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Oribatid mites (Acari: Oribatida) from the coastal region of Portugal. IV. The genera *Coronoquadroppia*, *Scheloribates*, *Haplozetes* and *Pilobates*

Gerd Weigmann

Free University, Institute of Zoology, Koenigin-Luise-Str. 1–3, 14195 Berlin, Germany

e-mail: weigmann@zedat.fu-berlin.de

Abstract

Four new species of Oribatida were found in soils of different coastal habitats in South Portugal. *Scheloribates litoralis* sp. n. is the first halophilous species of the subgenus *Scheloribates* (*Scheloribates*), living in the upper salt marsh zone in the estuary of Ribeiro de Aljezur (Western Algarve) and also in the Lagoon of Aveiro (North Portugal). All other described and redescribed species occur mainly in coastal bush-land in the estuary region of the Ribeira de Aljezur (Western Algarve): *Scheloribates ibericus* sp. n. and the similar *S. minifimbriatus* Mínguez, Subías & Ruiz, 1986 (Scheloribatidae), *Haplozetes differens* sp. n., *H. similis* (Gil & Subías, 1995), *Pilobates carpetanus* Pérez-Iñigo, 1969 (Haplozetidae) and *Coronoquadroppia guttata* sp. n. (Quadroppiidae). Taxonomical and systematical discussions are presented on all species and on the genus *Haplozetes*.

Key words: Taxonomy, systematics, Quadroppiidae, Scheloribatidae, Haplozetidae

1. Introduction

This contribution is the fourth one of a series on the taxonomy of new and remarkable species of Oribatida in Portuguese salt marshes and in adjacent coastal habitats, mostly coastal bush land and dune areas. The recent samplings are concentrated on habitats in the estuary region of Ribeira de Aljezur at the Atlantic west coast of the Algarve. Findings of new and remarkable species are supplemented with specimens of the same species from older samples of the author.

2. Materials and Methods

The samples from coastal areas of Portugal were collected by the author in 1971 and 2004 to 2009.

Po23: Sample from a salt marsh site at the shore of Rio do Minho near Seixas (Caminha), northern Portugal (41°53'N; 8°50'W); 15 April 1971.

Po36: Sample from a grassy salt marsh site in the Lagoon of Aveiro (40°37.30'N; 8°44.45'W); 21 April 1971.

Po106–108: Salt marsh site in the estuary region of Ribeira de Aljezur (37°20.22'N; 8°50.01'W); 9 September 2004. About 2 km from the sea; changing conditions regarding soil moisture and salinity.

Po132–135: Samples from estuary region of Ribeira de Aljezur, West-Algarve (37°20.38'N; 8°50.17'E); 21 March 2006. A low coastal dune site with scarce vegetation, with some bushes.

Po143–146: Samples from estuary region of Ribeira de Aljezur, adjacent to Po132 ff; 2 October 2008. A bushy area on a rock, about 5 m higher than the dune area.

Po150–161: Samples from estuary region of Ribeira de Aljezur, (37°20.52'N, 8°50.46'W); 6 April 2009. A bushy area of a rocky slope at the southern side, about 100 m from the sea and 5-10 m above the river.

The samples Po23 and 36 were taken semi-quantitatively with a special shovel, about 250 cm², 1–2 cm depth. The samples Po106–161 covered about 50 cm² each. The mites were extracted using a modified Tullgren apparatus. The specimens were preserved in ethanol and after clearing they were studied microscopically in lactic acid in cavity slides.

3. Results

3.1. *Coronoquadroppia* Ohkubo, 1995

Within the last decades the genus *Quadroppia* Jacot, 1939 (sensu lato) has undergone a diversified increase. Only five species of *Quadroppia* s. lat. have been described before 1980, whereas 33 species and subspecies were described up to 2009, as far as I know. In a revisional paper on Quadroppiidae, Ohkubo (1995) listed 27 species group taxa (species respective subspecies) and proposed a new genus *Coronoquadroppia*. Nine species group taxa remained within *Quadroppia* Jacot, 1939, with the type species *Notaspis quadricarinata* Michael, 1895; 18 species group taxa were referred to *Coronoquadroppia* with the type species *C. parallela* Ohkubo, 1995. In the following years, several species were supposed as synomym to older species, partly with and partly without argumentations on morphology and taxonomy (e.g. Mínguez et. al 1985; Woas 1986; Ohkubo 1995; Subías 2004; Fischer et. al. 2009; critical discussion in Mahunka & Mahunka-Papp 2000) resulting in a somewhat confusing nonuniform taxonomical image. This contribution refrains from synonymizations. Both genera need taxonomical revision.

Coronoquadroppia is downgraded by Subías (2004, 2009) to subgenus of *Quadroppia* but is accepted by Fischer et al. (2009) as distinct genus, characterized mainly by a unique prodorsal structure in front of the translamellar area which is proven by SEM photography as a more or less hemispherical elevation (Fischer et. al. 2009). In dorsal aspect of light microscopy, mainly the basic attachment of this structure is obvious as a distinct oval or horseshoe-like borderline. Fischer et al. (2009) listed eleven different terms on this structure used in literature, regarding either the elevated cuticular sculpture as observable in lateral view (e.g. "rostral sculpturing" – Luxton 1987; 'frontal appendage' – Ohkubo 1995) or regarding the optical transect image of the structure in dorsal view (e.g. 'cresta chitinosa' – Paoli 1908; 'oval crest in the rostral region' – Mahunka & Mahunka-Papp 2000; 'Ring- oder Hufeisenstruktur' – Weigmann 2006). In the following Luxton's term will be used. The notogastral chaetotaxy follows Mínguez et al. (1985). The characteristics of the family Quadroppiidae and the genus *Coronoquadroppia* are listed in Ohkubo (1995), Weigmann (2006), Norton & Behan-Pelletier (2009) and Fischer et al. (2009).

***Coronoquadroppia guttata* sp. n.**

Material examined

Holotype: Adult female, sample Po 144; coastal bush-land in the estuary region of Ribeira de Aljezur; mounted in microscopical slide, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG). Paratype: One female, from the same sample, in the collection of the author.

Diagnosis

Body length about 183 µm, length-width-ratio about 2.0. Rostral sculpturing anterior to translamella drop-shaped, anterior edge rounded, posterior part tipped, surface with a transverse suture. Protruding part of lamella ('cuspis') long, translamellar structures distinct; lamellar

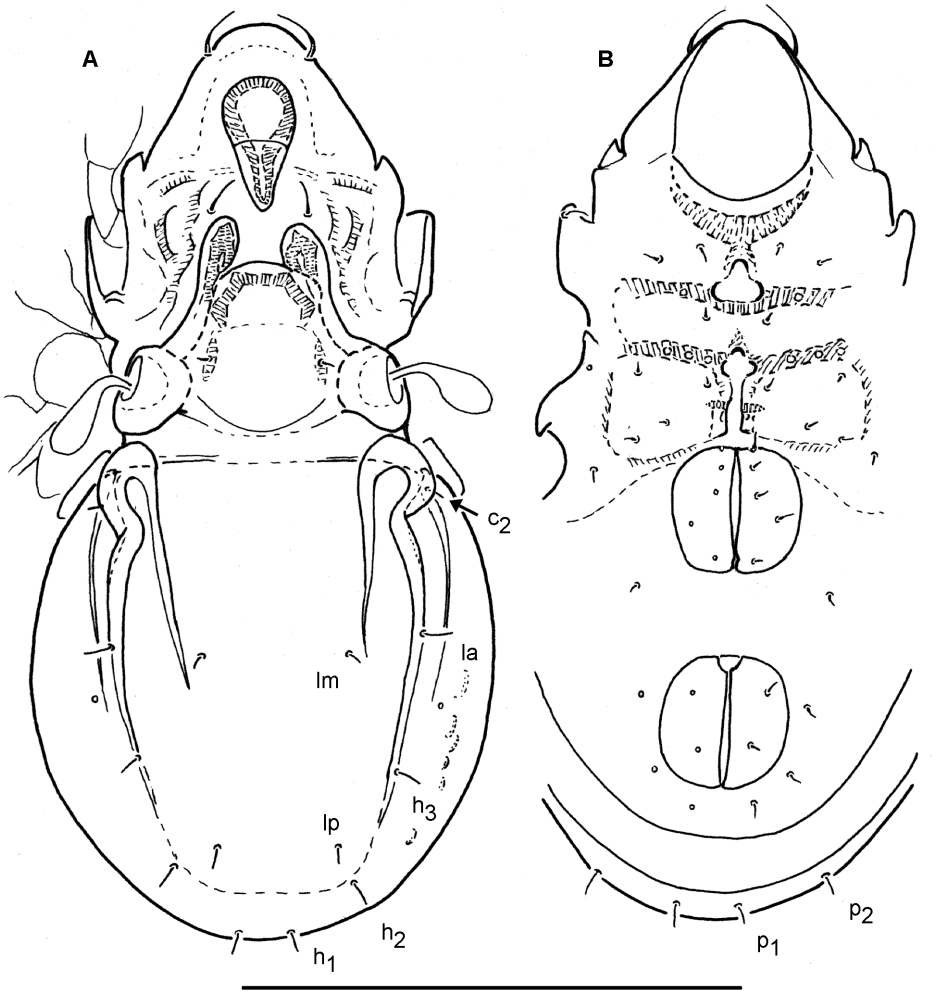

Fig. 1 *Coronoquadroppia guttata* sp. n.; A: dorsal aspect; B: ventral aspect. Abbreviations: c2, la, lm, lp, h1-h3, p1-p2 – notogastral setae. Scale bar 100 µm.

seta inserted on prodorsum surface. Sensillus nearly smooth. Humeral node on notogaster large and rounded, as genus-typical, connected with a median cuticular stripe and a long second stripe, a third lateral stripe present; nine pairs of moderately short notogastral setae, as typical. Sternal groove between epimers III–IV narrow, anterior with rounded-rhombiform extension, sternal groove between epimers I with three rounded extensions.

Description

General characters. Body length range 182–184 µm (n = 2), width of notogaster about 92 µm (the length-width-ratio in other species about 1.7–1.8). Cuticula smooth, pale yellow.

Prodorsum: Rostrum rounded, rostral seta the longest on prodorsum, about 11 µm (Fig. 1A); lamellar seta about 8 µm long, positioned on prodorsum anterior of 'cuspis'; interlamellar seta short, lateral on interlamellar mound; exobothridial seta short. Rostral sculpturing anterior of translamella as drop-shaped mound, anterior edge rounded, posterior part narrow and more or less tipped, surface with one transverse suture. Lateral prodorsal ridges as typical. Lamella as distinct costula, with a rounded 'cusp' (the homology of the structure is incertain) as long as wide, length from translamella to costular tip about the same as mutual distance; translamella distinct with obvious trapezoid 'sclerites' in microscopical impression; interlamellar mound large (lateral view: Fig. 2). Sensillus short club-shaped, nearly smooth.

Notogaster: Ovoid in shape, anterior border straight, in the middle indistinct. Humeral node on notogaster large and rounded, as genus-typical (Fig. 1A). Three pairs of longitudinal thickened cuticular stripes from the nodes backwards (looking like carinas in microscopical view) which indeed are depressed grooves (cf. SEM pictures in Fischer et al. 2009); the most median stripe reaching middle of notogaster near seta *lm*; the second and longest stripe indistinct in posterior notogaster region, with indistinct circumnotogastral mutual connection; a third lateral stripe as short as the most median one. As typical, nine pairs of moderately short fine notogastral setae, maximal length about 5 µm; *la*, *h3* and *h2* touching second longitudinal stripe; setae *p1* and *p2* visible from ventral.

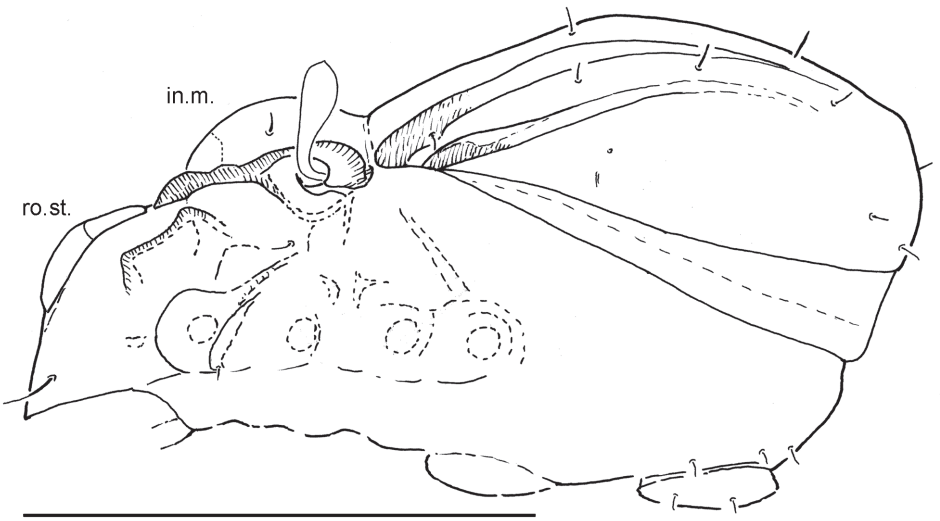

Fig. 2 *Coronoquadroppia guttata* sp. n., lateral aspect. Abbreviations: ro.st. – rostral structure; in.m. – interlamellar mound. Scale bar 100 µm.

Ventral region: Epimeral setation formula 3-1-3-3. Some small cuticular hollows on apodemes. Sternal groove between epimers III–IV narrow, anterior with rounded-rhombiform extension, short transverse apodemes in the border-region of epimers III to IV; sternal groove between epimers I with three rounded extensions (Fig. 1B). Ano-genital setation as typical (5 *g*, 1 *ag*, 2 *an*, 3 *ad*).

Legs: Not studied in detail; tarsus of leg II with one dorsal solenidium.

Derivatio nominis: The species name guttata refers to the drop-shaped rostral sculpturing, based on the Latin word gutta = drop.

Distribution and ecology: Two specimens of the species were found in a sample from coastal bush-land in the estuary region of Ribeira de Aljezur (West-Algarve). The ecological preference is unclear.

Remarks

The combination of following characters – (1) the relatively long lamellar seta, inserted anterior of the lamellar cuspis, (2) the relatively long cuspis, (3) the drop-shaped rostral sculpturing, and (4) the shape of the sternal groove between epimers III–IV – is unique within the genus and is characteristic for *C. guttata* sp. n. The shape of the rostral sculpturing and the shape of the sternal groove between epimers III–IV are used in recent literature as most important diagnostic characters of *Coronoquadroppia* species and will be discussed comparatively in the following.

A closed ring-like borderline of the rostral sculpturing, as observable in light microscopy, can be seen in several described species. In some of these, a longish-ovoid shape with posterior reduction of width can be found, e.g. in *C. omodeoi* Mahunka & Paoletti, 1984 (Italy), *C. media* Gordeeva, 1983 (Caucasus), *C. abchasica* Gordeeva & Tarba, 1990 (Caucasus), *C. gumista* Gordeeva & Tarba, 1990 (Caucasus; as interpreted by Fischer et al. 2009: Austria, Italy), *C. ritza* Gordeeva & Tarba, 1990 (Caucasus), *C. lesleyae* Monson, 2000 (U.K.; Monson 2000). None of these species has a rostral sculpturing with such a narrow posterior part as observed in *C. guttata* sp. n. After the SEM analysis of Fischer et al. (2009), the rostral sculpturing in *C. gumista* has a transversal double-ribbon in the posterior part which might be hardly visible in light microcopy or observable only as transversal suture. A similar transversal ribbon can be seen in the description of *C. abchasica*, a transversal suture in *C. ritza*. These three Caucasian species (in Gordeeva & Tarba 1990, and also *C. media* in Gordeeva 1983) are not described sufficiently in respect of the epimeral grooves and must be regarded as species inquirenda; type specimens are not available (Fischer et al. 2009). *Coronoquadroppia gumista* differs from *C. guttata* sp. n. by short lamellar cuspis, different shape of the epimeral groove (after material from Italy and Austria: Fischer et al. 2009) and a short second notogastral stripe. At least, *C. abchasica* could be suspected as senior synonym to *C. guttata* sp. n. with great uncertainty: the pictured sternal groove and the notogastral stripes might be similar, but at least the short lamellar cuspis and a long translamella are different (cf. Gordeeva & Tarba 1990).

The shape of the groove between epimers III–IV, narrow with an anterior expansion, in *Coronoquadroppia guttata* sp. n. is similar to that in *C. lesleyae*, *C. crenata* (in Mahunka 1984, Tanzania) and *C. galaica* Mínguez, Ruiz & Subías, 1985 (Spain). These three species differ significantly e.g. in the shapes of the rostral sculpturing and the lamellar cuspis as in the position of the lamellar seta. Additionally, in *C. galaica* and *C. lesleyae* the lateral notogastral stripe is longest and mutually fused posteriorly and not the second notogastral stripe, as found in *C. crenata* and *C. guttata* sp. n.

3.2. *Scheloribates* species

In the estuary region of the Ribera de Aljezur in the Western Algarve, four species of *Scheloribates* were collected. Recently, the monodactylous species *Scheloribates* (*Euscheloribates*) *algarvensis* Weigmann, 2009, has been described. *Scheloribates* s. str. is represented by three species in this region, *S. minifimbriatus* Mínguez, Subías & Ruiz, 1986, which is redescribed below, and two new species: *Scheloribates ibericus* sp. n. and *S. litoralis* sp. n.

Scheloribates (*Euscheloribates*) *algarvensis* lives in the flooding area of the estuary salt marsh (Ribera de Aljezur, new unpublished findings 2010), indicating a halophilous preference. At the upper zone of the salt marsh with drier conditions than in the flooding zone, *S. litoralis* sp. n. were found (as also one specimen in a salty meadow in the Lagoon of Aveiro in North Portugal), allowing the conclusion of at least halotolerant ecological preference. The species *S. minifimbriatus* and *S. ibericus* sp. n. occur partly syntopic in the typical bushy area of the coastal region, some meters higher than the tidal zone, but still influenced by occasional salt water spray in times of strong western winds. All species of the following descriptions have some basic characters in common (cf. Weigmann 2006).

Diagnosis of *Scheloribates* s. str.

Prodorsal setae (rostral, lamellar and interlamellar setae) well developed, exobothridial seta present; with typical lamellar-complex: lamella and prolamella as edge, sublamella as narrow blade; bothridium at posterior end of lamella, with dorsal scale. Pedotecta I and II well developed. Distinct anterior border of notogaster; pteromorph immovable rounded blade. 10 pairs of notogastral setae; octotaxic system presented by four pairs of mostly multiporous sacculi; Opisthonotal gland near sacculus S1, four visible pairs of lyrifissures. Epimeral setation formula 3-1-3-3; discidium present as rounded narrow blade; four genital, one aggenital, two anal and three adanal setae pairs. All tarsi with three claws, lateral claws thin.

***Scheloribates minifimbriatus* Mínguez, Subías & Ruiz, 1986**

Scheloribates minifimbriatus: Pérez-Iñigo (1993: 253)
Scheloribates fimbriatus Thor: Mahmud et al. (1983), syn. after Mínguez et al. (1986); non Thor (1930)

Material examined

(1) Three specimens from samples Po132–135, from a coastal dune site in the estuary region of Ribeira de Aljezur; (2) 57 specimens from samples Po143–146, from a coastal bush-land in the estuary region of Ribeira de Aljezur; (3) one specimen from sample Po23 from a salt marsh site at the shore of Rio do Minho, northern Portugal.

Diagnosis

Body length about 320 µm, notogaster width about 245 µm (pteromorphs not included). Prodorsal setae *le* and *in* moderately long, sparsely ciliated. Sensillus moderately long, head asymmetric fusiform with small acute tip and with short spines. Pteromorph as distinct convex blade, anterior border directed backwards. Notogastral setae fine and smooth, about 10–12 µm in length.

Redescription

General characters: Body length 275–355 µm — females 310–355 µm (mean length 336 µm, n = 16), males 275–335 µm (mean length 311 µm, n = 23); body length distributions in Figs 5C, D. The maximal body length is indicated as 387 µm in the original description (Mínguez et al. 1986). Shape of females with length-width-ratio about 2.0, males less elongated. Body colour pale yellow-brown, cuticula smooth, cerotegument not obviously developed.

Prodorsum: Rostrum rounded; lamellar complex of *Scheloribates*-type: very narrow sublamellar blade, prolamellar ridge shorter than distance lamellar to rostral seta, not directed to insertion of rostral seta (Fig. 3E); prodorsal setae sparsely ciliated; lamellar seta moderately

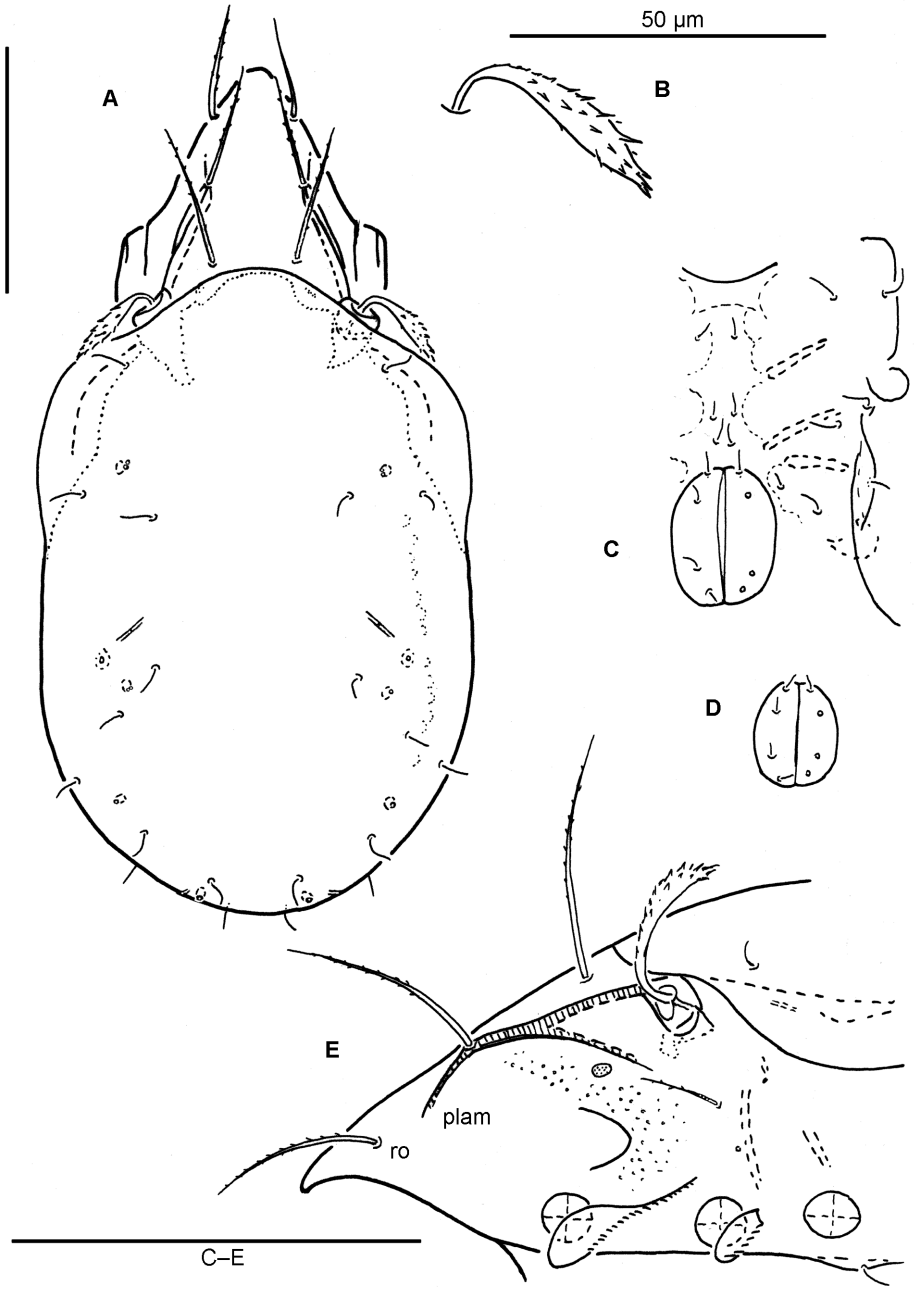

Fig. 3 *Scheloribates minifimbriatus.* A: dorsal aspect, legs omitted; B: sensillus; C: epimeral-genital region of female; D: genital plates of male; E: lateral aspect, legs omitted. Scale bars for A, C–E, 100 µm.

long (about 60 µm), not protruding rostrum tip, interlamellar seta about 65 µm, rostral seta about 45 µm long. Sensillus about 40 µm long, with slender-fusiform asymmetric head with maximal width in the distal half in lateral aspect, tipped, distinctly spinulated (Fig. 3B). Prodorsum laterally with granulated cerotegument, lateral field smooth, with ovoidly rounded posterior border-line; sublamellar porose area roundish; exobothridial seta about 20 µm long (Fig. 3E).

Notogaster: Ovoid shape of notogaster (pteromorphs not considered), dorsosejugal line convex, protruding the bothridia; pteromorph as distinct convex blade of moderate size, slightly bowed downwards, anterior border directed strongly backwards (Fig. 3A). Notogastral setae fine and smooth, about 12 µm in maximal length; sacculi of the octotaxic system at least partly multiporous.

Ventral region: Structures as normal for *Scheloribates* sensu lato. All ventral setae small and smooth. Genital plates broadest at the middle region (Fig. 3C, D). Cuticula of ventral plate smooth.

Legs: Shapes as usual in Scheloribatidae.

Distribution and ecology: Several specimens were found in three samples from coastal bush-land, moulded by strong wind and occasional salt water spay, in the estuary region of Ribeira de Aljezur (West Algarve, southern Portugal), few specimens in adjacent dune under a bush of *Ononis natrix*; one specimen was collected at the shore of Rio Minho (northern Portugal) above the littoral vegetation zone.

The original findings of the species were made in Central Spain (Mínguez et al. 1986) in uncultivated fallow-lands; earlier collections in Spain were misinterpreted as *Scheloribates fimbriatus* Thor, 1930 (see also Pérez-Iñigo 1993). Obviously, the species is more or less xerophilous, living in humus-poor soil with sparse vegetation. The occurrences in Central Spain, northern and southern Portugal indicate a wide Iberian distribution of this species.

Remarks

Scheloribates minifimbriatus is similar to a new species from South Portugal, described and discussed in the next section. Mínguez et al. (1986) differentiate *S. minifimbriatus* from other southern European *Scheloribates* species, which is confirmed in the following.

Scheloribates fimbriatus Thor, 1930, is described originally from Turkestan (Central Asia), having a completely developed prolamella which ends at the rostal seta (as also in the redescription from Iran by Bayartogtokh & Akrami 2000) in contrast to the redescription by Mahunka (1987; from Hungary) who indicated a shortened prolamella. The species has a very narrow sensillus head, about twice as broad as the stalk with a very long ciliated tip (cf. below: Fig. 4G after an Iranian specimen). The species is larger than *S. minifimbriatus* with indications of 480 µm length (Thor 1930), 394–460 µm (Mahunka 1987), 402–444 µm (Bayartogtokh & Akrami 2000). A recent report of findings of '*S. fimbriatus*' at Cabo de São Vicente (South-West Portugal: Gil & Subías 1990) gives no morphological indications but the length range of 344–428 µm, which does not agree well with Eastern European and Asian populations; these Portuguese reports are subject of the discussion in the next section.

Scheloribates xylobatoides Mahunka, 1977, from Greece differs from *S. minifimbriatus* by the larger body size (436–495 µm), a different shape of the genital plates and a complete prolamella reaching the rostral seta (Mahunka, 1977); the sensillus shape is similar to that of *S. minifimbriatus*, therefore we can deduce a sufficient difference also to *S. fimbriatus* Thor, 1930. *Scheloribates barbatulus* Mihelčič, 1956, from Spain, as redescribed by Pérez-Iñigo (1974; cf. 1993) differs by a larger body length (355–525 µm), a longer fusiform sensillus head with dorsal and ventral row of barbs, a complete prolamella. A similar species, *S. penicillatus* Mihelčič, 1957, from Spain is a species dubia (Pérez-Iñigo 1993).

***Scheloribates ibericus* sp. n.**

Scheloribates fimbriatus: ? Gil & Subías (1990); ? non Thor (1930).

Material examined

Holotype: Adult female, sample Po 145, coastal bush-land in the estuary region of Ribeira de Aljezur; preserved in ethanol, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG). Paratypes: Five specimens deposited in SMNG. 43 specimens from samples Po145–146 in the collection of the author.

Diagnosis

Body length about 400 µm, notogaster width about 225 µm (pteromorphs not included). Prodorsal setae *le* and *in* about 90 µm long, sparsely ciliated. Sensillus moderately long, head asymmetric fusiform with small acute tip and with short barbs. Pteromorph as large convex blade, anterior border more or less transverse. Notogastral setae fine and smooth, about 10 µm in length.

Description

General characters: Body length range 336–450 µm — females 375–450 µm (mean length 408 µm; n = 28); males 336–405 µm (mean length 380 µm; n = 21); body length distributions in Fig. 5 A, B. Shape of females with length-width-ratio about 1.8, males less elongated. Body colour pale brown, cuticula smooth, cerotegument not obviously developed.

Prodorsum: Rostrum rounded; lamellar complex of *Scheloribates*-type: with blade-like sublamella and prolamellar ridge (*plam*), the latter directed ventrad from lamellar seta, ending behind insertion of rostral seta (*ro*; Fig. 4F); lamellar and interlamellar setae long (about 90 µm), sparsely ciliated; lamellar seta protruding tip of rostrum; rostral seta ciliated, about 55 µm long. Sensillus about 70 µm long, in lateral aspect with fusiform asymmetric head, width about three times as that of stalk, tipped, shortly barbed (Fig. 4B, C). Prodorsum laterally with granulated cerotegument, lateral field smooth, with rounded posterior border-line; sublamellar porose area round; exobothridial seta about 25 µm long (Fig. 4F).

Notogaster: Ovoid shape of notogaster (pteromorphs not considered), dorsosejugal line convex, protruding the bothridia (Fig. 4A); pteromorph large convex blade, bowed downwards, sinuated anterior border transverse or directed slightly backwards. Notogastral setae fine and smooth, about 10 µm in length; at least anterior sacculi of the octotaxic system multiporous.

Ventral region: Structures as normal for *Scheloribates* sensu lato. Genital plates broadest in the middle (Fig. 4D, E); cuticula of ventral plate smooth.

Legs: Shapes as usual in Scheloribatidae.

Distribution and ecology: The species was found in two samples with altogether 49 specimens in a coastal bush-land in the estuary region of Ribeira de Aljezur (West Algarve). Probably the finding of '*Scheloribates fimbriatus*' at the Cabo de São Vicente (Gil & Subías 1990), about 40 km southern from Aljezur, belongs to the new species as discussed in the remarks below. Both coastal sites are similar in geographical and vegetation aspects, influenced by strong wind and occasional salt water spay. Only in one sample the both species *S. minifimbriatus* and *S. ibericus* sp. n. occur together, but in all other samples they were found separately.

Remarks

Scheloribates ibericus sp. n. is similar to *S. minifimbriatus*, at first sight both are suspected to be conspecific. Both species have been found at the same site, which offers the opportunity to study the sympatric populations in detail without the objection that differences could be nothing but geographical

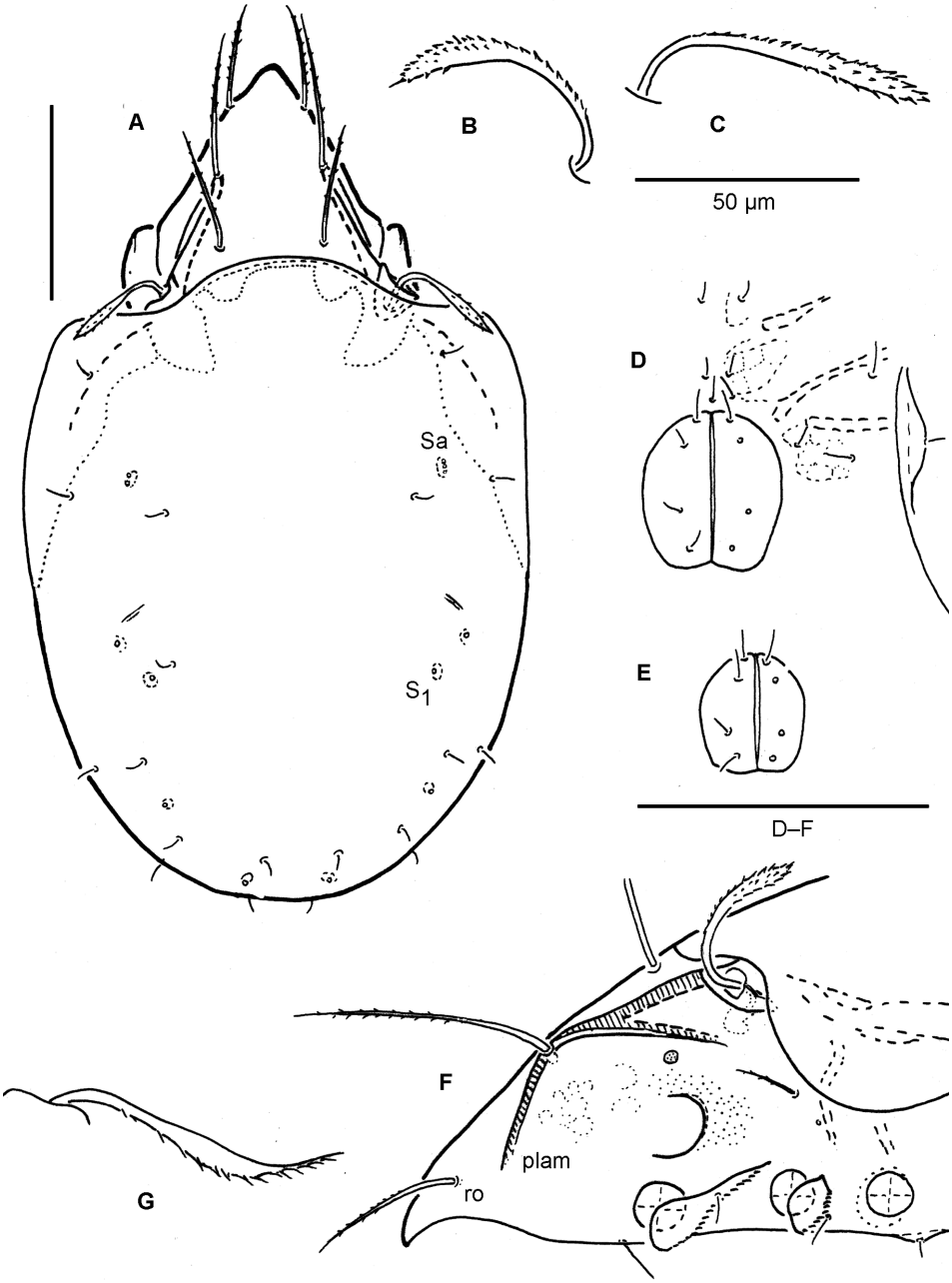

Fig. 4 *Scheloribates ibericus* sp. n.; A: dorsal aspect, legs omitted; B,C: sensillus; D: epimeral-genital region of female; E: genital plates of male; F: lateral aspect, legs omitted.

G: *S. fimbriatus* (original after an Iranian specimen): sensillus. Abbreviations: ro – rostral seta; plam-prolamella. Scale bars for A, D–F, 100 µm.

variability. Main differences are the colour, body size, shape of sensillus, length of prolamella, shape of pteromorph, shape of genital plates. The body length ranges were studied statistically, keeping females and males separately. Figure 5 illustrates the body size distributions, which are significantly different between females of the two species as well as between the males ($p = 0.00$ each in t-tests). No gradations between the diagnostic morphological characters of both species were observed, therefore, the separation as two species is regarded as valid.

Scheloribates fimbriatus Thor, 1930, is an Asian species with likely distribution as far as eastern Europe (Mahunka 1987); the characters are discussed also in the *S. minifimbriatus* section above: (1) The body length range for *S. fimbriatus* in literature is between 394–480 µm (Thor 1930; Mahunka 1987; Bayartogtokh & Akrami 2000); the length of *S. ibericus* sp. n. with 336–450 µm is smaller with partly overlap. Other main differences in *S. fimbriatus* are (2) the sensillus shape and (3) the prolamella, which is directed towards the insertion of the rostral seta and ends there following the original description (Thor 1930; cf. Bayartogtokh & Akrami 2000), but is shortened in the Hungarian population (Mahunka 1987). The sensillus has a very long filiform tip, which is about half as long as the thickened part of the sensillus head, with some ciliae on the long tip; the width of the sensillus head is only about twice the width of the sensillus stalk. In figure 4G the sensillus of an Iranian specimen (original drawing after slide material from Iran, collected 2000 by Hamid-reza Hajiquanbar, Tabriz) is presented which has been determined as *S. fimbriatus* by the author. By contrast, in *S. ibericus* sp. n. the sensillus ends in a long spine, lacking a filiform tip.

From Cabo de São Vicente in South-West Portugal, Gil & Subías (1990) reported the occurrence of '*S. fimbriatus*': no morphological indications were mentioned but the length range of 344–428 µm, which fits best to the new species *S. ibericus*. Therefore, this neighbouring population is suspected to be conspecific. Further different South European species, *S. xylobatoides* from Greece, *S. barbatulus* and *S. penicillatus* from Spain, are discussed above in the section 'remarks' on *S. minifimbriatus*.

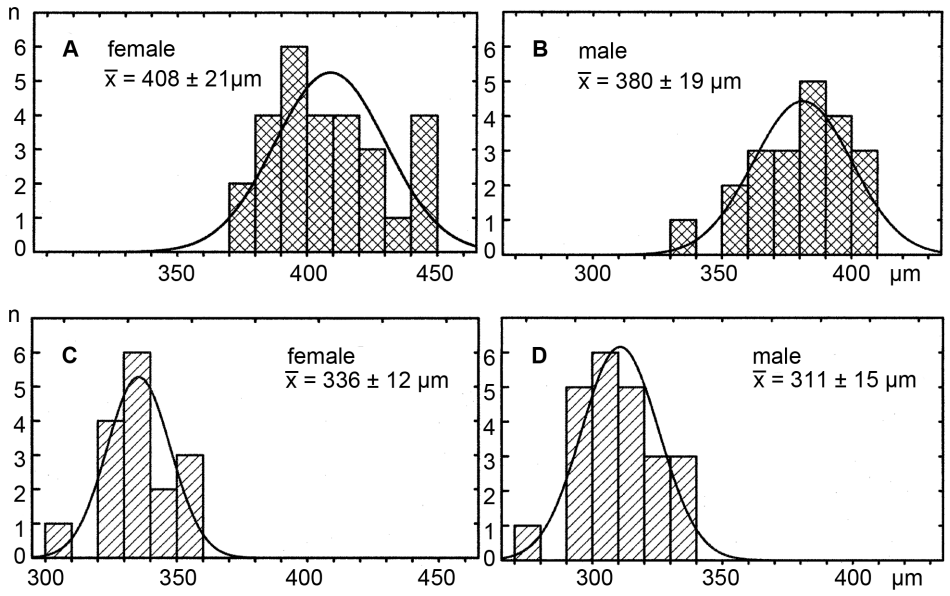

Fig. 5 Body length distributions.
Scheloribates ibericus sp. n.; A: females; B: males. *S. minifimbriatus;* C: females; D: males.

***Scheloribates litoralis* sp. n.**

Material examined

Holotype: Adult female. Sample Po 106, from a salt marsh site in the estuary region of Ribeira de Aljezur; preserved in ethanol, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG). Paratypes: one specimen deposited in SMNG. Four specimens from samples Po107–108 in the collection of the author. One specimen from sample Po36, from a salt marsh site in the Lagoon of Aveiro.

Diagnosis

Body length about 425 µm, notogaster width about 245 µm (pteromorphs not included). Prodorsal setae *le* and *in* very long, sparsely ciliated. Lateral field on prodorsum with undulating border-line. Sensillus moderately long, head asymmetric fusiform with small acute tip and with short spines. Pteromorph as distinct convex blade, its anterior border directed more or less transverse. Notogastral setae fine and smooth, about 30 µm in length; all sacculi of the octotaxic system multiporous.

General characters: Body length 385–455 µm — females 430–455 µm (mean length 444 µm, mean width of notogaster 248 µm; n = 4 from Ribeira de Aljezur); males 385–400 µm (mean length 392 µm, mean width of notogaster 232 µm; n = 2). One female from Aveiro Lagoon: body length 400 µm. Shape of females with length-width-ratio about 1.8, males less elongated, ratio about 1.6. Body colour yellowish-brown, cuticula smooth, cerotegument not obviously developed.

Prodorsum: Rostrum rounded; lamellar complex of *Scheloribates*-type; prolamellar ridge directed ventrad from lamellar seta, ending at some distance behind insertion of rostral seta (Fig. 6E); lamellar and interlamellar setae very long (about 80 µm), sparsely ciliated, lamellar seta protruding tip of rostrum; rostral seta ciliated, about 60 µm long. Sensillus about 50 µm long, with fusiform asymmetric head, tipped, shortly and diffusedly spinulated (Fig. 6B). Prodorsum laterally with granulated cerotegument, lateral field smooth, with irregularly undulating rounded border-line (Fig. 6E); sublamellar porose area round; exobothridial seta about 18 µm long.

Notogaster: Ovoid in shape (pteromorphs not considered), dorsosejugal line convex, protruding the bothridia (Fig. 6A); pteromorph as distinct convex blade, bowed downwards, sinuated anterior border directed slightly backwards to forwards. Notogastral setae fine and smooth, about 20–30 µm in length; most sacculi of the octotaxic system multiporous.

Ventral region: Structures as normal for *Scheloribates* sensu lato. All ventral setae small and smooth. Genital plates broadest at the anterior part (Fig. 6C, D). Cuticula of ventral plate smooth.

Legs: Shapes as usual in Scheloribatidae.

Distribution and ecology: The species was found in three samples with altogether six specimens in a shrubby salt marsh (with *Salicornia* and *Sueda* vegetation), from the upper border of the intertidal salt marsh zone in the estuary region of the Aljezur River (South-West-Portugal), about 1 km from the sea, with changeable conditions regarding salt content and wetness. One specimen was collected from a grassy salt marsh in the Lagoon of Aveiro. Obviously, the species is salt-tolerant.

Remarks

The new species resembles *S. pallidulus* (C.L. Koch, 1840) as redescribed by Willmann (1931), Weigmann (1969, 2006) and Wunderle et al. (1990), a species originally described from Germany, with

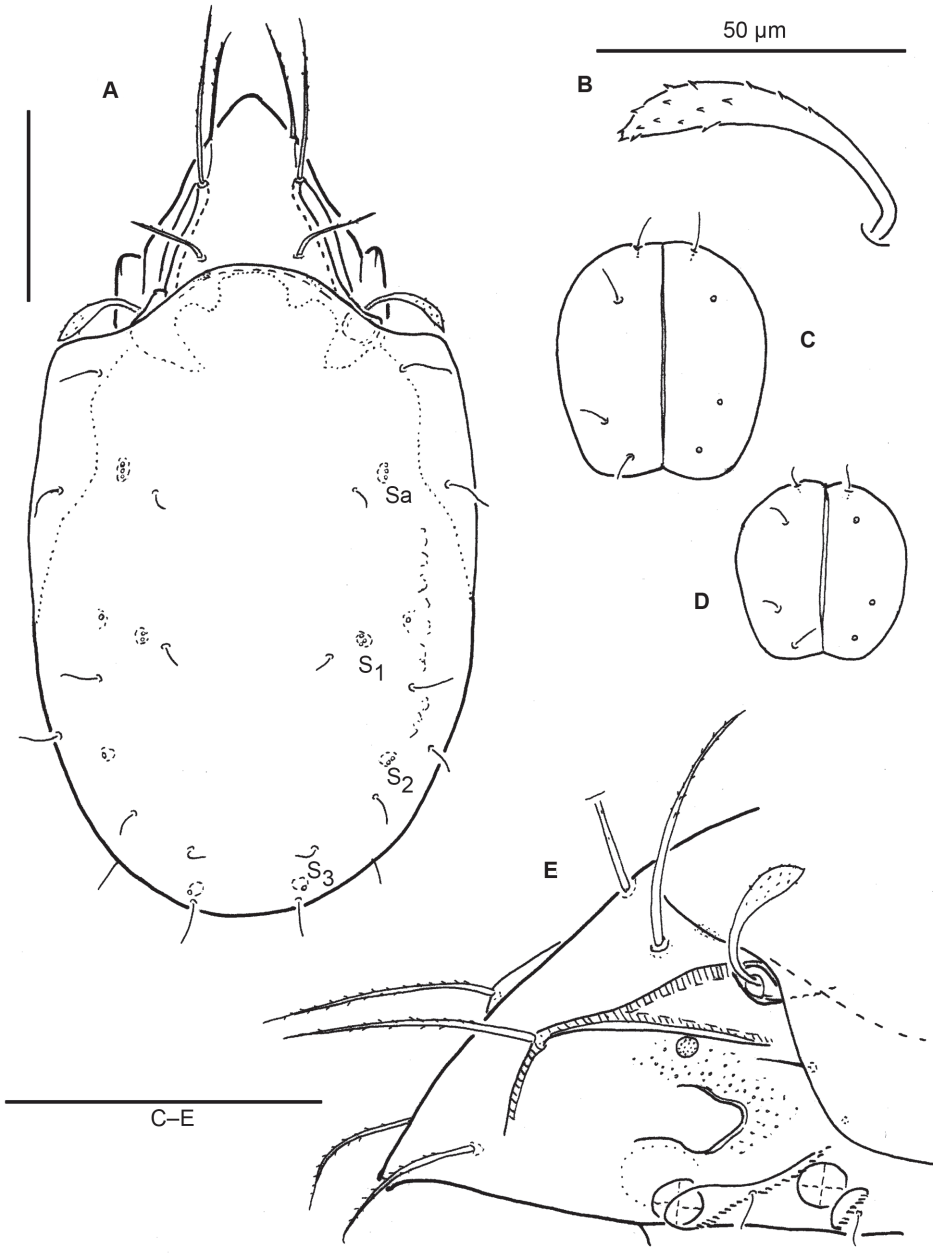

Fig. 6 *Scheloribates litoralis* sp. n.; A: dorsal aspect, legs omitted; B: sensillus; C: genital plates of female; D: genital plates of male; E: lateral aspect, legs omitted. Scale bars for A, C–E, 100 µm.

obviously holarctic distribution and an ecological preference to forest soils. Similar common diagnostic characters are: body size and shape; shape of sensillus and of pteromorphs; lengths of notogastral and prodorsal setae. Besides the extremely contrasting ecology of *S. litoralis* sp. n. in salty littoral soils, there are important differences in morphological details in *S. litoralis* sp. n. (Fig. 6) as comparably illustrated in Fig. 7 (see attached erratum) for *S. pallidulus* from Germany: (1) the prolamella of *pallidulus* (Fig. 7A, see attached erratum) is directed towards the insertion of the rostal seta, normally reaching it (in *litoralis*: ending behind in some distance); (2) the border of the lateral field of prodorsum in *pallidulus* is continuously rounded (*litoralis*: irregularly and undulating border); (3) the genital plates of *pallidulus* are broadest in the middle (in *litoralis*: broadest in the anterior half).

Pérez-Iñigo (1974) described a single specimen from the Madrid Museum collection of *S. pallidulus* from Spain (pictured in Pérez-Iñigo 1993: 258): the figure is not suitable to decide the identity of the Spanish specimen with certainty; the size indication with 500 µm length and 290 µm width (Pérez-Iñigo 1974) is out of the range of recently studied German populations (cf. Weigmann 2006), but it corresponds with a larger '*pallidulus'* form, as described by van der Hammen (1952) to which Pérez-Iñigo (1974) refers; the taxonomical status of this form is questionable (Weigmann 1969, 2006). After faunistic catalogues of Spain (Subías & Gil-Martin 1997; Subías & Mínguez 2001), *S. pallidulus* is a rare species there and no littoral findings are reported yet.

3.3. *Haplozetes* species

The family Haplozetidae Grandjean, 1936, was splitted by Balogh & Balogh (1984) into four subfamilies with altogether 18 genera at that time, a concept which is based mainly on widespread numerical characters, as numbers of genital, aggenital and notogastral setae and on number of claws. These 'typological' characters are useful for determination keys but can be regarded as less adequate arguments for assumed natural systematical unities which should be based better on probable synapomorphies. These characters are not special but are represented with obvious variability and with a homoplasious tendency to numerical reductions within diverse families. A different and even more diversified genus concept is presented by Subías (2004) in a catalogue without any substantiations for systematic changings. Regarding the genus *Haplozetes* Willmann, 1935, in the conservative sense of Grandjean (1936), the Iberian haplozetid fauna was revised taxonomically by Gil & Subías (1993) who arranged 18 species from different continents into the two genera *Haplozetes* and *Lauritzenia* each with two subgenera. The two species treated in the following belong to one of these genera each in the sense of Gil & Subías (1993), discussed in the respective 'remarks'. A diagnosis of *Haplozetes* as applied by Mahunka & Mahunka-Papp (2004) and Weigmann (2006) is presented in the next subsection.

Diagnosis of *Haplozetes* sensu Grandjean (1936)

Rostral border rounded; prodorsal setae (rostral, lamellar and interlamellar setae) well developed, exobothridial seta present, sensillus with fusiform or clavate head. Lamella without cusp, no translamella or sublamella, prolamella exceptionally present; lamellar seta at tip of lamella. Tutorium as long narrow blade, without free cuspis, at most with distal dens. Pedotecta I and II well developed. Distinct anterior border of notogaster; pteromorph as movable rounded blade. Ten pairs of notogastral setae; octotaxic system with four pairs of sacculi; four visible pairs of lyrifissures; opisthonotal gland near sacculus S1 and lyrifissure im. Epimeral setation formula mostly 3-1-3-3; discidium present as rounded blade with acute custodium; 4–5 genital, one aggenital, two anal and three adanal setae. Tarsi either with one or three claws.

***Haplozetes differens* sp. n.**

Material examined

Holotype: Adult male. Sample Po 143, from coastal bush-land in the estuary region of Ribeira de Aljezur; preserved in ethanol, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG). Paratype: One male specimen from sample Po143 in the collection of the author.

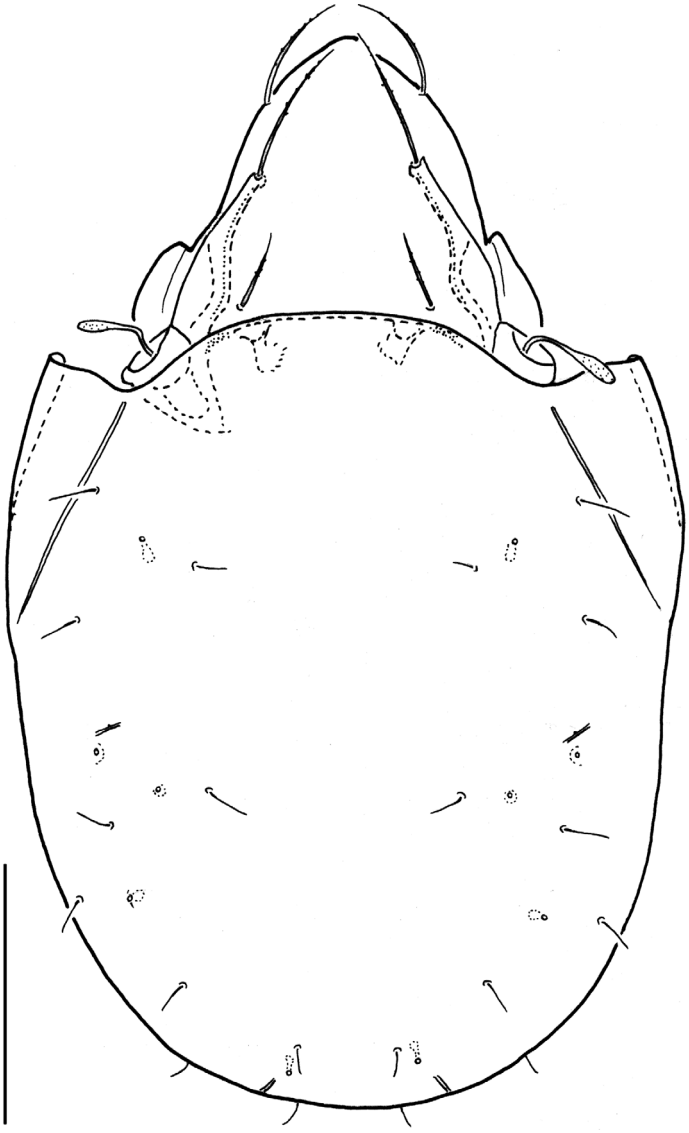

Fig. 8 *Haplozetes differens* sp. n.; dorsal aspect, legs omitted. Scale bar 100 µm.

Diagnosis

Body length about 420 µm, notogaster width about 250 µm (pteromorphs not included). Prodorsal setae *le* and *in* about 50 µm long, sparsely ciliated. Sensillus with long stalk, head longish claviform with short barbs. Lamellar tip with or without small dens. Tutorium distally with sharp dens and irregular edge; rostral seta inserted in some distance from tutorium on a transverse ridge (prolamella ?). Pteromorph as large movable blade, anterior border slightly bent forwards. Notogastral setae fine and smooth, about 20 µm in length; sacculi short, rounded, without long tubular part near small orifice. Five pairs of genital setae; legs with three claws.

Description

General characters: Body length range of the males 410–424 µm (females may be larger); body length-width-ratio about 1.7. Body colour pale brown, notogaster smooth, ventral plate with dispersed indistinct cuticular grooves.

Prodorsum: Rostrum rounded; lamella distally narrow, with or without small dens (Fig. 8); ciliated lamellar seta about 50–54 µm long, densely ciliated interlamellar seta about 45–50 µm long, ciliated rostral seta about 35 µm long, inserted in some distance to tutorium tip on a transversal ridge (prolamella?) which is arched ventrally, dorsally not reaching lamella (Fig. 9B). Exobothridial seta short (about 17 µm); sublamellar porose area round. Tutorium narrow, distally with sharp dens and irregular edge. Sensillus about 50 µm long, stalk long, head longish claviform with short barbs (Fig. 9A).

Notogaster: Broad-oval in shape (pteromorphs not considered); pteromorph as large movable blade, bowed downwards, sinuated anterior border directed slightly forwards (Fig. 8). Notogastral setae fine and smooth, about 20 µm in length; sacculi short, rounded, without long tubular part near small orifice.

Ventral region: Structures as normal for *Haplozetes* sensu lato. All ventral setae small and ciliated; epimeral setation formula 3-1-3-3; discidium present as rounded blade with very small custodium tip. Genital plates broadest at the anterior part (Fig. 9C).

Legs: Shapes as usual in *Haplozetes*; claws heterotridactylous.

Distribution and ecology: The species was found in a sample in a coastal bush-land, moulded by strong wind and occasional salt water spay, in the estuary region of Ribeira de Aljezur (West Algarve, southern Portugal) with altogether 2 male specimens; the ecological preference is unclear.

Remarks

Gil & Subías (1993) separated those species of *Haplozetes* sensu lato with four pairs of genital setae as *Lauritzenia* Hammer, 1958, and divided remaining *Haplozetes* species into two subgenera, *Haplozetes* (*Haplozetes*) and *Haplozetes* (*Mixobates*) Gil & Subías, 1993: the typical subgenus with the type species *H. vindobonensis* (Willmann, 1935) defined by five pairs of genital setae and monodactylous legs, and the subgenus *Mixobates* with the type species *H. triungulatus* Beck, 1964, defined by five pairs of genital setae and heterotridactylous legs. The definitions of the subgenera by Gil & Subías (1993) based on the erroneous assumption that *H. vindobonensis* were monodactylous, as Beck (1964) remarked without studying the species. In the short original description as in the detailed studies of Grandjean (1936) the number of claws is not mentioned. Proved specimens of *H. vindobonensis* from Austria and Italy (pers. comm. H. Schatz) and own specimens from Greece and Siberia have three claws and other specific characters as redescribed in Grandjean (1936: sensillus shape longish-claviform, sacculi with long tubulus, sacculus S2 bi-furcated). The subspecies *H. vindobonensis* curtipilis Kunst, 1977, from Czechia has legs with three claws according to Kunst (1977), as well as *H.* (*Mixobates*) *insularis* Pérez-Iñigo & Peña, 1996, from the Canary Islands, both with the mentioned specific characters of *H. vindobonensis*;

therefore, the latter species, *H. insularis*, may be regarded as Canarian subspecies of *vindobonensis*. After the rules of nomenclature, the type species of the genus *Haplozetes* must be also the type species of the nominal subgenus: in consequence the tridactyly of *H. vindobonensis* is a diagnostic character of the

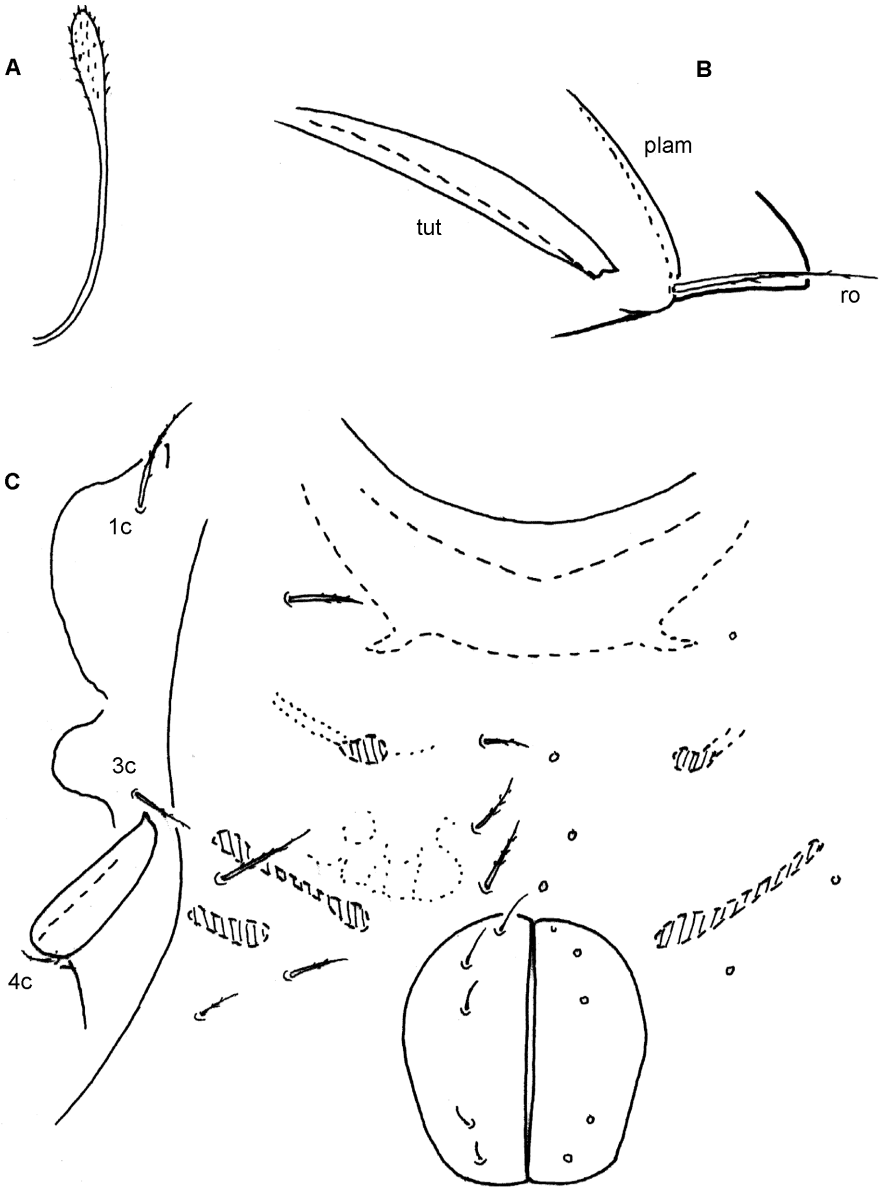

Fig. 9 *Haplozetes differens* sp. n.; A: sensillus; B: lateral aspect, legs omitted; C: epimeral-genital region. Abbreviations: plam – prolamella; tut – tutorium; ro – rostral seta; 1c, 3,c 4c – epimeral seta. Scale bar 100 μm.

genus and subgenus *Haplozetes* as well. Therefore, the subgenus *Haplozetes* (*Mixobates*) Gil & Subías, 1993, as defined by tridactyly, is a junior synonym and its members belong to *Haplozetes* (*Haplozetes*).

Haplozetes differens sp. n. is mainly distinguished by the character combination of (1) five pairs of genital setae, (2) legs with three claws, (3) presence of 'prolamella', (4) comparably short sacculi, (5) sensillus with long stalk and longish claviform head, (6) tutorium tip with dens. Only species with characters (1) and (2) are discussed in the following. The presence of a probable prolamella is unique within this species group, as far as the lateral aspect of the rostrum is indicated in species descriptions. In contrast to *Haplozetes differens* sp. n., all other members of this species group have sacculi with very long proximal tubulus. There are three subgroups of species with regard to the shape of sensilli: (i) *Haplozetes triungulatus* Beck, 1964, from El Salvador, and *H. fusifer* (Berlese, 1891) from Italy as redescribed by Mahunka & Mahunka-Papp (1995) have a very long head of the sensillus with two lateral rows of ciliae; (ii) *H. vindobonensis* and related species (*H. v. curtipilis*, *H. v. insularis*, *H. ulykpani* Bayartogtokh & Aoki, 1998 (cf. Bayartogtokh 2000) from Mongolia, have a sensillus with barbed fusiform head about half as long as sensillus on the whole; (iii) *H. clavatus* Bayartogtokh, 2000, from Mongolia has a long-stalked sensillus with claviform head as is observed in *H. differens* sp. n. also, but *clavatus* differs in the rounded tutorium tip, the shape of sacculi and lack of prolamella.

Haplozetes similis (Gil & Subías, 1995)

Lauritzenia (*Incabates*) *sinuatus*: Gil & Subías, 1993; non Pérez-Iñigo Jr., 1990
Lauritzenia (*Incabates*) *similis:* Subías & Gil-Martin, 1995

In 1993 Gil & Subías described a species from South-West Portugal by the name *Lauritzenia* (*Incabates*) *sinuatus* Pérez-Iñigo Jr., 1990, originally described from northern Spain, and they indicated some differences. After the study of original material of *Haplozetes sinuatus*, the authors described the population from Portugal as distinct species *Lauritzenia* (*Incabates*) *similis* Subías & Gil-Martin, 1995. This species occurs also in the estuary region of Ribera de Aljezur, about 40 km northern from the locus typicus, Cabo de São Vicente. This finding gives the possibility to add some details to the descriptions of the species (tutorium, ventral setation) and to discuss the taxonomy.

Material examined

One male specimen from sample Po 158, coastal bush-land from the southern slope of the estuary of Ribeira de Aljezur; preserved in ethanol, deposited in the collection of the author.

Diagnosis

Body length 279–343 µm, notogaster width 146–189 µm (pteromorphs not included; measurements from Subías & Gil-Martin 1995 and the new specimen). Prodorsal setae sparsely ciliated, *ro* and *in* about 20–25 µm, *le* about 30–35 µm long. Sensillus moderately long (about 35 µm), head longish claviform with short barbs. Lamellar tip with or without small dens. Tutorium distally with sharp dens and irregular edge; rostral seta inserted in some distance from tutorium (Fig. 11B). Pteromorph as large movable blade, its anterior border transverse or slightly directed backwards. Notogastral setae fine and smooth, about 15 µm in length; sacculi short, rounded pear-like. Four pairs of genital setae; legs with three claws.

Morphological remarks

The body length of the male specimen from Aljezur is 290 µm, the notogaster width 146 µm; the length-width-ratio is about 2.0 (Fig. 10), according the indications of Subías & Gil-Martin (1995) about 1.8 for their population. The sensillus of the specimen is somewhat more slender (Fig. 11A) than pictured in Subías & Gil-Martin (1995) which indicates a certain variability. The epimeral setation formula is 3-1-3-2 (?); seta *4c* not observed (Fig. 11C) in

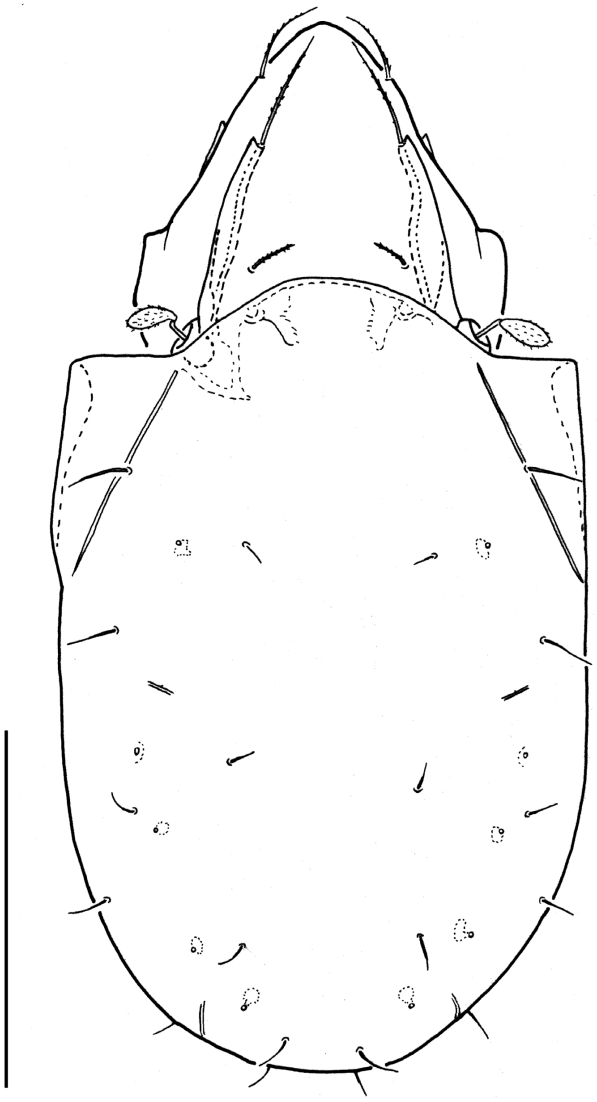

Fig. 10 *Haplozetes similis*. a: dorsal aspect, legs omitted. Scale bar 100 µm.

the position as figured by Subías & Gil-Martin 1995). At one side, the present specimen has only three genital setae instead of four, which is the normal setation, obviously. All diagnostic characters, as given by Gil & Subías (1993) and Subías & Gil-Martin (1995) in contrast to *H. sinuatus*, can be confirmed: the body size, the sensillus shape, the ciliated prodorsal setae and the broadened sacculi.

Distribution and ecology: The species was found in coastal bush-land, moulded by strong wind and occasional salt water spay, at Cabo São Vicente (Gil & Subías 1990) and in the estuary of Ribeira de Aljezur about 100 m from the sea and about 10 m above water level. The

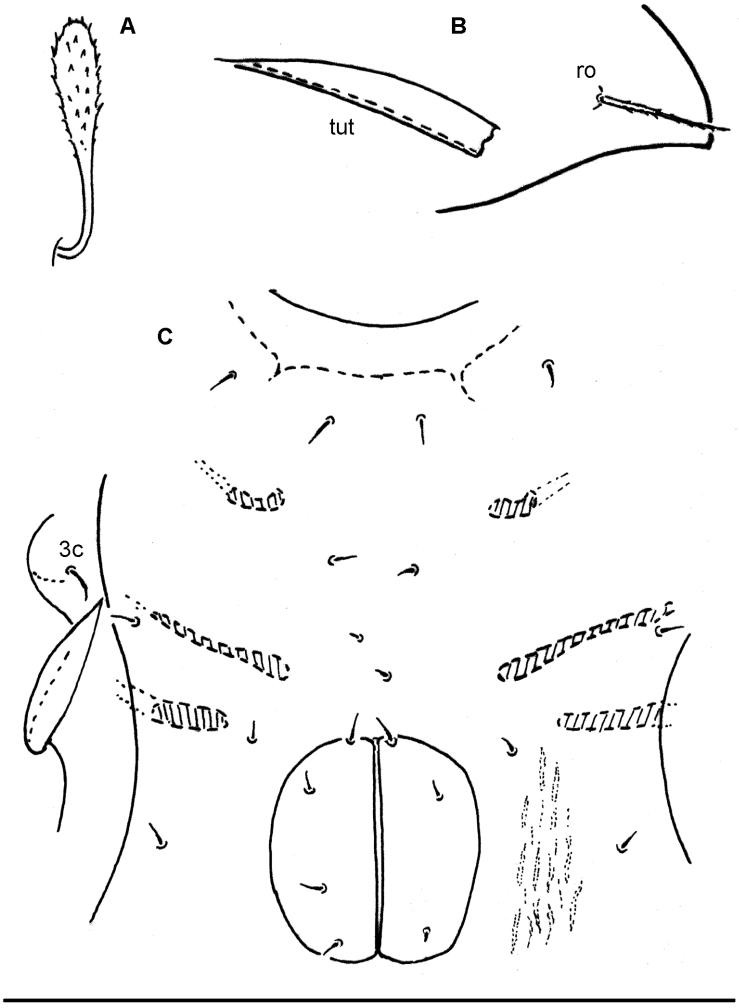

Fig. 11 *Haplozetes similis*. A: sensillus; B: lateral aspect, legs omitted; C: epimeral-genital region. Abbreviations: as Fig. 9. Scale bar 100 µm.

ecological conditions of both localities are similar: bush-land on rocky underground with poor soil. Until now the species is endemic in South-West Portugal.

Remarks

As partly reported in the introduction of chapter 3.3, the genus conception of *Haplozetes* sensu lato (i.e. in the sense of Grandjean 1936) changed by splitting into some genera and subgenera (cf. Balogh & Balogh 1984; Pérez-Iñigo 1993; Gil & Subías 1993; Subías 2004). Obviously, *Haplozetes similis* is most related to *H. sinuatus* and *H. pallidus* (Mihelčič, 1956) from Spain as compared by Subías & Gil-Martin (1995). Pérez-Iñigo (1993) referred two of the species in different genera, *Haplozetes sinuatus*, but *Incabates pallidus*. Yet, following the concept of Gil & Subías (1993) (cf. Subías 2004), the three species belong to *Lauritzenia* Hammer, 1958, because of having four pairs of genital setae, and within this

genus belong to the subgenus *Incabates* Hammer, 1961, because of tridactylous legs. All the three species are comparatively small and slender, but within *Lauritzenia* (*Incabates*) as listed in Subías (2004) are several larger and more compact species (as *tenuifusus* Berlese, 1916; *elegans* Kunst, 1977): obviously the body shape is not a character for a generic characterization. In my opinion, the reduction from five to four pairs of genital setae as well as the number of claws are no sufficient arguments to separate different genera or subgenera, if not combined with other special characters of higher taxonomical value. Until a modern phylogenetical analysis of Haplozetidae, at least the *Haplozetes-Lauritzenia* complex, I plead for maintaining the genus *Haplozetes* sensu lato (in the sense of Grandjean 1936).

3.4. *Pilobates* Balogh, 1960

The haplozetid genus *Pilobates* (proposed by Balogh 1960) is represented in Europe only by *P. carpetanus* Pérez-Iñigo, 1969 from Central Spain (cf. Pérez-Iñigo 1993); now the occurrence in South-West Portugal is reported. In the following, some additions to the description (Pérez-Iñigo 1969, 1993) are represented. The type of this genus is *Protoribates pilosellus* Balogh, 1958. Some further species occur in tropical regions (Africa, Cuba, South-East Asia).

Diagnosis of *Pilobates*

Haplozetid species with long lamella; four pairs of notogastral sacculi, 14 pairs of notogastral setae; five to six pairs of genital setae, three pairs of aggenital setae (!); as usual, three pairs of adanal setae, two pairs of anal setae; legs monodactylous.

Pilobates carpetanus Pérez-Iñigo, 1969

Pilobates carpetanus: Pérez-Iñigo (1993: 243)

Material examined

12 specimens from samples Po145–146, from a coastal bush-land in the estuary region of Ribeira de Aljezur.

Diagnosis

Cuticula pale brown, on notogaster and ventral plate with dispersed fine granulation. Longish and flattened body shape: length 415–515 µm; length-width-ratio 2.2–2.3. Prodorsal setae small (10–20 µm); lamellar seta on tip of long lamella; no translamella; tutorium narrow and undulated, parallel to lamella; pedotecta I and II small. Sensillus very long (about 65–100 µm; Fig. 12A), head short, spindle-shaped, with few spines. Notogaster longish ovoid (pteromorphs not considered); notogastral setae fine and short (about 10 µm); 4 pairs of small notogastral sacculi (Fig. 12C). Five pairs of genital setae, three pairs of aggenital setae in longitudinal row, distance genital plate to anal plate trice the genital-plate length (Fig.12D). Discidium with short custodial tip.

Morphological remarks

The Portuguese population seems to be smaller than the Spanish one: body length 450–515 µm, width 220–280 µm (data from Pérez-Iñigo 1969); Portuguese population: females-body length 435–470 µm (mean 455 µm, n = 6), body width 195–208 µm (mean 200 µm); males-body length 415–440 µm (mean 425 µm, n = 5), body width 180–195 µm (mean 186 µm). The dorsoventral dimension at the level of the genital region is about 150 µm.

Pérez-Iñigo (1969) noticed that there is no tutorium; but in the Portuguese population it is present as narrow undulating blade (Fig. 12B). The epimeral setal formula is 3-1-3-3 (after Pérez-Iñigo (1969: 400), but the seta *4c* is not observable in the Portuguese specimens. A short

custodium is present on the discidium (Fig. 12B), which is not illustrated by Pérez-Iñigo.

Distribution and ecology: The species was found in Spain in the regions of Madrid and Toledo (Pérez-Iñigo 1993) and now at the western coast of Algarve (Portugal). All findings are from open areas with herbs and bushes, partly cultivated areas, in more or less dry soils.

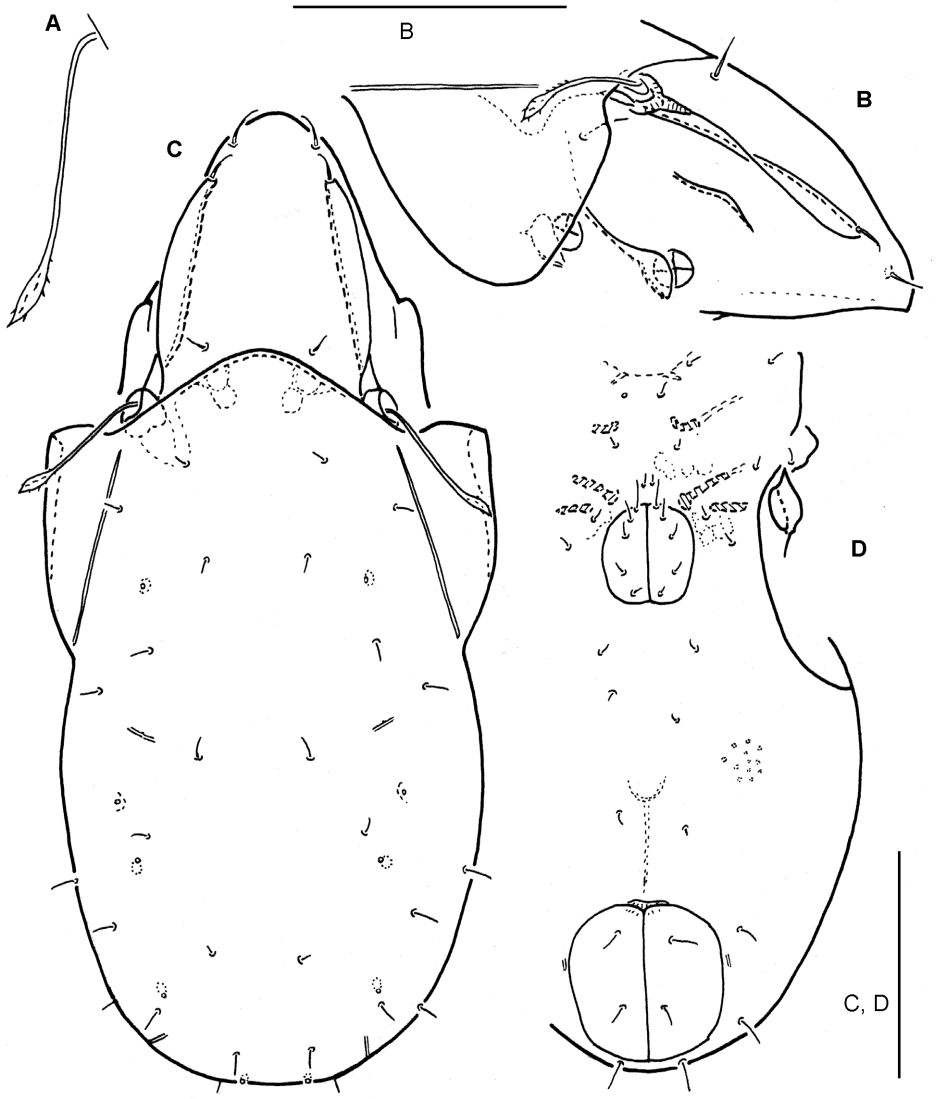

Fig. 12 *Pilobates carpetanus*. A: sensillus; B: lateral aspect; C: dorsal aspect, legs omitted; D: ventral aspect. Scale bars for B, C–D: 100 µm.

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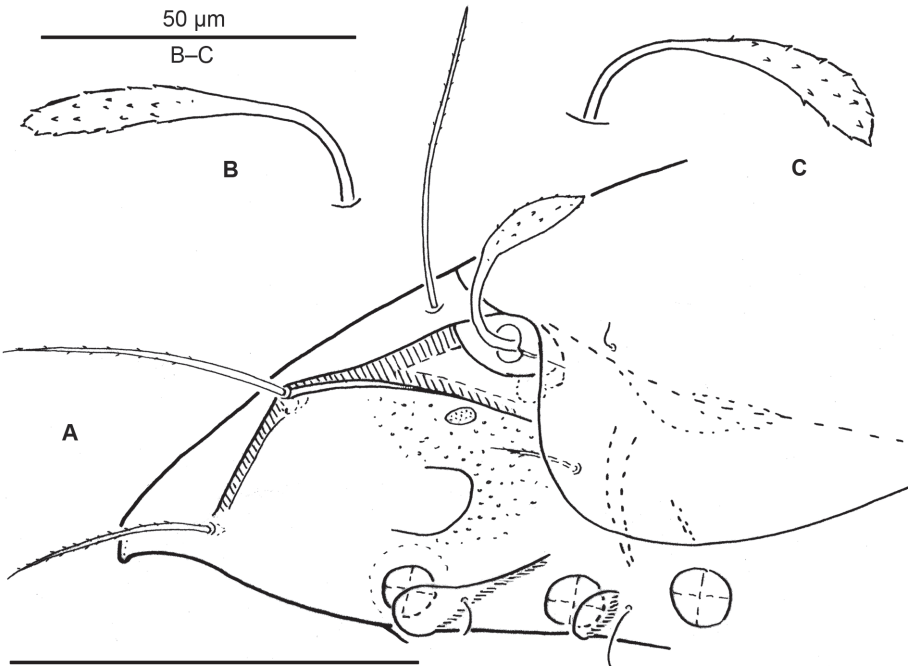

Fig. 7 *Scheloribates pallidulus* (From Germany): A: lateral aspect, legs omitted; B, C: sensillus variations. Scale bars for A: 100 µm.

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Fig. 7 of the manuscript was accidentally omitted.