Some rare species of cephalobs (Nematoda: Rhabditida: Cephalobidae) from Southern Iberian Peninsula

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ABSTRACT
Six rare species of the family Cephalobidae (*Pseudacrobeles laevis*, *Heterocephalobellus magnificus*, *Stegelleta ophioglossa*, *Paracrobeles psammophilus*, *Nothacrobeles nanocorpus* and *Acrobeles bushmanicus*) are described from the Southern Iberian Peninsula, mainly from sandy habitats. Five of these species are reported for the first time from Spain and four of them from Europe. Furthermore, the male of *N. nanocorpus* is described for the first time. Descriptions, measurements and illustrations are presented for all species. Scanning electron microscope study is provided for *H. magnificus*, *N. nanocorpus* and *A. bushmanicus*. In addition, comparative morphometrics for all species studied compared with other populations of the same species are included.

Introduction

The cephalobs (Cephalobidae Filipjev, 1934) are nematodes distinguishable from other representatives of the order Rhabditida mainly by their very narrow stoma with small rhabdia, three-sectioned pharynx, female genital system mono-prodelphic, spermatheca differentiated in a sac, postvulval sac and males lacking bursa. Most cephalobs are also characterized by the presence of six lips and three labial probolae around the oral opening, both structures becoming highly variable and especially useful for separation of genera. They show saprophagous or microbivorous feeding habits and are very widely distributed as well as frequent and abundant dwellers of soils (Andrássy 2005). Some taxa are found in particular habitats, for instance dry sandy soils (Yeates 1967; Orsel and Vinciguerra 2002; Waceke et al. 2005; Abolafia et al. 2014; Boström and Holovachov 2014).

In the present paper six rare species belonging mainly to uncommon genera of cephalobids are described from natural areas of the Southern Iberian Peninsula; most of them recorded for the first time from this region.

Materials and methods

Nematodes were extracted from soil samples using modifications of Flegg’s method (1967) and Baermann’s funnel technique (1917). They were relaxed and killed by heat,
fixed in 4% formaldehyde, and processed to anhydrous glycerine according to Siddiqi (1964). Measurements were directly taken using an ocular micrometer and/or a curvimeter upon drawing the corresponding organ or structure. Drawings were made using a drawing tube (camera lucida) attached to a Leitz Laborlux S microscope (Leitz, Wetzlar, Germany), LM pictures were taken using a Nikon Eclipse 80i microscope (Nikon, Tokyo, Japan) equipped with a digital video camera Nikon Digital Sight DS-5M; raw photographs were edited using Adobe® Photoshop® CS (Adobe Systems, San José, CA, USA). For scanning electron microscope (SEM) studies, fixed specimens were hydrated in distilled water, dehydrated in a graded ethanol (25, 30, 50, 70, 80, 95, 100%) series and acetone (100%), critical point dried, coated with gold, and observed with a Zeiss Merlin microscope (Zeiss, Jena, Germany) (Abolaña and Peña-Santiago 2005; Abolaña 2015). The terminology used for the morphology of stoma and spicules follows the proposals by De Ley et al. (1995) and Abolaña and Peña-Santiago (2006), respectively.

**Taxonomy**

_Pseudacrobeles (Pseudacrobeles) laevis_ (Thorne, 1937)
De Ley, Siddiqi and Boström, 1993a
(Figure 1A–F)

**Material examined**
Two females from one locality, in good state of conservation.

**Morphometrics**
See Table 1.

**Description**

**Female.** Moderately slender to slender nematodes, 0.62–0.66 mm long. Body cylindrical, tapering towards both ends but more distinctly towards the posterior extremity as the tail is conical. Habitus weakly curved ventrad upon fixation. Cuticle c. 1 µm thick at midbody, with conspicuous annuli about 1 µm wide. Lateral field 3 µm wide, occupying 16–19% of mid-body diameter, and consisting of two wings or three longitudinal incisures fading out at level of tail phasmid. Lip region continuous with the adjacent body, _circa_ one-third of body diameter at neck base; three pairs of asymmetrical lips, one dorsal and two lateroventral, conoid and without setae-like cephalic probolae; primary axils deep, U-shaped, and secondary axils marked by shallow incisures, both lacking guard processes; oral aperture surrounded by three labial probolae, connected at their bases by tangential ridges and attached to their respective pair of lips; amphid aperture small and oval. Stoma cephaloboid, 2.5–2.7 times the lip region diameter long: cheilostom with well-developed bar-shaped rhabdia, gymnostom very short and stegostom with minute, hardly discernible rhabdia. Pharynx typical cephaloboid: corpus cylindrical and 4.6–5.2 times as long as isthmus; isthmus marked from corpus by a narrowing and slightly tapering throughout its length; basal bulb ovoid, with valvular apparatus. Nerve ring located at 61–62% of total neck length from anterior end, at the posterior fourth of corpus. Excretory pore at 64% of total neck length or 91 annuli from anterior end.
Figure 1. *Pseudacrobes (Pseudacrobes) laevis* (Thorne, 1937) De Ley et al. 1993a (female): (A) neck region; (B) anterior region; (C) reproductive system; (D) lateral field; (E) entire female; (F) posterior end. *Heterocephalobellus magnificus* (Andrássy, 1987) De Ley et al. 1993b (juvenile): (G) neck region; (H) anterior region; (I) posterior end.
Table 1. Morphometrics of *Pseudacrobes (Pseudacrobes) laevis* (Thorne, 1937) De Ley et al. 1993a, *Stegelleta ophioglossa* Andrássy, 1967b, *Paracrobes psammophilus* Navarro and Lluch, 1999, *Nothacrobes nanocorpus* De Ley, De Ley, Baldwin, Mundo-Ocampo and Nadler, 1999 and *Acrobes bushmanicus* Heyns, 1969 from southern Iberian Peninsula. Measurements in μm and in the form: mean ± standard deviation (range).

| Species          | H. magnifica | S. ophioglossa | P. psammophilus | Linares | N. nanocorpus | A. bushmanicus |
|------------------|--------------|----------------|----------------|---------|---------------|---------------|
| **Locality**     |              |                |                |         |               |               |
| **Province**     | Badajoz      | Matalascañas   | Murcia         | Almería | Salinas de    | Salinas de    |
| **Habitat**      | Oak          | Sandy dune     | Greenhouse     | Saline  | Cabo de Gata  | Cabo de Gata  |
| **Character**    | 2 ♂♂         | 2 ♂♂           |                | 2 ♂♂    | 4 ♂♂          | 6 ♂♂          |
| **Body length**  | 621, 657     | 701            | 325, 403       | 452, 488 | 458, 491      |                |
| **a**            | 32.7, 41.1   | 28.0           | 23.2, 18.3     | 15.1, 15.7 | 17.0, 18.9   | 15.6 ± 1.4 (14.5–17.4) |
| **b**            | 3.4, 4.0     | 3.8            | 3.3, 3.7       | 3.3, 3.6 | 3.4, 3.3      | 3.7 ± 0.1 (3.6–3.9) |
| **c**            | 16.3, 17.3   | 17.9           | 11.6, 12.6     | 10.0, 10.2 | 10.0, 12.6   | 13.1 ± 0.9 (12.0–14.2) |
| **c’**           | 3.5, 3.8     | 2.4            | 3.1, 2.3       | 2.4, 2.7 | 2.2, 2.1      | 2.0 ± 0.1 (1.8–2.1)  |
| **V**            | 67, 66       | 66             | 60, 63         | 62, 60  | 63, 66        | 63.9 ± 1.2 (63–66)  |
| **Labil probolae** | –            | 1.5            | 5, 5           | 10, 11  | 10, 11        | 1.1 ± 0.3 (1–2)   |
| **Lip region width** | 6, 6         | 8              | 6, 8           | 14, 10  | 12, 14        | 7.5 ± 0.6 (7–8)   |
| **Stoma length** | 16, 15       | 8              | 8, 7           | 11, 11  | 10, 12        | 5.5 ± 0.6 (5–6)   |
| **Pharyngeal corpus length** | 124, 110   | 134             | 64, 66         | 75, 74  | 76, 82        | 20.5 ± 1.7 (18–22) |
| **Isthmus length** | 27, 26      | 24              | 14, 22         | 28, 27  | 30, 29        | 23.0 ± 0.8 (22–24) |
| **Bulbus length** | 18, 15       | 16              | 14, 14         | 24, 22  | 19, 24        | 13.0 ± 0.8 (12–14) |
| **Pharynx length** | 169, 151    | 182             | 92, 102        | 127, 123 | 125, 135      | 56.5 ± 3.1 (52–59) |
| **Nerve ring – anterior end** | 115, 102    | 104             | 82, 74         | 100, 102 | 106, 106      | 38.3 ± 3.3 (34–42) |
| **Excretory pore – anterior end** | 7, 105    | 112             | 7, 82          | 102, 104 | 104, 104      | 43.0 ± 3.5 (40–48) |
| **Deirid – anterior end** | 7, 121    | 136             | 7, 100         | 122, 126 | 126, 126      | 50.7 ± 4.7 (47–67) |
| **Neck length** | 185, 166     | 193             | 100, 109       | 138, 134 | 135, 147      | 62.0 ± 3.4 (57–64) |
| **Annulli width** | 0.8, 0.8     | 1.5             | 2.0, 2.5        | 4, 3    | 3, 3          | 1.5 ± 0.0 (2) |
| **Cuticle at midbody** | 0.8, 0.8    | 1.5             | 2.0, 2.5        | 2.0, 2.5 | 2, 2          | 0.5 ± 0.0 (1) |
| **Body diameter at neck base** | 18, 15      | 26              | 14, 20         | 30, 30  | 28, 24        | 14.3 ± 0.5 (14–15) |
| **Body diameter at midbody** | 19, 16      | 25              | 14, 22         | 30, 31  | 27, 26        | 14.8 ± 1.0 (14–16) |
| **Lateral field width** | 3, 3        | 6               | 3, 6           | 6, 7    | 4, 4          | 3.0 ± 0.0 (3) |
| **Anterior ovary/testis length** | 131, 122    | 32              | 74, 71         | 113, 112 | 172, 118      | 37.0 ± 4.2 (32–42) |
| **Sperrmatheca** | 20, 16       | 6               | 14, 16         | 24, 27  | 23, 26        | 6.3 ± 2.1 (3–8) |
| **Anterior uterus length** | 37, 30     | –               | 45, 50         | 56, 56  | –            | 23.8 ± 8.7 (14–34) |
| **Postovul sac** | 35, 24       | 9, 10           | 64, 72         | 3.5 ± 0.6 (3–4) | –          | – |
| **Vagina length** | 8, 7         | –               | 5, 6           | 8, 10   | –            | 4.3 ± 0.5 (4–5) |
| **Vulva – anterior end** | 419, 434    | 432             | 196, 254       | 281, 292 | –            | 146.8 ± 9.0 (134–153) |
| **Rectum length** | 17, 20       | 20              | 9, 14          | 14, 19  | 13, 21       | 10.8 ± 1.5 (10–13) |
| **Anal body diameter** | 11, 10      | 16              | 9, 14          | 19, 18  | 21, 21       | 9.0 ± 0.8 (8–10) |
| **Tail length** | 41, 39       | 39              | 28, 32         | 45, 45  | 46, 39        | 17.5 ± 0.6 (17–18) |
| **Phasmid – anus distance** | 19, 18      | 11              | 12, 11         | 19, 19  | 27, 23        | 9.3 ± 0.5 (9–10) |
| **Spicules length** | –            | –               | –             | 48, 38  | –            | – |
| **Gubemaculum** | –            | –               | –             | 19, 14  | –            | – |

1. Stoma + pharynx
Deirids at 73% of total neck length or 102 annuli from anterior end. Cardia conoid, enveloped by intestinal tissue. Intestine a tube-like structure, without appreciable differentiations. Genital system monodelphic-prodelphic, in dextral position: ovary 122–132 µm long, with double flexures behind the vulva level; oviduct short; spermatheca 16–20 µm long or equal to the corresponding body diameter; uterus 37–30 µm long or 1.9 times the corresponding body diameter; posterior branch reduced to a postvulval sac 24–35 µm long or 1.5–1.8 times the corresponding body diameter bearing septa; vagina extending inwards 41–44% of body diameter and slightly bent anteriad; vulval lips not protruding. Rectum 1.4–2.0 times the anal body diameter long, with three large glandular cells around its junction to the intestine. Tail conical, tapering very gradually, visibly curved ventrad, ending in an acute tip and having 34 ventral annuli; phasmid observed at 18–19 µm or 46–49% of tail length.

Male. Not found.

Distribution
Badajoz province, near the road to Badajoz, where it was collected from grassland with holm oak (Quercus rotundifolia Lam.) trees.

Remarks
The two Iberian females examined are in general morphology and morphometrics very similar to the North American material described by Thorne (1937) as Eucephalobus laevis and De Ley et al. (1993a) (see Table 2). Nevertheless, some minor differences, regarded as geographical variations, are also observed: more slender body (a = 33–41 vs a = 24–29 in North American specimens), slightly shorter isthmus (26–27 vs 29–36 µm long), both excretory pore and deirids located more posterior (91 and 102 annuli from anterior end vs 60–81 and 71–90 annuli, respectively), and female tail slightly shorter (39–41 vs 46–64 µm long).

Andrássy (1967a) studied a Chinese population as Heterocephalobus laevis that shows significantly smaller body size (body 490–530 µm long), rounded cheilorhabdia (vs bar-shaped in Iberian females), longer postvulval uterine sac (1.5–1.8 vs 0.8 times the corresponding body diameter). Thus, some doubt persists on the true identity of this population.

This is the first report of Pseudacrobelles (P.) laevis for the European fauna.

Heterocephalobellus magnificus (Andrássy, 1987)
De Ley, Siddiqi and Boström, 1993b
(Figures 1G–I, 2A–E, 3)

Material examined
Two juveniles from one locality.

Morphometrics
See Table 1.
Table 2. Comparative morphometrics of *Pseudacrobeles (Pseudacrobeles) laevis* (Thorne, 1937) De Ley et al. 1993a and *Heterocephalobellus magnificus* (Andrássy, 1987) De Ley et al. 1993b. All measurements in µm.

| Character          | P. (P) laevis |  | H. magnificus |
|--------------------|---------------|-----------------|---------------|
|                    | Spain | Utah, USA | China | Oregon, USA | Spain | Hungary | Samos, Greece | Iran |
| Reference | Present paper | Thorne, 1937 | Andrássy 1967a | De Ley et al. 1993a | Present paper | Andrássy 1987 | Boström 1991 | Amirzadi et al. 2013 |
| Habitat | Holm oak | Alpine soil | ? | ? | Sandy dune | Wet mosses | Sandy brush | Weed |
| n | 2♂♀ | 2♂♂ | 2♂♀ | 6♂♀ | 7♂♂ | 2♂♀ | 3♂♂ | 6♂♀ | 3♂♂ |
| L | 621, 657 | 700 | 700 | 490–530 | 595–705 | 595–685 | 701 | 910 | 850 | 742–784 | 895–1039 | 792–878 |
| a | 33, 41 | 24 | 29 | 25–28 | 25–28 | 25–29 | 28 | 33 | 27 | 25–30 | 29–36 | 32–33 |
| b | 3, 4, 40 | 3, 9 | 4, 0 | 3,2–3,3 | 3,4–3,8 | 3,4–3,7 | 3,8 | 3,4 | 3,7 | 3,4–3,6 | 3,4–3,8 | 3,2–3,8 |
| c | 16, 17 | 11–14 | 15 | 12–13 | 12–14 | 17 | 18 | 23 | 19 | 22 | 20–23 | 22–24 |
| c′ | 3, 5, 38 | 3,4* | 2,3* | 3,8–4,2 | 3,1–3,8 | 2,1–2,3 | 2,4 | 2,5 | 2,4 | 1,6–1,7 | 2,4–2,9 | 1,7–2,1 |
| V | 67, 66 | 63 | – | 60–61 | 61–66 | – | 62 | 65 | 64 | – | 64–66 | – |
| Lip region diameter | 6 | 6*** | ? | 6* | ? | ? | 8 | 10 | 9* | ? | 9–11 | 8–10 |
| Stoma length | 16, 15 | 11*** | ? | 13–15 | 12–15 | 14–15 | 8 | 13 | 7–8 | 7–8 | 11–15 | 10–13 |
| Corpus length | 124, 110 | 116*** | ? | 102* | 97–122 | 108–120 | 134 | 200 | 188* | ? | 140–218 | 173–187 |
| Isthmus length | 27, 26 | 33*** | ? | 30* | 29–33 | 30–36 | 24 | 40** | 34* | ? | 30–40 | 32–38 |
| Bulb length | 18, 15 | 19*** | ? | 14* | 18–21 | 16–20 | 16 | 23 | 18–19 | 18–19 | 20–23 | 20–23 |
| Neve ring – anterior end | 115, 102 | 113*** | ? | 101* | 96–111 | 83–119 | 104 | ? | 125* | ? | 101–152 | 118–129 |
| Excretory pore – anterior end | 7, 105 | 115*** | ? | ? | 100–115 | 88–117 | 112 | 135 | 133 | 125 | 104–157 | 126–131 |
| Deirid – anterior end | 7, 121 | 130*** | ? | ? | 117–121 | 117 | 130 | ? | ? | ? | 122–177 | 143–151 |
| R_{ep} | 7, 91 | 81* | 81* | ? | 62–71 | 60–67 | 67 | ? | ? | ? | 58–63 | ? |
| R_{dei} | 7, 102 | 90* | 90* | ? | 70–77 | 75 | 73 | ? | ? | ? | 66–71 | ? |
| Neck length | 185, 166 | 179** | 175* | 153* | 159–182 | 163–189 | 193 | 268** | 244* | 215–221 | 250* | 245* |
| Body diameter – neck base | 18, 15 | 26** | ? | 22* | ? | ? | 26 | ? | 33* | ? | 11–14 | 11–12 |
| middle | 19, 16 | 29** | 24** | ? | 22–28 | 22–27 | 25 | 28 | 31 | ? | 27–31 | 25–27 |
| Anus | 11, 10 | ? | ? | 20** | ? | 12–16 | 16–18 | 16 | 15** | 19** | 23* | 15–17 | 18–21 |
| Sperrmatheca | 16–20 | ? | – | ? | 24–43 | – | – | ? | 67 | – | 47–93 | – |
| Postvulval sac | 35, 24 | ? | ? | ? | 29–45 | – | – | ? | 185 | – | 163–201 | – |
| Postvulval sac/body width | 18, 15 | ? | ? | 0.8* | 1,2–1,6 | – | – | 6,0 | 5,6* | – | 6,0–64 | – |
| Vagina length | 8, 7 | ? | – | ? | 7–10 | – | – | ? | 7* | – | 9–11 | – |
| Vulva – ant. end | 419, 434 | 441** | – | ? | ? | – | 432 | 592** | 544** | – | 578–674 | – |
| Rectum length | 17, 20 | ? | ? | 19* | 17–24 | ? | 20 | 32** | 26 | 9* | 26–34 | =5x²³ |
| Tail length | 41, 39 | 50–63** | 47** | 40* | 46–57 | 36–40 | 39 | 38 | 45 | 33–36 | 39–46 | 34–40 |
| Spicules length | – | – | 24*** | – | – | 21–25 | – | – | 22–27 | – | 22–28 | – |
| Gubernaculum length | – | – | 18*** | – | – | 12–14 | – | – | 12–16 | – | 12–15 | – |

* Measurements from drawings. ** Calculated from data in description. *** Calculated from data combining description and drawings.
1 Measurements from adult not specifying whether it is male or female.
2 As pharynx length.
3 The measurements provided by Amirzadi et al. (2013), 27–34 µm, are clearly a mistake.
Figure 2. *Heterocephalobellus magnificus* (Andrássy, 1987) De Ley et al. 1993a (LM, juvenile): (A) neck region (arrow points at excretory pore); (B) stoma; (C) lip region; (D) genital primordium; (E) posterior end. *Stegelleta ophioglossa* Andrássy, 1967b (LM, female): (F) neck region (arrow points at excretory pore); (G) lip region (arrow points at amphid); (H) vagina region; (I, J) posterior end at rectum and lateral field levels, respectively (arrow points at phasmid); (K) cuticle.
Figure 3. *Heterocephalobellus magnificus* (Andrássy, 1987) De Ley et al. 1993b (SEM, juvenile): (A, F, I) lateral at anterior end, pharyngeal corpus level and middle body length; (B–E, G) lip region in dorsal, left lateral, subfrontal, dorsal and frontal, respectively; (H) cheilostom; (J, K) tail in ventral and left lateral views, respectively.
**Description**

**Juvenile.** General morphology similar to females. Cuticle with smooth annuli. Lateral fields with two areolated wings or three longitudinal incisures, extending to phasmid. Lip region continuous with the adjacent body, having six low and rounded lips in pairs and bearing six labial and four cephalic sensillae, with deep primary axils and shallow secondary axils; oral opening surrounded by three low labial probolae; each pair of lips and its corresponding labial probolae demarcated by a narrow incisure. Amphids oval. Stoma cephaloboid: cheilostom with rounded rhabdia, short gymnostom, and well-developed stegostom. Pharynx typical of the genus, consisting of very long pharyngeal corpus, 5.6 times longer than isthmus, short isthmus and pyriform bulb. Nerve ring surrounding the posterior part of the pharyngeal corpus. Excretory pore located at level of the posterior part of the pharyngeal corpus, at 58% of neck length. Deirids located at level of the posterior part of the pharyngeal corpus, at 68% of neck length. Cardia conoid. Intestine differentiated anteriorly in a cardiac region with narrower walls, 2.5 times the corresponding body width long. Genital system incipient. Tail conical, curved ventrad, with finely rounded tip. Phasmids located at 28% of tail length.

**Adult.** Not found.

**Distribution**

Matalascañas, Huelva province, where it was collected from the rhizosphere of *Ammophila arenaria* (L.) Link in sand dunes.

**Remarks**

Although adult specimens of this Iberian population were not collected, the morphology of juveniles agree very well with previous records of *H. magnificus* from Hungary (Andrássy 1987), Greece (Boström 1991; as *H. potamiensis*, a junior synonym according to Andrássy 2005) and Iran (Amirzadi et al. 2013) (see Table 2). The genus contains three valid species (cf. Boström and Holovachov 2013); from *H. brasiliensis* Rashid et al. 1984 it can be distinguished by having wider lip region diameter (8 vs 6 µm wide) and less slender female tail (c’ = 2.4 vs 4.2); from *H. panamericanus* Boström and Holovachov 2013 by having, even being juvenile, longer body (L = 0.70 vs L = 0.52–0.63 in females), labial probolae wider than high (vs as wide as high) and excretory pore and deirids more posterior (R<sub>ep</sub> = 67, R<sub>dei</sub> = 73 vs R<sub>ep</sub> = 42–51, R<sub>dei</sub> = 47–57).

Figure 2 provides a rich series of SEM pictures illustrating the morphology of lip region, lateral field and caudal region which allow a better characterization of the genus.

**Stegelleta ophioglossa** Andrássy, 1967b

(Figures 2F–K, 4A–E)

**Material examined**

Two females from one locality, in good state of preservation.

**Morphometrics**

See Table 1.
Figure 4. Stegelleta ophioglossa Andrássy, 1967b (female): (A) neck region; (B) anterior region; (C) lateral field; (D) reproductive system; (E) posterior end. Nothacrobes nanocorpus De Ley, De Ley, Baldwin, Mundo-Ocampo and Nadler, 1999: (F) lip region; (G) neck region; (H) female reproductive system; (I) lateral field; (J) female posterior end; (K) male posterior end.
**Description**

**Female.** Stout to moderately slender nematodes, 0.33–0.40 mm long. Habitus weakly curved ventrad after fixation. Cuticle deeply annulated and tessellated, with 16 longitudinal rows of blocks at midbody. Lateral field with two wings separated by a narrow groove, appearing as four longitudinal incisures under LM, occupying 27% of midbody diameter and extending posteriorly almost to tail tip. Lip region continuous with the adjacent body; three pairs of asymmetrical lips, one dorsal and two ventrolateral, with more or less straight and smooth margins and bearing six labial and four cephalic sensillae; primary axils deep and U-shaped, and secondary axils demarcated by a shallow incisure, both lacking guarding processes; oral opening surrounded by three labial probolae, connected at bases by tangential ridges; each labial probola bifurcated, snake-tongue-shaped, with prongs long and convergent, curved, lacking lateral tines and secondary bifurcations. Amphids clearly visible, small and with oval shape. Stoma cephaloboid: cheilostom with well-developed rounded rhabdia, gymnostom very short, and stegostom with minute discernible rhabdia. Pharynx typical of the group: corpus 3.0–4.6 times isthmus length, slightly fusiform; corpus–isthmus junction slightly swollen at corpus and narrower at isthmus; isthmus slender, demarcated by a break in muscular tissue; basal bulb ovoid, with valvular apparatus. Nerve ring at 68–82% of neck length, at level of isthmus. Excretory pore at 75% of neck length, at level of isthmus, 41 annuli from anterior end. Deirids at 92% of neck length, at level of bulb, 47 annuli from anterior end. Cardia conoid, surrounded by intestinal tissue. Intestine without distinct specializations. Reproductive system monodelphic-prodelphic, in a dextral position to intestine: ovary short, with flexures at the postvulval part; oviduct short; spermatheca reduced, half as long as the corresponding body diameter; uterus tubular, 2.3–3.2 times as long as the corresponding body diameter; postvulval sac short, 0.5–0.6 times as long as the body diameter; vagina short, extending inwards 27–36% of body width; vulval lips not protruding. Rectum as long as the body width at anus level, having three large gland-like cells around the intestine–rectum junction. Tail conical with rounded terminus. Phasmids located at 34–43% of tail length.

**Male.** Unknown.

**Distribution**

This species was collected from two localities: (i) Murcia province, in a greenhouse with biofumigate soil; and (ii) Almería province, Salinas de Cabo de Gata, volcanic sandy soil, in association with *Sarcocornia fruticosa* (L.) Scott.

**Remarks**

The description above and morphometrics agree with those of other known populations from Mongolia (Andrássy 1967b), Uzbekistan (Mavljanov 1978; as *S. cylindrica*, a junior synonym according to De Ley et al. 1990), Senegal (De Ley et al. 1990; Boström and Holovachov 2014) and Iran (Shokoohi et al. 2008) (see Table 3). Type material from Mongolia, however, differ from other populations in having appreciably larger body size (470–490 vs 315–403 µm long), longer labial probolae (8 vs 4–7 µm long), and lower number of longitudinal rows of cuticle blocks (14 vs 16). The specimens described as *S.
Table 3. Comparative morphometrics of *Stegelletta ophioglossa* Andrásy, 1967b and *Paracrobeles psammophilus* Navarro and Lluch, 1999. All measurements in µm.

| Country | S. ophioglossa | P. psammophilus |
|---------|----------------|-----------------|
|         |     | Spain | Mongolia | Uzbekistan | Senegal | Iran | Senegal | Spain | Spain | Italy |
| Reference | Present paper | Andrásy 1967b | Dörfel et al. 1990 | De Ley et al. 2008 | Boström and Holovachov 2014 | Present paper | Navarro and Lluch 1999 | Orselli and Vinciguerra 2002 |
| Habitat | Sandy dune | Cotton | Turf | Saline sandy soil | Dune sand | Dune sand |
| Character | | | | | | | |
| L | 325–403 | 470–490 | 335–390 | 324–356 | 324–356 | 315–382 | 452–488 | 458–491 | 360–552 | 424–531 | 490–580 | 520–610 |
| a | 18–23 | 20–21 | 18–23 | 20–23 | 21–22 | 19–20 | 15–16 | 17–19 | 10–17 | 10–18 | 13–16 | 12–20 |
| b | 3.3–3.7 | 3.3–3.4 | 3.1–3.6 | 3.2–3.5 | 3.7–3.8 | 3.2–3.7 | 3.3–3.6 | 3.3–3.4 | 2.9–3.7 | 3.1–3.6 | 2.3–2.9 | 2.4–3.2 |
| c | 12–13 | 11–12 | 10–12 | 10–13 | 11–12 | 11–12 | 10 | 10–13 | 7–11 | 9–12 | 8.1–9.5 | 8.1–9.3 |
| c’ | 2.3–3.1 | 3.0–3.5 | 3.0* | 3.0–3.6 | 2.9–3.4 | 2.6–3.2 | 2.4–2.7 | 1.9–2.2 | 1.9–2.7 | 1.6–2.2 | 2.2–2.8 | 1.7–2.8 |
| V | 60–63 | 60–62 | 63–67 | 61–63 | 63–64 | 65–65 | 60–62 | – | 59–63 | – | 59–62 | – |
| Labial probolae | 5 | 8 | 5–6* | 5–6 | 4–5 | 6–7 | 10–11 | 10–11 | 10–12 | 9–13 | 11–18 | 13–17 |
| Lip region diameter | 6–8 | ? | 8* | 6* | 4–6 | 6–7 | 10–14 | 12–14 | 14–16 | 12–16 | 19* | ? |
| Stoma length | 7–8 | ? | 15* | 7–9 | 6–8 | 9 | 11 | 10–12 | 10–14 | 10–14 | 10–18 | 12–19 |
| Corpus length | 64–66 | ? | 40* | 63–71 | 60–68 | 62–69 | 74–75 | 76–82 | 89* | ? | 112–138 | 107–139 |
| Ischimathus length | 14–22 | ? | 23* | 18–25 | 12–18 | 15–17 | 27–28 | 29–30 | 30–40 | 32–40 | 25–43 | 28–49 |
| Bulb length | 14 | ? | 14* | 13–14 | 16–17 | 12–15 | 22–24 | 19–24 | 22–28 | 22–26 | 28–33 | 28–33 |
| Neve ring – anterior end | 74–82 | ? | 68* | 60–71 | 67–71 | 64–81 | 100–102 | 106 | 89–125 | 87–113 | 140–169 | 140–171 |
| Excretoary pore – anterior end | 82 | ? | 64* | 61–71 | 70–74 | 72–83 | 102–104 | 104 | 69–117 | 75–107 | 114–139 | |
| Deirid – anterior end | 100 | ? | ? | 72–78 | 70–78 | 75–87 | 122–126 | 126 | ? | ? | ? | ? |
| Rp | 41 | ? | ? | 36–39 | 36–38 | 32–35 | 23–25 | 23 | 20*** | ? | 20*** | ? |
| Rdel | 47 | ? | ? | 43 | 37–40 | 28–30 | 29 | ? | ? | ? | ? | ? |
| Neck length | 100–109 | ? | 115** | 103* | 108** | 100* | 134–138 | 135–147 | 164* | ? | 175* | ? |
| Body diameter – neck base | 14–20 | ? | 16* | 16* | 17* | 18* | 30 | 24–28 | 30* | ? | 41* | ? |
| midbody | 14–22 | ? | 18* | 15–18 | 15–18 | 16–21 | 30–31 | 26–27 | 32–42 | 28–42 | 35–46 | 30–45 |
| anus | 9–14 | ? | 10 | 9–10 | 9–10 | 10–12 | 18–19 | 21 | 18–24 | 22–30 | 23–28 | 25–32 |
| Rows of cuticle blocks | 16 | 14 | 16 | 16 | 16 | 16 | – | – | – | – | – | – |
| Spermaphaca | 14–16 | ? | ? | 11–13* | 8 | 7–12 | 24–37 | – | 50* | – | 30–37 | – |
| Postvulval sac | 9–10 | ? | 7* | 11–14 | 8–17 | 7–9 | 64–72 | – | 57–101 | – | 65–106 | – |
| Postvulval sac/body width | 0.5–0.6 | 0.8* | 0.5* | 1.1–1.4 | 0.5–0.9 | 0.4–0.5 | 2.1–2.3 | – | 3.0* | – | 2.5* | – |
| Vagina length | 5–6 | ? | 3* | 3–5 | 6 | 3–7 | 8–10 | – | 18* | – | 14–19 | – |
| Vulva – anterior end | 196–254 | ? | 253* | 209–238 | 200–243 | 281–292 | – | ? | ? | ? | ? | ? |
| Rectum length | 9–14 | ? | 8* | 10–16 | 12–14 | 10–15 | 14–19 | 13 | 18–22 | ? | 18–25 | ? |
| Tail length | 28–32 | ? | 35* | 28–33 | 29–32 | 29–34 | 45–48 | 39–46 | 46–53 | 42–53 | 58–68 | 56–70 |
| Spicules length | – | – | 38–48 | – | 42–57 | – | 68–81 | – | – | – | – | – |
| Submasculum length | – | – | 14–19 | – | 20–39 | – | 28–31 | – | – | – | – | – |

* Measurements from drawings. ** Calculated from data in description. *** Counted on drawings.

1 Measurements from adult not specifying whether it is male or female.
*ophioglossa* by Orselli and Vinciguerra (2002) from Italy corresponds with *S. incisa* according to Boström and Holovachov (2014).

The material described here from Murcia was reported previously by Abolafia et al. (2011), but is now being re-examined to provide new data. The material from Almería was preserved for molecular analysis.

**Paracrobesles psammophilus** Navarro and Lluch, 1999
(Figures 5, 6A–F)

**Material examined**
Two females and two males from one locality.

**Morphometrics**
See Table 1.

**Description**

**Adult.** Stout nematodes, body 0.45–0.49 mm long. Habitus somewhat curved ventrad after fixation. Cuticle deeply annulated and tessellated, distinctly divided in blocks. Lateral field with four longitudinal incisures or two wings separated by a broad groove, occupying 15–25% of midbody diameter, and nearly reaching the tail tip. Lip region continuous with the adjacent body, bearing three pairs of asymmetrical lips, one dorsal and two ventrolateral, six labial and four cephalic sensillae; primary axils deep, U-shaped, having one elongate triangular process originating from the incomplete first annulus; secondary axils with two guarding processes, each one originating from each lip; lips asymmetrical, each one with three setiform processes along its margin, the lateral ones longer than the median one; oral opening surrounded by three labial probolae, connected at bases by tangential ridges; each labial probola with a very short basal part, and a longer and bifurcated distal part, bearing very long, divergent and straight prongs that lack lateral tines and secondary bifurcations; the base of bifurcation is slightly expanded toward the secondary axil. Amphids clearly visible, large, oval. Stoma cephaloboid: cheilostom consisting of well-developed, oval rhabdia; gymnostom very short; and stegostom with minute rhabdia. Pharynx also cephaloboid: pharyngeal corpus 2.5–2.7 times isthmus length, with subcylindrical, posteriorly narrower procorpus, and elongate and dilated metacorpus with expanded lumen and sclerotized walls; pharyngeal corpus–isthmus junction slightly swollen at corpus and narrower at isthmus; isthmus slender, demarcated by a break in muscular tissue; basal bulb ovoid, with valvular apparatus. Cardia conoid, surrounded by intestinal tissue. Nerve ring at 72–79% of neck length, at level of isthmus. Excretory pore at 74–77% of neck length, at level of isthmus, 23–25 annuli from anterior end. Deirids at 88–94% of neck length, at level of bulb, 28–30 annuli from anterior end. Intestine without distinct specializations.

**Female.** Reproductive system monodelphic-prodelphic, dextral in relation to intestine. Ovary short, not reaching the distal part of postvulval sac, without flexures. Oviduct short. Spermatheca well developed, about equal to the corresponding body diameter in length. Uterus tubular, 1.8–1.9 times the corresponding body diameter long. Postvulval
Figure 5. *Paracrobeles psammophilus* Navarro and Lluch, 1999: (A) neck region; (B) lip region; (C) entire female; (D) female posterior end; (E) lateral field; (F) female reproductive system; (G) entire male; (H) male posterior end.
Figure 6. *Paracrobeles psammophilus* Navarro and Lluch, 1999 (LM): (A) neck region; (B) lip region (I = primary axil, II = secondary axil, black arrows point at labial processes, white arrows point at guarding processes); (C) female posterior end; (D) male posterior end; (E) female reproductive system; (F) lateral field. *Nothacrobeles nanocorpus* De Ley, De Ley, Baldwin, Mundo-Ocampo and Nadler, 1999 (LM): (G) neck region; (H, I) female posterior end; (J) male posterior end; (K) lateral field.
sac well developed, 2.1–2.3 times body diameter long, differentiated in two regions, a tubular proximal and another swollen distal. Vagina elongated forming a tube connecting uterus and postvulval sac. Vulval lips protruding. Rectum 0.7–1.1 times anal body diameter; three large gland-like cells are distinguishable around the intestine–rectum junction. Tail conical with finely rounded terminus. Phasmids located at 40–42% of tail length.

**Male.** General morphology similar to female. Reproductive system monorchic, dextral in position, with testis reflexed ventrad anteriorly. Spicules paired and symmetrical, very slender and curved ventrad: variably rounded manubrium, conoid calamus, and ventrad curved lamina with acute tip. Gubernaculum well developed, almost straight, about one half of the spicules length, lanceolate at its terminus. Three small gland-like cells are distinguishable around the beginning of the cloaca. Genital papillae as follows: three pairs precloacal, one adcloacal papilla, and five pairs caudal (one ventral, one lateral and three near tail terminus). Tail conical, curved ventrad, with acute tip. Phasmids located at 59% of tail length.

**Distribution**
Province of Almería, Salinas de Cabo de Gata, Cabo de Gata-Nijar Natural Park, near salt mine, in volcanic sandy soil, associated with *Sarcocornia fruticosa* (L.) Scott., *Urginea maritima* (L.) Baker and *Lygeum spartum* L.

**Remarks**
The population of *P. psammophilus* from Cabo de Gata (Almería, Spain) examined here is similar to the original material described by Navarro and Lluch (1999) from El Saler (Valencia, Spain), only differentiated by having shorter neck, and by the ranges of length for spicules and gubernaculum (see Table 3). Compared with the material described by Orselli and Vinciguerra (2002) from Italy, the specimens of the Spanish population examined here, like the type population, have a smaller size (shorter body length, pharyngeal corpus, spicules and gubernaculum).

**Nothacrobeles nanocorpus** De Ley, De Ley, Baldwin, Mundo-Ocampo and Nadler, 1999
(Figures 4F–K, 6G–K, 7)

**Material examined**
Four females and one male from two localities.

**Morphometrics**
See Table 1.

**Description**
**Adult.** Stout nematodes, body 0.20–0.24 mm long. Habitus straight to slightly curved ventrad. Cuticle annulated, annuli about 1.5 μm wide. Lateral field with two main and two outer and narrower wings, or five longitudinal incisures, the outer ones poorly
Figure 7. *Nothacrobes nanocorpus* De Ley, De Ley, Baldwin, Mundo-Ocampo and Nadler, 1999 (SEM, female): (A, F) neck region (arrow points at excretory pore); (B, C) lip region at primary and secondary axils, respectively; (D) lateral field and vulva in lateral view; (E) vulva in ventral view; (G, H) posterior end in ventral and lateral views, respectively (arrow points at phasmid in H).
visible under LM; only the central wings are present but fused (lacking the median incisures) behind the phasmids. Lip region continuous with the adjacent body, bearing six lips fused into pairs, and four cephalic and six labial sensillae; lips having smooth margin and divided at level of the labial sensilla; primary axils U-shaped and with two very small triangular guarding processes; secondary axils lacking guarding processes; three very low labial probolae, with neither prongs nor tines, and a basal ridge encircling each entire probola having a rounded concave shape. Amphid openings located to bases of lateral lips. Stoma cephaloboid, 0.6–0.9 times the lip region width long, and divided into cheilostom, gymnostom, and stegostom, the latter the longest. Pharynx also cephaloboid: corpus cylindrical, muscular, 0.9–1.0 times as long as the isthmus, with metacorpus clearly more muscularized than precorpus; isthmus long, very narrow, muscular; basal bulb pyriform, with striated transverse valves located anteriorly. Excretory pore opening at the level of isthmus posterior part, located at 66–75% of neck length, or at 26–31 annuli from anterior end. Deirids located at 73–88% of neck length, or at 36 annuli from anterior end. Cardia conoid, short. Intestine without differentiations.

**Female.** Reproductive system monodelphic, prodelphic, dextral in relation to intestine. Ovary reflexed at postvulval part, containing oocytes at different developmental stages. Oviduct short. Spermatheca swollen, short, 0.3–0.6 times the corresponding body diameter. Uterus 0.9–2.4 times the body width long, differentiated in a distal tubular part with thick walls, and a swollen proximal part with thin walls. Postvulval sac very short, 0.2–0.3 times the corresponding body diameter. Vagina extending inwards 25–36% of body diameter. Vulva not protruding. Rectum 1.0–1.4 anal body widths long. Tail conical, with 9–11 ventral annuli and finely rounded tip. Phasmids located at 50–59% of tail length.

**Male.** General morphology similar to female (unfortunately the specimen examined was broken before the measurements were obtained). Reproductive system monorchic, dextral in position, with testis reflexed ventrad anteriorly. Spicules paired and symmetrical, robust and slightly curved ventrad: more or less rounded manubrium, conoid calamus, and ventrad curved lamina with acute tip. Gubernaculum well developed, almost straight, about one half of spicules length. Three small gland-like cells are distinguishable around the cloacal anterior end. Precloacal genital papillae not well observed; postcloacal genital papillae five pairs, one lateral, one ventral, two subventral and one subdorsal. Tail conical, almost straight, visibly narrowing at its tip. Phasmids located at 48% of tail length.

**Distribution**
Species found in (i) Linares, province of Jaén, in soil from a garden with ornamental plants; and (ii) Salinas de Cabo de Gata, Cabo de Gata-Níjar Natural Park, province of Almería, near a salt mine, in volcanic sandy soil, associated with *Sarcocornia fruticosa* (L.) Scott., *Urginea maritima* (L.) Baker and *Lygeum spartum* L.
Table 4. Comparative morphometrics of *Nothacrobes nanocorpus* De Ley, De Ley, Baldwin, Mundo-Ocampo and Nadler, 1999 and *Acrobeles bushmanicus* Heyns, 1969. All measurements in µm.

| Character                  | N. nanocorpus | A. bushmanicus |
|----------------------------|---------------|---------------|
| **Country**                | Spain         | California, USA | Spain | Namibia |
| Reference                  | Present paper | De Ley et al. 1999 | Present paper | Heyns 1969 |
| n                          | 4♀♂          | 15♀♂          | 6♀♂ | 2♂♂ |
| Lip region diameter        | 7–8          | 3–9           | 13–14 | 10–12 |
| Labial probolae            | 1–2          | 1              | 8–10 | 10–12 |
| Stoma length               | 5–6          | 7              | 12–23 | 14–16 |
| Corpus length              | 18–22        | 25             | 69–79 | 86–88 |
| Isthmus length             | 22–24        | 35             | 18–24 | 16–26 |
| Bulb length                | 12–14        | 14             | 20–23 | 16–24 |
| Neve ring – anterior end   | 34–42        | 53             | 82–100 | 83–106 |
| Excretory pore – anterior end | 40–48   | 32–51         | 98–114 | 96–98 |
| Deirid – anterior end       | 47–56        | 53–60         | 104–120 | 102–122 |
| R_{ep}                     | 26–31        | 30**          | 35      | 38    |
| R_{dei}                    | 36           | 37**          | 38–39  | 38    |
| Body diameter – neck base  | 14–15        | 16             | 25–33  | 22–40 |
| midbody                    | 14–16        | 16             | 23–32  | 20–30 |
| anus                       | 8–10         | 13             | 18–22  | 18–26 |
| Sperrmatheca               | 4–8          | 9–17           | 19–36  | 19–36 |
| Postvulval sac             | 3–4          | 8–15           | 14–22  | 14–22 |
| Postvulval sac/body width  | 0.2–0.3      | 0.4–0.8        | 0.6–0.8 | 0.6–0.8 |
| Vagina length              | 4–5          | 3–5           | 7–9    | 7     |
| Vulva – anterior end        | 134–153      | 159***         | 284–361 | 284–361 |
| Rectum length              | 10–13        | 5              | 17–22  | 8     |
| Tail length                | 17–18        | 27             | 42–48  | 39–54 |
| Spicules length            | –            | 14             | 24–34  | –    |
| Gubernaculum length        | –            | 7              | 14–18  | –    |

* Measurements from drawings. ** Counted on drawings. *** Calculated from data in description.

Remarks

The Iberian material of this species is very similar to the type material described by De Ley et al. (1999) from California. Nevertheless, some morphometric differences between both populations have been also noted (see Table 4): shorter body length (204–243 vs 240–295 µm), slightly longer stoma (5–6 vs 3–5 µm) and corpus–isthmus ratio (0.9–1.0 vs 0.5–0.9), slightly shorter isthmus (22–24 vs 26–34 µm long), neck (57–64 vs 65–77 µm long), spermatheca (4–8 vs 9–17 µm long) and postvulval sac (3–4 vs 8–15 µm long).

This is the first record of the male of this species, which is reported for the first time in the Iberian Peninsula and Europe.

*Acrobeles bushmanicus* Heyns, 1969

(Figures 8–10)

Material examined

Six females and six males from one locality.
Figure 8. *Acrobeles bushmanicus* Heyns, 1969: (A) neck; (B) female genital system; (C) lip region; (D, E) female tail; (F) entire female; (G) entire male; (H) male posterior end; (I) lateral field.
Figure 9. *Acrobeles bushmanicus* Heyns, 1969 (LM): (A) neck (arrow points at excretory pore); (B, C) lip region in dorsal and lateral views, respectively (I: primary axil, II: secondary axil; arrow points at amphid); (D) lateral field at deirid level (arrow); (E) male genital system; (F, G) female posterior end (arrow points at phasmid); (H) male posterior end (ph = phasmid, p1–p5 = genital papillae).
Figure 10. Acrobeles bushmanicus Heyns, 1969 (SEM): (A) anterior end showing the beginning of the lateral field; (B–E) lip region in left subventral, left sublateral, frontal and ventral views, respectively (I = primary axil, II = secondary axil; arrow points at amphid); (F) oral opening (ap = adoral pedestal, tp = tubular projection); (G) lip (ls = labial sensilla, cs = cephalic sensilla); (I, J) female tail (lateral and ventral views, respectively).
**Morphometrics**
See Table 1.

**Description**

**Adult.** Stout to moderately slender nematodes, body length 0.43–0.57 mm. Habitus somewhat curved ventrad after fixation. Cuticle deeply annulated. Lateral field with three longitudinal incisures or two areolated wings, occupying 17–23% of midbody diameter, extending to tail tip. Lip region continuous with the adjacent body, bearing three pairs of asymmetrical lips, one dorsal and two ventrolateral, and six labial and four cephalic sensillae; primary axils deep, U-shaped, bearing two elongate, triangular, guarding processes originating from the incomplete first annulus; secondary axils with two triangular guarding processes, each one originating from each lip; lips asymmetrical, triangular, with dentate margin, five tines at primary axil (all rounded), six tines at secondary axil (rounded except the fifth acute) and a long acute apical tine; oral opening surrounded by three labial probolae, connected at bases by tangential ridges; each labial probola with a very short basal part and a longer and bifurcated distal part with prongs very long and divergent, straight, bearing lateral tines (eight rounded plus one apical acute at outer margin and eight or nine at inner margin plus one apical acute); the base of bifurcation is slightly expanded toward the secondary axil; two tubular projections and one adoral pedestal at base of each labial probola. Amphids clearly visible, large and rounded. Stoma cephaloboid: cheilostom with well-developed oval rhabdia, gymnostom very short, and stegostom with minute discernible rhabdia. Pharynx also cephaloboid: pharyngeal corpus subcylindrical, 3.0–4.3 times isthmus length; isthmus robust; basal bulb ovoid, with valvular apparatus. Cardia conoid, surrounded by intestinal tissue. Nerve ring at 65–76% of neck length, at level of isthmus. Excretory pore at 71–90% of neck length, at level of isthmus, 35 annuli from anterior end. Deirids at 84–92% of neck length, at level of bulb, 38–39 annuli from anterior end. Intestine without distinct specializations.

**Female.** Reproductive system monodelphic-prodelphic, in dextral position to intestine. Ovary long, lacking flexures. Oviduct very short. Spermatheca well developed, slightly longer than the corresponding body diameter, sometimes with sperm. Uterus 2.2–3.4 times as long as the corresponding body diameter, tubular at distal part and swollen at proximal part. Postuterine sac short, 0.6–0.8 times body diameter long, swollen. Vagina short, extending inward 22–39% of body diameter. Vulva with protruding lips. Rectum 0.9–1.2 times anal body diameter; three large gland-like cells are distinguishable around the intestine–rectum junction. Tail conical with acute terminus. Phasmids located at 14–22% of tail length.

**Male.** General morphology similar to female. Reproductive system monorchic, dextral in position, with testis reflexed ventrad anteriorly. Spicules paired and symmetrical: more or less rounded manubrium, conoid calamus and ventrad curved lamina with acute tip. Gubernaculum well developed, curved, about one half of the spicules length, with *cornua crurum* well developed. Three small gland-like cells are distinguishable around the beginning of the cloaca. Genital papillae as follows: two pairs precloacal, one adcloacal and five pairs caudal (two at the middle part, one ventral pair and one lateral pair, and three pairs near tail terminus, one dorsal and two subventral). Tail conical and curved ventrad, ending in an acute mucro. Phasmids located at 38–49% of tail length.
**Distribution**
Province of Almería, Salinas de Cabo de Gata, Cabo de Gata-Nijjar Natural Park, near a salt mine, in volcanic sandy soil, associated with *Sarcocornia fruticosa* (L.) Scott., *Urginea maritima* (L.) Baker and *Lygeum spartum* L.

**Remarks**
This Iberian population is very similar to those described from South Africa and Namibia by Heyns (1969) but, as usual, some minor morphometric differences exist (see Table 4): more posterior position of nerve ring (82–100 vs 74 μm from the anterior end) and excretory pore (98–114 vs 89 μm from the anterior end), shorter postvulval sac (0.6–0.8 vs 1.0–1.5 times the corresponding body diameter long) and slightly longer rectum in females (17–22 vs 14 μm long).

This species is reported for the first time from the Iberian Peninsula and Europe.

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**Disclosure statement**
No potential conflict of interest was reported by the authors.

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