

A new species of *Lasioseius* (*Endopodalius*) (Acari: Mesostigmata: Blattisociidae) coexistent with the invasive agave weevil (Coleoptera: Dryophthoridae) in the southeast of the Iberian Peninsula

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Original research

ABSTRACT

A new species of the subgenus *Endopodalius* associated with agave weevil of the species *Scyphophorus acupunctatus* Gyllenhal (Coleoptera: Dryophthoridae) is described based on adult females from the southeast region of the Iberian Peninsula. This beetle, relative of the palm weevil, is an invasive exotic species already present in the Iberian Peninsula (Mediterranean region) as a new pest spreading among the agave plants. Morphological aspects of this mite, such as a simplified laelapid-type sperm access system, the remarkably elongated cheliceral shafts with an elongate subcapitular platform and other characteristics reveals new undescribed attributes for the subgenus.

Keywords Gamasina; *Scyphophorus acupunctatus*; phoresy; Spain; taxonomy

Zoobank <http://zoobank.org/9267A4D1-3BC9-4138-B203-593CE2314521>

Introduction

Scyphophorus acupunctatus Gyllenhal, 1838 (Coleoptera: Dryophthoridae) is the most important pest affecting the *Agave* species. Popularly known as the agave weevil, it is a beetle native to the southwestern United States, Mexico and Central America. It was introduced into the Iberian Peninsula, being first detected in 2007 (Riba i Flinch and Alonso-Zarazaga 2007) and is considered an invasive species (Molina 2013). This beetle feeds exclusively on plants of the Agavaceae and Dracaenaceae families (Ruiz-Montiel *et al.* 2009), although occasionally on *Pachycereus pringlei* (Maya *et al.* 2011).

The larval feeding on the plant tissues, together with its association with different species of bacteria, kills the agave plants (Rubio 2007). This species is present in various countries in Asia, Africa, North and South America, Europe, and Australia. In the Mediterranean region of the Iberian Peninsula, this beetle species has been detected in several locations (Barcelona, Murcia and Alicante) (Molina 2013), and its distribution is currently expanding into the southeast of Spain.

In the first survey of the mites associated with *S. acupunctatus*, the most abundant and frequent species was a new species of the subgenus *Lasioseius* (*Endopodalius*) Christian & Karg (2006), which is described here.

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Lasioseius (*Endopodalius*) Christian & Karg, 2006 currently includes ten species: *L. (E.) alter* (Vitzthum, 1925), *L. (E.) araucariae* Hirschmann, 1972, *L. (E.) convexus* Krantz, 1962, *L. (E.) gabriellae* Santos & Argolo, 2018, *L. (E.) hirschmanni* Christian & Karg, 2006, *L. (E.) humberti* (Athias-Henriot, 1959), *L. (E.) prorsoperitrematus* Abo-Shnaf, Sánchez & Moraes, 2016, *L. (E.) scutalis* (Banks, 1914), *L. (E.) tectus* Hyatt, 1964 and *L. (E.) vitzthumi* Westerboer, 1963 (Christian & Karg, 2006; Moraes *et al.* 2016; Abo-Shnaf *et al.* 2016; Argolo *et al.* 2018), although several other species described under *Lasioseius* may actually belong to *Endopodalius* (Moraza and Lindquist 2018). Several species have been reported associated with Coleoptera: *L. (E.) tectus* on *Hololepta humilis* Paykull, 1811 (Histeridae) in Venezuela (Hyatt 1964); *L. (E.) prorsoperitrematus* Abo-Shnaf *et al.*, 2016 associated with *Sphenophorus levis* Vaurie, 1978 (Curculionidae) in Brasil (Esteca *et al.* 2020), and *L. (E.) scutalis* (Banks, 1914) with scarabs (Scarabaeidae) in Brasil (Argolo *et al.* 2018).

The present paper describes a new species of *L. (Endopodalius)* phoretic on *Scyphophorus acupunctatus*.

Material and methods

All mite specimens were adult females, some were removed directly from the beetles using a brush and subsequently preserved in 70% ethanol and other females were found in the ethanol conserving several specimens of *S. acupunctatus*. Studied specimens were mounted in Hoyer's medium on microscope slides and sealed with GLPT insulating varnish.

Morphological observations, measurements, and illustrations were made using compound microscopes equipped with differential interference contrast and phase contrast optical systems, drawing tubes and stage-calibrated eyepiece micrometers. Setal notation for the idiosoma follows that of Lindquist and Evans (1965) as modified slightly by Lindquist (1994) and adapted for superfamilies of mesostigmatic mites in general by Lindquist *et al.* (2009). Measurements of structures are given in micrometers (µm) and indicate the ranges among specimens measured. Dorsal shield lengths were taken as midline length from the anterior margin anterior to the bases of vertex setae *j1* to the caudal margin posterior to the bases of clunal setae *J5*. Ventrianal or anal shield lengths were taken midline, from the anterior margin to the posterior edge of the cribrum. Notation for leg and palpal setation follows that of Evans (1963, 1964, 1969); the siglas *v-1* and *v-2* indicate or encapsulate pseudosymmetrical pairs *av-1*, *p_v-1* and *av-2*, *p_v-2*, respectively. Leg lengths were taken from the base of the coxa to the apex of the tarsus, excluding the pretarsus. Distinction of pore-like structures on the idiosomal integument as either poroids (lyrifissures) or glandular openings (solenostomes), as distinguished morphologically by Athias-Henriot (1969) and physiologically by Krantz and Redmond (1987), was applied. The holotype of *L. (Endopodalius) tectus* (BMNH(E)1963.10.3.11) was examined given the similarity between it and the specimens described. Images taken at different levels of focus were combined using CombineZ5© program.

Identification of the beetles associated with the mites was made by I. Balanzategui and M.A. Gómez de Dios.

The holotype and some paratypes of the new species are deposited in the Mesofauna Collection in the Estación Experimental de Zonas Áridas (EEZA-CSIC), Departamento de Ecología Funcional y Evolutiva, Almería, Spain; four paratypes are in the Museum of Zoology, University of Navarra (MZUNAV), Pamplona, Spain, and four paratypes females are in the Canadian National Collection of Insects and Arachnids (CNCI), Science & Technology Branch, Agriculture & Agri-Food Canada, Ottawa (Canada).

Taxonomy

Lasioseius Berlese, 1916

Lasioseius Berlese, 1916: 33; Lindquist & Evans, 1965: 46; Christian & Karg, 2006: 105; Moraes *et al.* 2016: 159.

Diagnosis (adult female). The genus diagnosis of Moraes *et al.* (2016) was followed.

Lasioseius (*Endopodalius*) *ibericus* n. sp.

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(Figures 1-5)

Diagnosis

Adult female: idiosomal shielding and gnathosomal elements with dense, fine puncta; antero-lateral area of dorsal shield with delineation lines. Dorsal shield usually with a prominent transverse line and groove across entire face behind setae *J4* and *Z4*. Dorsal setae heterogeneous in length and shape: setae *j1-j6* and *z2-z6* pointed and usually straight; setae *z1*, *s1-s6*, *r*-serie and all opisthonotal setae longer and filiform half their length; *j5* and *z6* half the length of *j6*; *J4* slightly barbed; setae *Z4* more than 2 times as long as *J1* with penicillate distal region, *Z5* smooth and *J5* minute and basally spiculated; seven pairs of *R* setae and 3-4 pairs of *UR* setae. Sternal shield densely punctate together with large rounded clear puncta, about 0.7 longer along midline than the narrowest width between coxae II; second pair of presternal plates subtriangular in form, sometimes divided in two.

Description

Idiosomatic dorsum — Adult female (Figure 1A). Dorsal shield length 500-573 long, 317-345 wide at its widest at level of setae *S2* ($n = 7$). Dorsal shield with smooth margins, ornamented with dense small puncta over the entire surface, lineated anterolaterad setae *j2* to *s4*, and variably transversely lineate laterally from setae *s4* nearly to *S4*; with ornamental lines anterior to setae *j3*; shield with a pair of transverse costulae in area of consolidation of podonotal and opisthonotal shields behind setae *z6*; a light reticula of large puncta in the opisthonotal region between setae *J1-J3* and *Z1-Z3* and with a more or less prominent transverse line and groove across the entire face behind setae *J4* and *Z4* posterior to pygidial region of the dorsal plate with dense small puncta. Dorsal shield with 34 pairs of setae, *r2-r5* on shield (*r5* sometimes asymmetrically off shield); setae smooth, except *J4* scarcely barbed, *Z4* distally penicillate, and *J5* basally barbed, of dissimilar length, setae *z1*, *s1-s6*, *r2-r5* and all opisthonotal setae with more finely attenuated tips, and setae *j1-j6*, *z2-z6* without attenuated tips (Figure 1B): *j1* (8-11), *j2* (17-20), *j3-j5* (16-18), *j6* (24-30), *z2*, *z3* (16-21), *z4*, *z5* (24-27), *z1*, *z6*, *s1* (16-19), *s2*, *s3*, *r2-r5* (20-23), *s4*, *s6* (23-25), *s5* second longest (27-31); *J1* (24-27), *J2-J4* (27-30), *J5* (10-12); *Z1-Z3* (34-39), *Z4* longest (54-60) about 1.5-1.6 longer than *Z3*, *Z5* (27-28), *S1-S3*, *S5* (34-37), *S4* (41-45). Lateral soft cuticle usually with setae *R1-R7*, and three or four pairs of *UR*-setae (21-27). Peritrematal shields reduced to a narrow strip dorsal to peritreme, broadly united with dorsal shield anteriorly at level between setae *s1* and *z2*; peritremes long, sharply angled subapically, and reaching anteriorly to level of setae *z1* (Figure 1A). Dorsal shield with complement of 23 pairs of discernible pore-like structures (9 podonotal, 14 opisthonotal), of which seven pairs (four podonotal, three opisthonotal) superficially appear secretory (gland pores) and 16 pairs (five podonotal, 11 opisthonotal) non-secretory (poroids).

Idiosomatic venter — (Figure 2A). Tritosternum with base about twice as long (16-18) as basal width (ca. 10), with laciniae fused for about 55 percent of total length (97-101 excluding base), their fused length with long, sparse, lateral setules, and free lengths more finely setulose distally (Figure 1C). Presternal area with a small platelet strip at base of tritosternum, sometimes interrupted medially, and one pair of large subtriangular platelets, 23-27 long 41-48 wide (Figure 2A), sometimes divided into two contiguous platelets (Figure 2B). Sternal shield

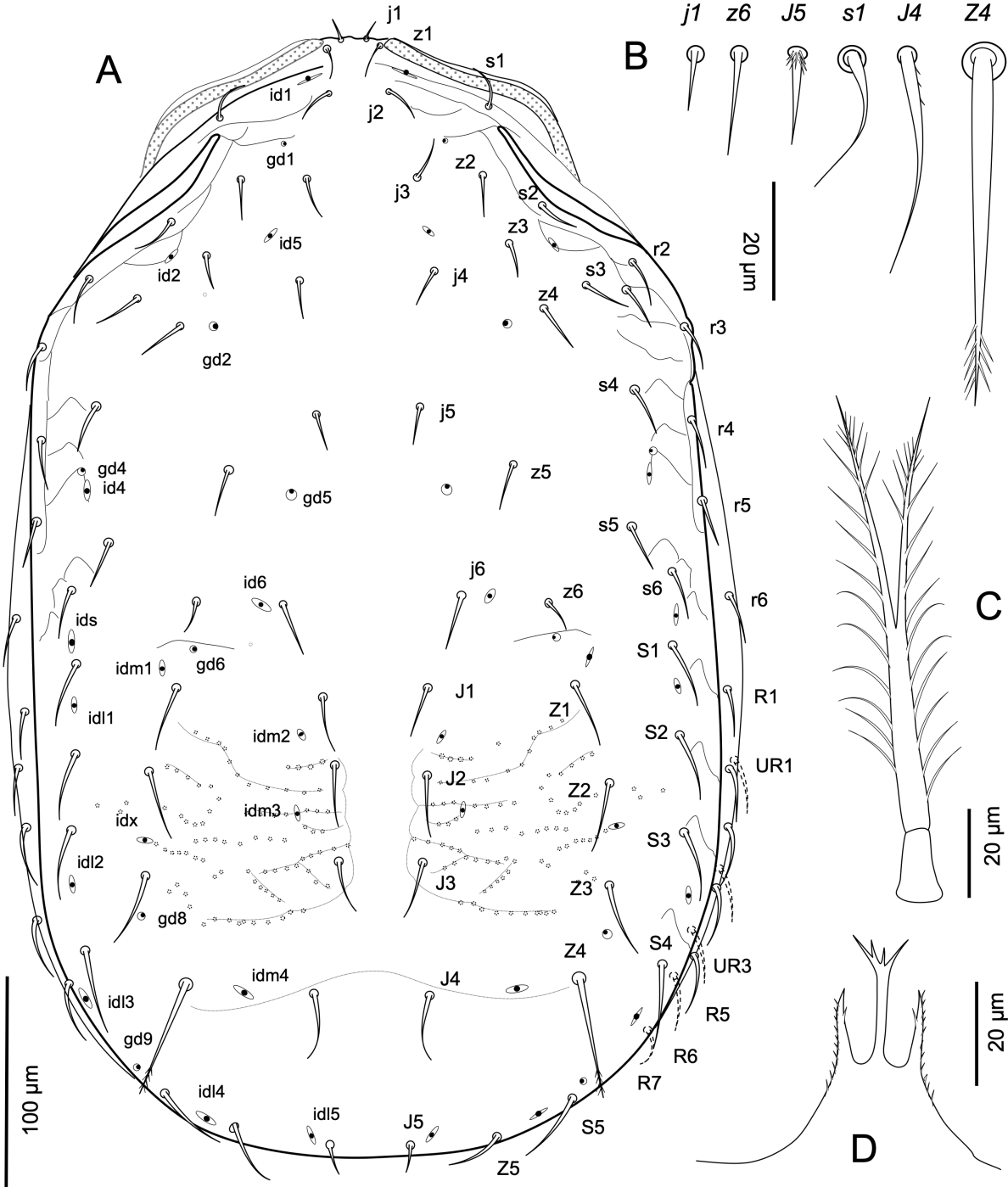


Figure 1 *Lasioseius (Endopodalius) ibericus* n. sp., adult female: A – Idiosoma, dorsal aspect; B – details of separate views of dorsal setae denoted; C – details of sternoapophysis; D – gnathotectum.

entire, with strongly developed endopodal extensions between coxae I-II and II-III, and lacking gland pore (*gbv*); shield moderately elongate, length from anterior margin at level between setae *stl* to posterior margin 147-154, narrowest width between legs II 101-110, densely punctate over nearly entire surface, with conspicuous rounded clear puncta in the medial area, and poorly lineate along lateral margins; with a line connecting poroids *iv2* and a dark

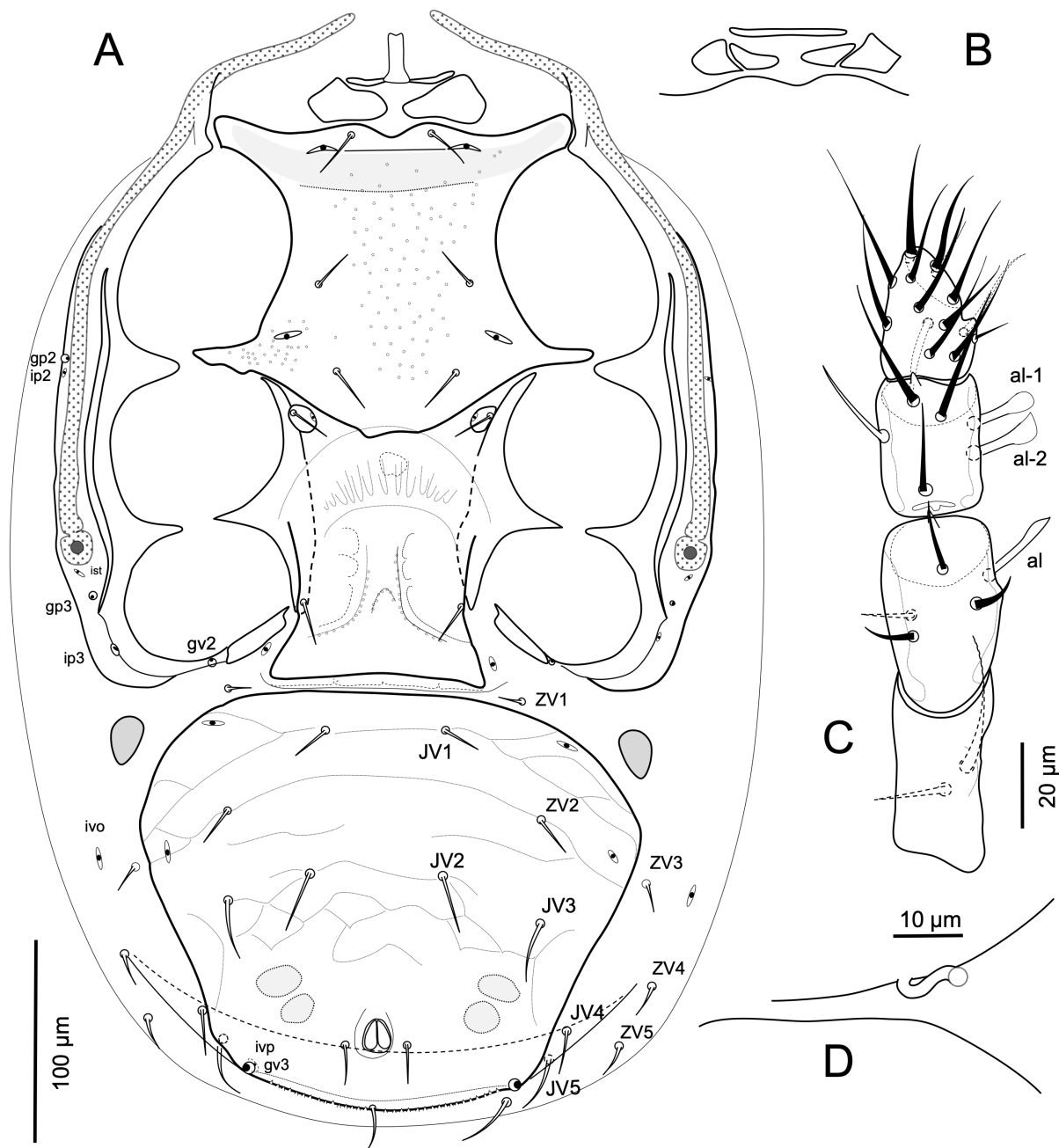


Figure 2 *Lasioseius (Endopodalius) ibericus* n. sp., adult female: A – Idiosoma, ventral aspect; B – detail of presternal platelets; C – palpus, dorsal view; D – detail of the spermathecal duct.

cuticular band behind this line continuing into broad strong endopodal extensions between coxae I and II; shield with anterior margin lobulate between setae *st1*, and with convex posterior margin extending medially to level between metasternal platelets; shield with strong endopodal extensions between coxae I-II and III; sternal shield with setae *st1-st3* similar in their short length (20-23). Setae *st4* (20-22) together with poroids *iv3* on small metasternal plates. Large endopodal strips alongside coxae III and IV, their anterior ends sometimes touching but not uniting with posterolateral margins of sternal shield and extending slightly under metasternal platelets. Epigynal shield 124-130 long, 107-111 at its widest at its posterolateral corners, ornamented with small puncta arranged along lateral lines, and with truncate posterior margin;

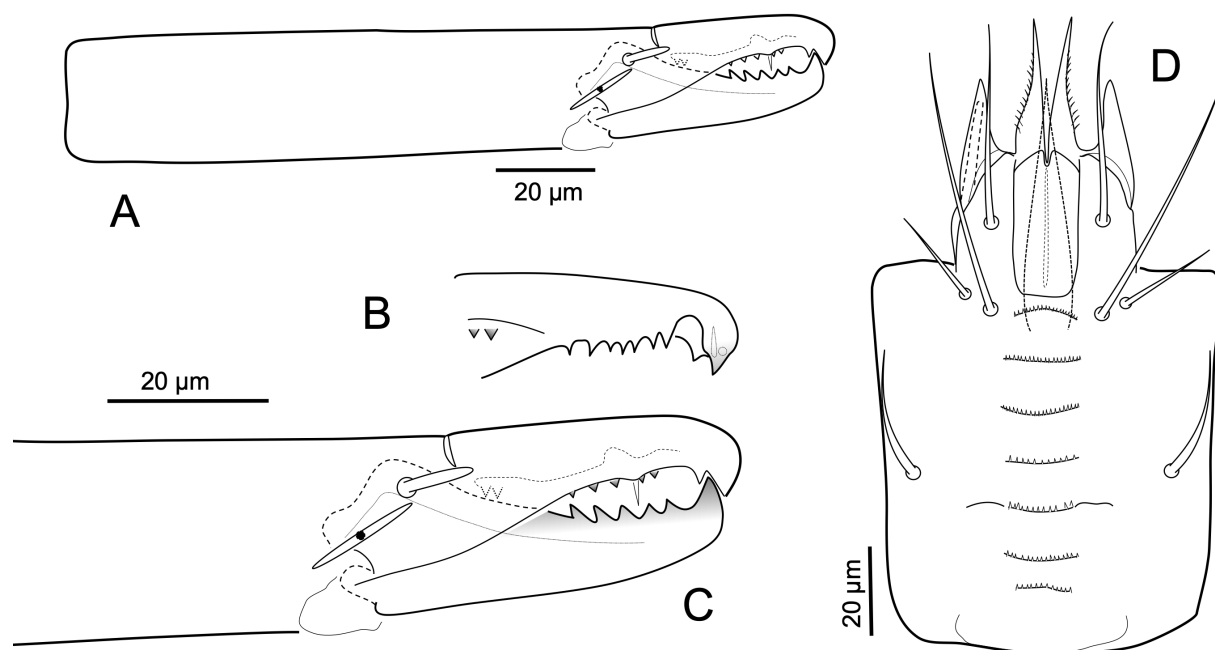


Figure 3 *Lasioseius (Endopodalius) ibericus* n. sp. adult female: A – chelicera, lateral view; B – details of fixed cheliceral digit, lateral aspect; C – detail of distal region of chelicera, lateral view; D – subcapitulum.

setae *st5* subequal in length to *st4*. Paragenital poroids *iv5* on soft cuticle well removed from posterolateral margins of epigynal shield. Two pairs of linear postgenital sclerites present in cuticular fold between epigynal and ventrianal shields. Ventrianal shield broader than long, densely punctate, variably transversely lineated anterolaterally, with large puncta restricted to edges of sparse reticula, and laterad pigydial region with large dense puncta; shield with broadly rounded posterior margin; shield's greatest width (246-265) at level of setae *ZV2* about 1.2 its mid-length (209-215); shield with four pairs of opisthogastric setae (*JV1-JV3*, *ZV2*) of dissimilar length; *JV1*, *ZV2* (17-19), *JV2* (27-31) slightly shorter than *ZV3* (31-34); shield with two pairs of poroids, gland pores *gv3* on margin posterior to level of anal opening, and a pair of weak preanal depressions; postanal seta (20-24) slightly longer than parianal setae (17-19); posterior shield margin with cribrum formed as a widely extended but narrow strip embedded in postanal fold of cuticle. Soft cuticle with six pairs of opisthogastric setae, *ZV1* (9-11) anteriorly, *JV4* (19-22), *JV5* (27-29), *ZV3* (15-18) *ZV4-ZV5* (19-24) laterally, flanked variably by *R4-R6* and one or two pairs of *UR*-setae. Peritrematal shield broadly consolidated with exopodal strip curving behind coxa IV, and bearing poroids *ip2*, *gp2* at level of exopodal II-III, *ip3* and *gp3* behind stigma, and *ist* next to the stigma; shield free from exopodal elements from middle of coxae II to middle of coxae IV; adcoxal *gv2* present. One pair of divided or undivided subtriangular metapodal plates, length 29-38, width 18-23. Spermathecal apparatus with sinuous tubular major duct (c.a. 3 diameter) opening between bases of coxae III and IV (Figure 2D).

Gnathosoma — Gnathotectum (Figure 1D) with dorsal surface convex, densely punctate, with anterior margin projecting into three elongate, pilose/ciliated tines, medial tine (25-30) longer than lateral ones (15-18). Cheliceral shaft, excluding basal section, 153-159 long, with moderately small digits (Figure 3A); dorsal face of fixed digit with short blunt dorsal seta; fixed digit with minute (3-5) pilus dentilis, with bifid apical hook, with ridge of five to eight and two basal teeth (Figure 3B); movable digit (48-52) with five large teeth (Figure 3C). Corniculi moderately long (33-36), slender (10-12 where inserted), parallel; internal malae tapered (30-38), extending well beyond tips of corniculi and with lateral margins slightly fimbriated

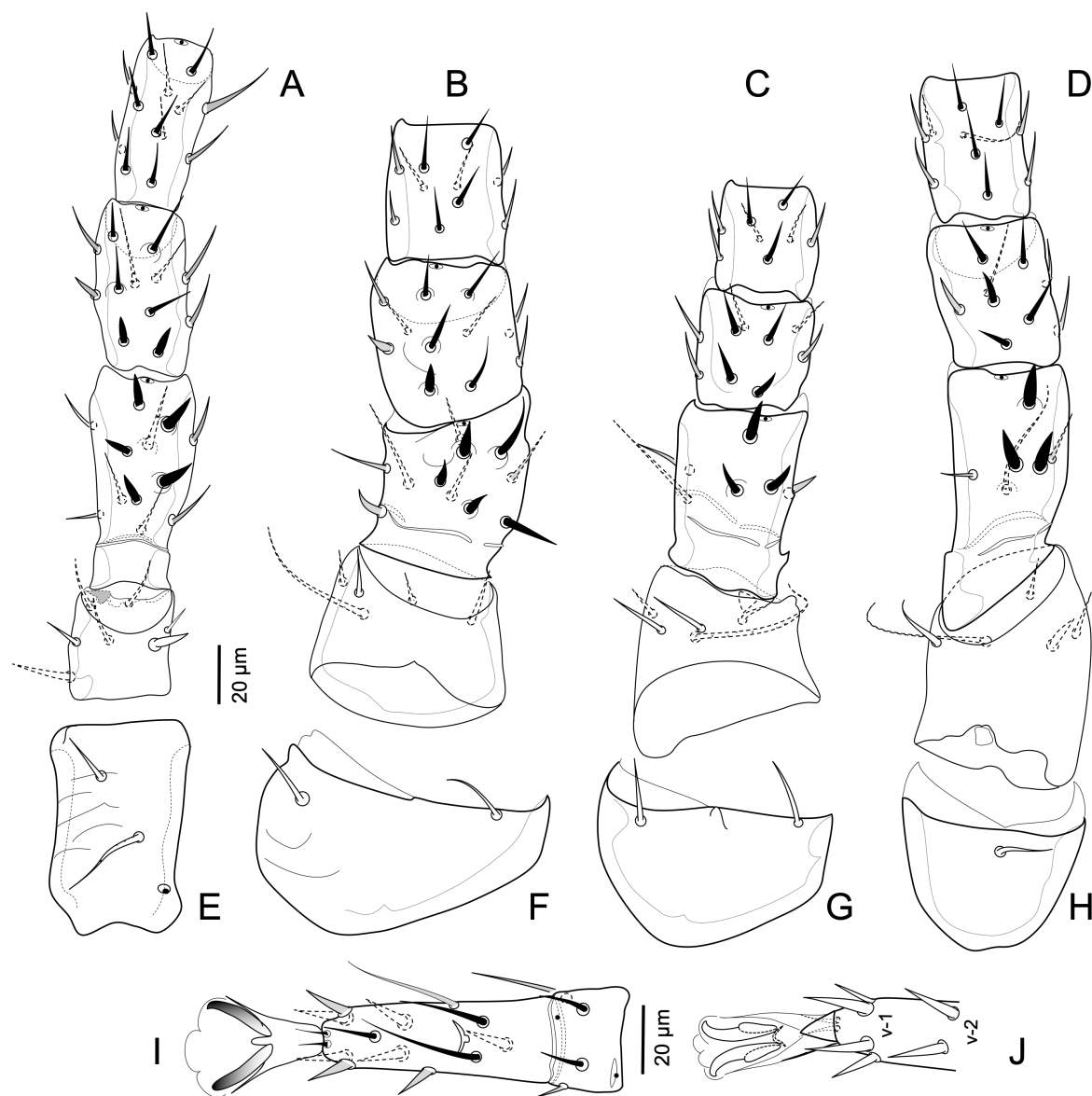


Figure 4 *Lasioseius (Endopodalius) ibericus* n. sp. adult female, legs I-IV, excepting tarsi: A – leg I, dorsal view; B – leg II, dorsal view; C – leg III, dorsal view; D – leg IV, dorsal view; E, F, G, H – coxae I, II, III, IV, ventral view; I – tarsus IV, right leg, dorsal view; J – detail of ventral setae on distal region of tarsus IV. Solid black setae are dorsal setae, grey color are lateral setae.

or ciliated. Subcapitulum (Figure 3D) with seven finely multidenticulate, similarly wide rows of deutosternal denticles, anteriormost row slightly convex, fifth with short lateral costulae, rows not connected by lateral margins. Subcapitulum with smooth setae; *hpl* shorter (44-46) than *hp3* (61-68); setae *hp2* (22-29), *pc* (30-35). Palpus (160-170) nearly straight (Figure 2C); palptrochanter with inner seta inserted on protuberance, longer (33-40) and more attenuated than outer seta (17-20); palpfemoral seta *al* (17-18) with somewhat blunt, somewhat spatulate tip; palpgenual setae *al-1* and *al-2* spatulate, *al-2* with more rounded tip; palptarsal claw with two times spatulate with rounded tips.

Legs — (Figure 4) Legs of moderate length, legs I and IV no longer than dorsal shield. Legs I slightly thinner, and legs II slightly thicker, than legs III and IV. Setation on segments of legs I to IV slightly deficient from full complement of Ascidae (as presented by Lindquist & Evans 1965 for Ascini), coxae, 2-2-2-1; trochanters, 6-5-5-5; femora, 12 (2 3/1 2/2 2) - 11

(2 2/1 3/2 1) - 6 (1 2/1 1/0 1) - 6 (1 2/1 1/0 1); genua, 13 (2 3/2 3/1 2) - 11 (2 3/1 2/1 2) - 9 (2 2/1 2/1 1) - 9 (2 2/1 3/0 1); tibiae, 13 (2 3/2 3/1 2) - 10 (2 2/1 2/1 2) - 8 (2 1/1 2/1 1) - 10 (2 1/1 3/1 2); genua IV lacking *pv-I*. Tarsi II-IV with ventral setae *v-1* and *v-2* somewhat spine-like and claws strong, *vm* spine-like but slenderer than *v-1* (Figures 4I-J); other leg setae simple, not strongly modified. At level of genu and tibia, respectively, legs I slightly slenderer (width ca 31, 26), and legs II thicker (ca 49, 41) than legs III (ca 37, 34) and IV (ca 40, 37); legs I to IV (Figure 4A-H) each clearly shorter than dorsal shield length; leg lengths, excluding pretarsi: I 387-402, II 359-381, III 367-388, IV similar in length to leg I, 384-402. Leg I tarsus (105-11) about 1.4-1.8 longer than each of the similarly long femur (74-80), genu (58-63), and tibia (60-66). Tarsus I with well-developed pedicel bearing pretarsus (c.a. 20 to base of claws); tarsus I without markedly elongated setae apically, seta *s* imperceptively lanceolate subapically. Legs II to IV with tarsus about 1.8-2.2 times as long as tibia. Tarsi II-IV with pair of apical setal processes *ad-1*, *pd-1* (11-12) inconspicuous, shorter than length of pretarsus to base of claws (14-16); with ventroapical process short (5-8), pointed apically, about half the length of pretarsus to base of claws (as in Figure 4J); pretarsi with paradactyli inconspicuous as narrow sclerotized shafts flanking, and slightly shorter than claws. Coxae I-II lineate on ventral surfaces; coxal setae simple, short (21-24), except *v2* on coxae I long, flageliform (31-33) (Figures 4E-H). Leg segments with modified spine-like setae (Figures 4A-D), including *pl* on trochanters I and IV. Seta *pv* on trochanters I-IV and femora II-IV (Figures 4A-D) thin, markedly elongate with filiform end.

Type material

HOLOTYPE: adult female, from a specimen of *S. acupunctatus* Rodalquilar (Almería), Spain, 18 Nov. 2017, M.D. Alcázar-Alba colr. PARATYPES: 22 females with same data as holotype; two females from a specimen of *S. acupunctatus*, Algarrobo-Costa (Málaga), Spain, 27 Feb. 2018, D. Serrano colr.; fifty females from a specimen of *S. acupunctatus*, Torregarcía (Almería), Spain, 19 May 2019, J. Moya colr.; thirteen females from a specimen of *S. acupunctatus*, La Cañada de San Urbano (Almería), Spain, 18 Oct. 2019, E. de Mas colr.; eight females from a flying specimen of *S. acupunctatus*, La Cañada de San Urbano (Almería), 28 Nov. 2019, I. Balanzategui colr. Nine females 30 Jan. 2016 and two females 19 Apr. 2016, Nijar (Almería), and one female Cuevas del Almanzora (Almería) 29 Aug. 2016, found in the ethanol conserving several specimens of *S. acupunctatus* collected by M.A. Gómez de Dios. Adult males and immature instars were not available.

Etymology

The specific epithet refers to the geographical name of the Iberian Peninsula of southwestern Europe, occupied by Spain and Portugal, the region from where this species material was collected.

Differential diagnosis

In the incomplete original description of *L. (E.) tectus*, Hyatt indicated the presence of dense large puncta on the concave (groove) area behind level of setae *J4-Z4*, which was clearly present in the studied holotype (Figure 5A), and a similar ornamentation on the pigydial region of the ventrianal shield. Specimens of *L. (E.) ibericus* n. sp. collected in Spain show a similar ventral ornamentation on several specimens. However, the dense dorsal area of large clear puncta is not obvious, although the line delimiting this region behind setae *J4-Z4* is clearly observed. In the holotype of *L. (E.) tectus*, setae *Z4* are clearly longer than *J3*, such as in the specimens studied now (the length of these two setae does not match the illustration given in Figure 1 of the original description).

Regarding the teeth on the fixed cheliceral digit, Hyatt indicated and illustrated in Figure 4, a row of 13 teeth (Figure 5B). Our specimens have a row of 7 or 8 teeth plus offset basal, excluding the two apical teeth of the bifid apical hook.

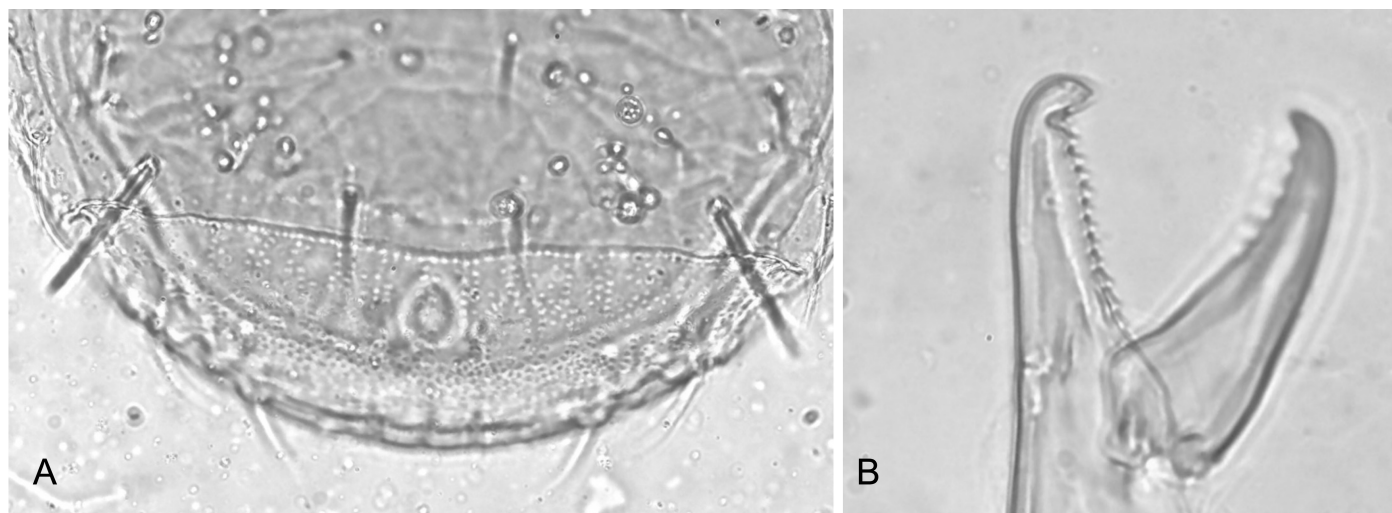


Figure 5 *Lasioseius (Endopodalius) tectus* Hyatt, holotype BMNH(E)1963.10.3.11, adult female: A – detail of opisthonotal posterior region; B – detail of cheliceral digits.

Lasioseius (E.) tectus and *L. (E.) ibericus* share with *L. (E.) vitzthumi* Westerboer, 1963 dorsal setae Z4 untapered, stout, blunt-tipped, penicillate distally, and Z5 simple. However, *L. (E.) vitzthumi* lacks the prominent transverse line across the entire face behind setae J4 and Z4, the presternal region with two pairs of platelets and the ventrianal shield bears 5 pairs of opisthogastric setae.

Discussion

Scyphophorus acupunctatus, the phoront of the new species of *Lasioseius (Endopodalius)* is distributed across five continents, and various website images of these beetles show a phoretic mite or two on them, some of which may be this type of mite species. In any case, a worldwide distribution of this mite is likely.

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