R_{anus}*	188	188	179±13 (161-206)	167 (158-178)	187±3 (184-191)	175; 199

* Number of annules from the anterior end.

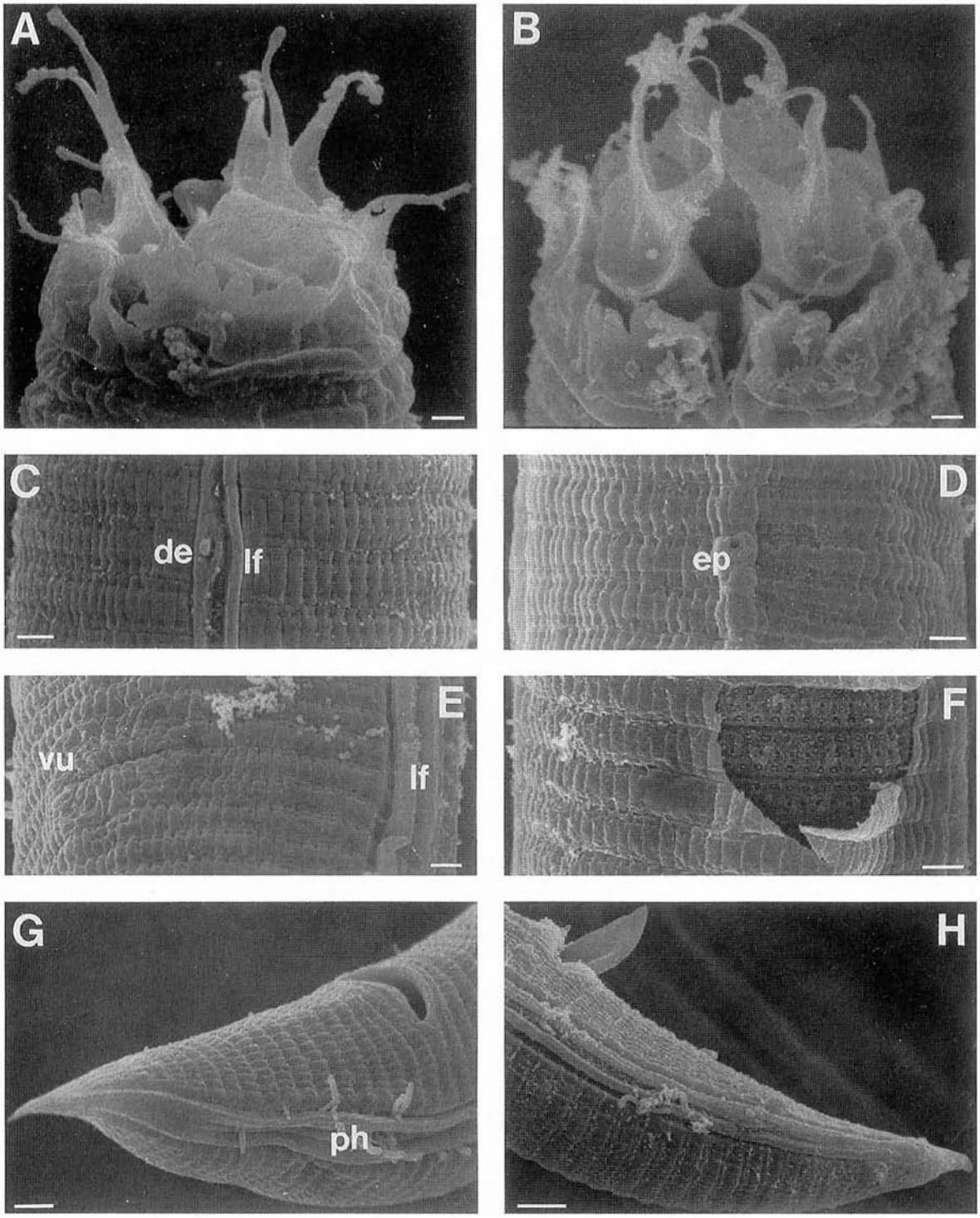

Fig. 2 - *C. capricornis* sp. n.: female (B, D-G). B, anterior end, ventral view; D, excretory pore (ep); E, vulva (vu) and lateral field (lf); F, disrupted cuticle showing pattern of "pores" in internal layer; G, tail region with phasmid (ph). Male (A, C, H). A, anterior end, lateral view; C, deirid (de) and lateral field (lf); H, tail region. Scale bars 1 µm for A-B, 2 µm for C-F and 4 µm for G-H.

Lower Nahal Keziv (additional) population

Female. Similar to the type population except for a somewhat longer PUS and a larger number of annules from anterior end to nerve ring (R_{nr}).

Male. Similar to the type population except for a somewhat longer body, longer spicules and gubernaculum, slightly shorter labial probolae, a more posterior position of nerve ring, excretory pore and deirid, and a larger number of annules from anterior end to nerve ring (R_{nr}), excretory pore (R_{ep}) and deirid (R_{dei}).

Diagnosis

Cervidellus capricornis sp. n. has a body length of about 0.5 mm; cuticle with longitudinal incisures; lateral fields with four incisures; labial probolae bifurcated two-thirds of their length with a basal shallow, cup-shaped, abaxial swelling; asymmetrical lips with six tines; two slender, elongate guarding processes in each primary axil; corpus 2.1-3.0 times longer than isthmus; spermatheca 27.5-50.0 µm long; PUS 0.5-1.0 time VBW; tail conical with acute terminus.

Relationships

The new species shows characters intermediate between the genera *Cervidellus* and *Nothacrobeles* Allen *et* Noffsinger, 1971. Along with the emended and broadened diagnoses of these two genera, the differences between them have become vaguer (Boström and De Ley, 1996; De Ley *et al.*, 1999). We have here opted to place the new species in the former genus, *inter alia* on basis of the following character status: labial probolae with long and slender prongs, labial probolae basally joined by tangential ridges, and elongate guarding processes in the primary axils.

The new species differs from all other species of *Cervidellus* by the organisation of the tines on the lips. It differs from most species of the genus by the abaxial swelling on the labial probolae except for *C. capraeolus* (De Ley, Geraert *et* Coomans, 1990) Boström *et* De Ley, 1996, *C. laticollaris* (De Ley *et* Vandebroek, 1992) Boström *et* De Ley, 1996 and *C. rarus* (Nesterov, 1969) Boström *et* De Ley, 1996. However, the three latter species have the abaxial swelling below the primary bifurcation of the labial probolae, while the abaxial swelling in *C. capricornis* sp. n. is the base of the bifurcation of the labial probolae. They also differ from *C. capricornis* sp. n. in having secondary (and tertiary) bifurcations of the labial probolae. The new species resembles *C. neftasiensis* Boström, 1986, *C. vexilliger* (de Man, 1880) Thorne, 1937 and *C. vinciguerrae* Clausi, 1998 in having a single bifurcation of the labial probolae. It differs from: (i) *C. neftasiensis* by a longer body (0.46-0.68 mm *vs.* 0.20-0.38 mm), wider labial region (13-16 µm *vs.* 7-11 µm), longer stoma (11-15 µm *vs.* 4-9 µm), longer spermatheca (28-50 µm *vs.* 4-13 µm), longer spicules (26-31 µm *vs.* 18-20 µm); (ii) *C. vexilliger* by a longer body (0.46-0.68 mm *vs.* 0.28-0.43 mm), wider labial region (13-16 µm *vs.* 9-13 µm), longer stoma (11-15 µm *vs.* 6-9 µm), comparatively shorter PUS (PUS/BW = 0.5-1.0 *vs.* 0.9-2.2), longer spicules (26-31 µm *vs.* 18-21 µm); (iii) *C. vinciguerrae* by wider labial region (13-16 µm *vs.* 11-12 µm), longer stoma (11-15 µm *vs.* 8-10 µm), somewhat longer spermatheca (28-50 µm *vs.* 16-31 µm), somewhat longer spicules (26-31 µm *vs.* 23-27 µm); (iv) *C. capraeolus* by a longer body (0.46-0.68 mm *vs.* 0.23-0.31 mm), wider labial region (13-16 µm *vs.* 11 µm), longer spermateca (28-50 µm *vs.* 6-14 µm), longer PUS (PUS/BW = 0.5-1.0 *vs.* absent), number of levels of bifurcations of the labial probolae (single *vs.* three); (v) *C. laticollaris* by a longer body (0.46-0.68 mm *vs.* 0.29-0.31 mm), wider labial region (13-16 µm *vs.* 11-12 µm), longer stoma (11-15 µm *vs.* 7-9 µm), higher corpus/isthmus ratio (2.1-3.3 *vs.* 1.1-1.8), longer spermatheca (28-50 µm *vs.* 4-12 µm), longer PUS (PUS/BW = 0.5-1.0 *vs.* <0.5), number of levels of bifurcations of the labial probolae (single *vs.* two), absence of lateral tines on the

basal branch of labial probolae (*vs.* present); (vi) *C. rarus* by a longer body (0.46-0.68 mm *vs.* 0.29-0.31 mm), number of levels of bifurcations of the labial probolae (single *vs.* two). The description of *C. rarus* (Nesterov, 1969) lacks many important characters and therefore the two species cannot be compared accurately.

Type locality and habitat

Israel, Lower Nahal Oren, Mount Carmel, "Evolution Canyon I"; Mediterranean maquis plant association of *Pistacio-Quercetum calliprini* typicum (Nevo, 1995); red dry soil; August, 1999.

Other locality and habitat

Israel, Lower Nahal Keziv, Western Upper Galilee Mountains; lush and dense forest of *Acer obtusifolium* Sibl. *et* Smith and *Laurus nobilis* L. (Finkel *et al.*, 2000); red dry soil; November, 1999.

Type specimens

Holotype (WT 3360), allotype (3361) and four paratype females (WT 3362) deposited in the Laboratory of Nematology, Wageningen Agricultural University, Wageningen, the Netherlands; five female and two male paratypes deposited in the type collection of the Department of Invertebrate Zoology, Swedish Museum of Natural History, Stockholm, Sweden; two female and one male paratypes deposited in the nematode collection of the State Museum of Natural History, L'viv, Ukraine; three female and one male paratypes deposited in the nematode collection of the Department of Nematology, University of California, Riverside, USA.

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Etymology

The specific epithet is derived from the Latin words *capra* (goat) and *cornus* (horn) and refers to the resemblance of the labial probolae to horns of a goat.

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