

Oribatid mites (Acari: Oribatida) from the coastal region of Portugal. III. New species of Scutoverticidae and Scheloribatidae

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Abstract

Three new species of Oribatida were found from soils of different coastal habitats in South Portugal. *Scutovertex mikoï* sp. nov. (Scutoverticidae) is the smallest European species of the genus, collected in a low dune area of the estuary of Ribeiro de Aljezur, western Algarve. *Micropirmodus longissimus* gen. nov, sp. nov. (Scheloribatidae s. lat.) is described and compared with members of *Parapirmodus*, which are considered the closest known relatives. The species was collected from a shrubby vegetation area on rock substrate, in the estuary of Ribeiro de Aljezur, adjacent to the dune area with *S. mikoï* sp. nov. The monodactylous *Scheloribates* (*Euscheloribates*) *algarvensis* sp. nov. (Scheloribatidae) was collected from salt marshes in the Lagoon of Faro, southern Algarve. Its systematic position is discussed, and a new taxonomic status of *Euscheloribates* as subgenus of *Scheloribates* is proposed.

Keywords: taxonomy, systematics, marine salt marsh, coastal dune, coastal bush vegetation

1. Introduction

Until the publication of Gil & Subías (1990) with a list of 62 species, Portugal was a white area with respect to research on oribatid mite fauna, except for a few faunistic remarks in the extensive work on the Spanish fauna by Pérez-Iñigo (e.g. Pérez-Iñigo 1993). The first ecological data on the Portuguese oribatid mite fauna were presented by Weigmann (2008a), and this contribution is the third of a series on the taxonomy of new and remarkable species of Oribatida in Portuguese salt marshes and adjacent habitats (cf. Weigmann 2008b, 2009b). The three species described herein belong to the genera *Scutovertex*, *Euscheloribates* and *Micropirmodus* gen. nov., which is related to *Parapirmodus*.

2. Materials and methods

Samples from coastal areas of Portugal were collected by the author in 1971, 2006 and 2008.

Po59–67: Samples in the Lagoon of Faro ('Ria Formosa'), western part (37°01'N, 7°59.30'E); 29 April–1 May 1971. Salt marshes with halophilous scrubs, dominated by perennial vegetation of the Chenopodiaceae (*Sarcocornia*, *Arthrocnemum*, *Atriplex*, *Suaeda*).

Po132–134: Samples from estuary region of Ribeiro de Aljezur, Algarve (37°20.37'N, 8°50.17'E); 21 March 2006. A low dune site with sparse vegetation, with some bushes.

Po137–141: Samples from the same dune site as Po132–134; 25 October 2008.

Po144–145: Samples from estuary region of Ribeiro de Aljezur, adjacent to Po132 ff; 2 November 2008. A bushy area on a rock, about 5 m higher than the dune area.

Samples Po59–67 were taken semi-quantitatively with a special shovel, about 250 cm², 1–2 cm depth. Samples Po132–145 covered about 50 cm² each. Mites were extracted using a modified Tullgren apparatus. Specimens were preserved in ethanol and after clearing they were studied microscopically in lactic acid on cavity slides.

3. Description of new species

3.1. *Scutovertex mikoi* sp. nov. (Scutoverticidae)

The new species shares some diagnostic characters with the classical Palaearctic species *S. minutus* (C. L. Koch, 1835); yet, the body size is distinctly smaller, the colour is pale brown, not dark brown, and in detail there are some more differentiating characters. Recently, a series of publications included accurate re-descriptions of the type species *Scutovertex sculptus* Michael, 1879, of *S. minutus* and a description of the Austrian *S. pileatus* Schäffer & Krisper, 2008 (Schäffer & Krisper 2007, Pfingstl et al. 2008, Schäffer et al. 2008). These publications resolved several discrepancies in the literature regarding the classical species *S. sculptus* and *S. minutus* and have made it possible to revise diagnoses of other species and to prepare a revised genus diagnosis, presented in the following. The genus diagnosis includes some variable characters (such as the number of notogastral setae, shape of humeral process, transverse ridges on rostrum) which may need to be corrected or clarified in the future, when more species with currently insufficient diagnoses are restudied (cf. Tab. 2 in Schäffer et al. 2008).

Revised diagnosis of *Scutovertex* Michael, 1879

Notogaster ovoid, humeral process at most a narrow blade; notogaster medially fused with prodorsum. Lamella distinct but slender, with cuspis; translamella a narrow ribbon; without interlamellar seta; sensillus claviform with spinose head. Rostrum anterior of translamella with transverse ridge, camerostome with separated rostraphragma inside border of rostrum forming a second anterior border, without genal incision. Infracapitulum diarthric. Notogaster mostly with longish lenticulus; cuticle with varied pattern, with more or less distinct cerotegument. 9–12 pairs of notogastral setae (with or without *da*, *dp* and *c*-seta). Octotaxic system usually present as 3 pairs of minute saccules, often hard to observe. Ano-genital setation normally: 6 *g*, 1 *ag*, 2 *an*, 2 *ad*; epimeral setation normally 3-1-2-2. Tutorium scarcely developed; pedotect I and II well developed. Legs hetero tridactylous, tarse II with 2 solenidia, tibiae I–IV with brachytracheas or saccules, tibia IV with solenidion.

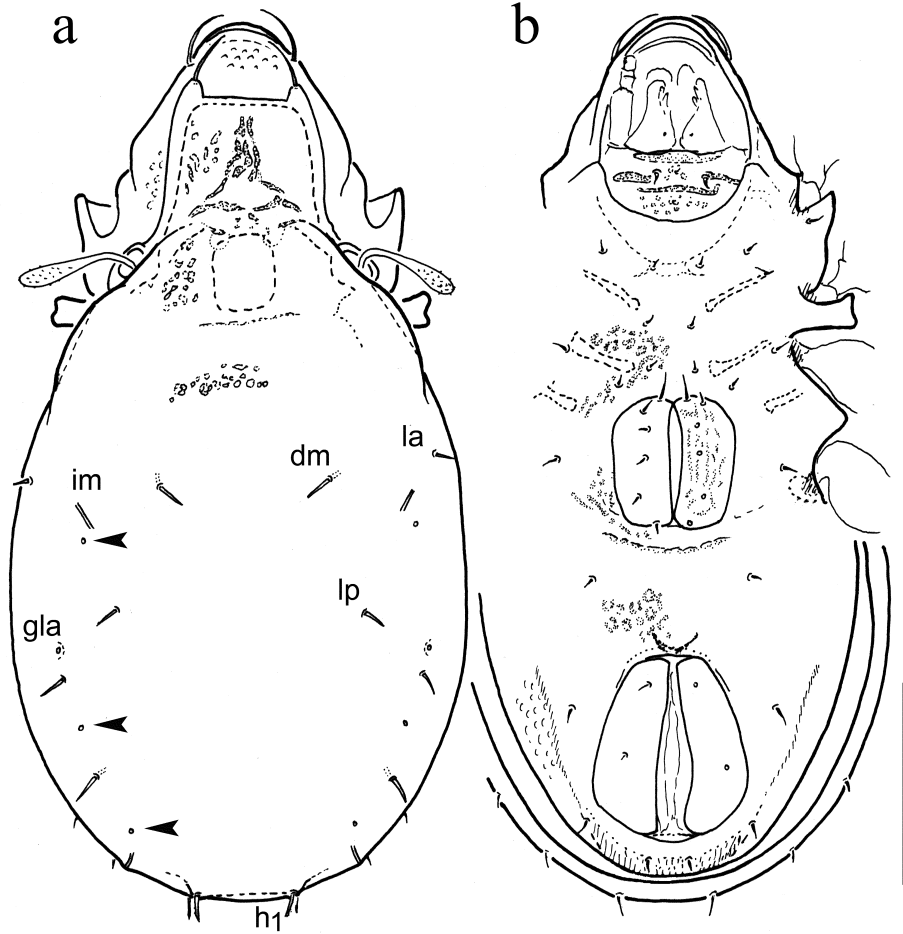


Fig. 1 *Scutovertex mikoi* sp. nov. (legs removed): a: dorsal aspect; b: ventral aspect. Abbreviations: *im*: second notogastral lyrifissure; *la*, *dm*, *lp*, *h₁*: notogastral setae; *gla*: opisthonotal gland porus; arrow heads: pori of notogastral sacculi. Scale bar 100 μ m.

Description of *Scutovertex mikoi* sp. nov.

Material examined

Holotype: Adult female. Portugal, sample Po139, 25 October 2008, collected by the author in a low dune site on the estuary shore of Ribeiro de Aljezur (Algarve); preserved in ethanol, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG). Paratypes: 10 specimens from the same sample, preserved in ethanol, deposited in the collections of SMNG; 40 specimens in the collection of the author. About 50 specimens from the samples Po137, Po141; three specimens from the same locality, samples Po132, Po133, Po134, in the collections of the author.

Diagnosis

Body length 387–445 μm . Lamellar cusp short; lamellar seta about as long as rostral seta; median ridge of interlamellar field not reaching translamella, formed by elongated variable ridges and nodules. Tutorium a bowed ridge; transverse ridge on rostrum anterior of translamella distinct. Humeral process an indistinct, very slender blade; 9 pairs of small acuminate notogastral setae (seta c_2 absent), setae h_1 and p_1 indistinctly broadened. Cuticule of notogaster and ventral region with small nodules, partly forming circular groups, covered by granular cerotegument. Transverse ridge on mentum usually interrupted.

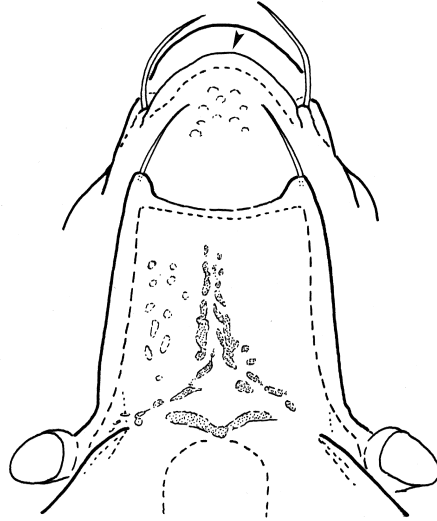


Fig. 2 *Scutovertex mikoi* sp. nov.: dorso-frontal aspect of prodorsum (sensilli removed). Arrow head border of transversal ridge. Scale bar 100 μm .

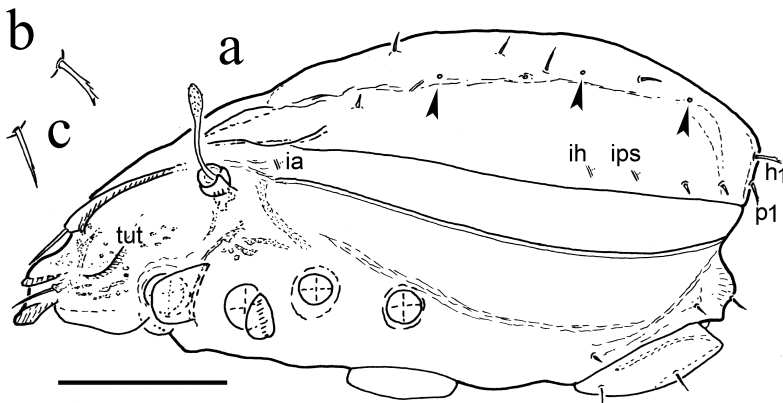


Fig. 3 *Scutovertex mikoi* sp. nov.: a: lateral aspect; b: notogastral seta h_1 , enlarged; c: notogastral seta p_1 , enlarged. Abbreviations: *ia*, *ih*, *ips*: notogastral lyrifissures; *tut*: tutorial ridge; arrow heads, poria of notogastral sacculi. Scale bar 100 μm .

Description

General characters: Body length 387–445 μm ; females 420–445 μm (mean 433 μm ; $n = 6$), males 387–415 (mean 397 μm ; $n = 9$). Body colour pale brown; cuticle of notogaster and ventral region with small nodules, partly forming circular groups, covered by granular cerotegument.

Prodorsum: Rostrum rounded, anterior edge bulged, transverse ridge anterior to translamella distinctly protruding, in antero-dorsal view visor-like (Fig. 2). Tutorium a bowed ridge (Fig. 3). Slender lamella with short cuspis; translamella narrow. Lamellar and rostral setae about same length. Median interlamellar ridge Y-shaped, distinctly darker than surrounding cuticle, formed by longish ridges and nodules; transverse ridge anterior to lenticulus weakly developed, variable in shape (Figs 1a, 2).

Notogaster: Lenticulus longish, not obvious, posterior to it a transverse wrinkle. Humeral (pteromorpha) process a very slender blade. 9 pairs of notogastral setae, at most about 15 μm long, acuminate, but h_1 and p_1 slightly broadened with indistinct setulas; c -seta absent; the most anterior setae la and dm near lyrifissure im . All 5 pairs of lyrifissures present, ia below humeral process (lateral view) on a nodule. Opisthonotal gland indistinct, opening anterior to seta h_3 . In some specimens, posterior outline of notogaster undulating, i.e., seta h_1 and lyrifissure ips each on bulges (Fig. 1a, 3).

Ventral region: Genital plates with longitudinal pattern of ridges; two anterior genital setae positioned side by side. Distance between genital and anal opening about the length of genital plates (Fig. 1b). All ventral setae small, pointed; pattern of ventral plate and epimeres with small closely spaced nodules, partly forming circular groups. Transverse wrinkle behind genital plates. Ventral plate lateral and behind anal plates bowed upwards causing the imagination of a darkened semicircular sclerotisation in ventral view. Lyrifissures iad near anterior edge of anal plates. Transverse ridge of mentum mostly interrupted.

Derivatio nominis: The new species is named after my friend and colleague Dr Ladislav Miko, honouring his merits in oribatid mites research and the long years of cooperation and fruitful discussions with the author.

Distribution and ecology: The species was collected in the coastal region of South Portugal within the Parque Natural da Costa Vicentina (West-Algarve) at Praia de Amoreira about one km from the mouth of Ribeira de Aljezur in a low dune area on the estuary shore. About 100 specimens were extracted from litter and moss under low bushes of *Ononis natrix* and other plant species; the soil substrate is dune sand with a very low content of organic matter. As discussed below, the species recorded as '*Scutovertex minutus*' by Gil & Subías (1990) at the Cabo São Vicente in Portugal (about 35 km south of Aljezur) was probably *S. miko*.

Remarks

Scutovertex mikoi sp. nov., with about 387–445 µm body length, is the smallest European species of the genus. Similar size ranges are reported for *S. siculus* (Berlese, 1887), with about 450 µm, and *S. pictus* Kunst, 1959, with 445–525 µm. Other sufficiently described European species (cf. Table 2 in Schäffer et al. 2008), as also the Japanese *S. japonicus* Aoki, 2000, differ in morphological details and exceed this size range with lengths of more than 470 µm: *Scutovertex alpinus* Willmann, 1953 (Austria, Germany); *S. bulgaricus* Kunst, 1961 (South-East Europe); *S. minutus* (C. L. Koch, 1835) (worldwide?); *S. panonicus* Schuster, 1958 (Palearctic); *S. pileatus* Schäffer & Krisper, 2008 (Austria); *S. sculptus* Michael, 1879 (Palearctic).

Scutovertex siculus was sampled by Berlese from Palermo (Sicily). The description and figures (Berlese 1887: AMS 35,8; plate 70) are poor but sufficient to differentiate it from *S. mikoi* sp. nov.: wrinkled notogastral structure; posterior notogastral setae distinctly larger, distally broadened and barbed. The type material is lost, i.e., not present in the Berlese Collection in Florence, according to the catalogue (Castagnoli & Pegazzano 1985) and the remarks of Bernini & Arcidiacono (1985) who reported no records but the type from Sicily. Mahunka & Mahunka-Papp (1995: p. 63/64, Fig. 77) prepared a short description of the single specimen in the unique slide (82/28) in the Berlese-collection labelled as *S. siculus*. But this specimen was collected from Tiarno, Trentino in North Italy, and not from the locus typicus: it is not conspecific with Berlese's *Scutovertex siculus* and therefore the declaration as lectotype by Mahunka & Mahunka-Papp (1995) is invalid. The main difference with the original description relates to the posterior notogastral setae, which are bacilliform, not broadened. *Scutovertex siculus* remains a species inquirenda. Probably, the species described by Mahunka & Mahunka-Papp (1995) is closely related to (or conspecific with) *Scutovertex mikoi* sp. nov.: the prodorsal characters and the notogastral setation pattern look very similar, and there is no *c*-seta.

Scutovertex pictus differs from *S. mikoi* sp. nov. by: the lack of the median interlamellar ridge and the lenticulus; the presence of a larger cuspis, a strong posterior transverse ridge on prodorsum and of notogastral seta *c*₂; a different dorsal and ventral pattern of cuticle; and a different arrangement of genital setae.

Scutovertex minutus differs from *S. mikoi* sp. nov. mainly by: the larger body size (550–660 µm); a V-shaped turtorium ridge; 10–12 notogastral setae with larger size; and a cuticular pattern differing in detail. Nevertheless, the similarity in habitus led probably to a mix-up: Gil & Subías (1990) reported collecting specimens of a small '*S. minutus*' (length 387–438 µm) from South-West Portugal, which are similar in size to *S. mikoi* sp. nov. and probably are conspecific with it. Another finding of a small form of '*S. minutus*' (422–453 µm in length) from Columbretes Islands (South-East Spain), briefly characterised by Minguez & Subías (1986) and discussed in Pérez-Iñigo (1993: p. 69), may also refer to *S. mikoi*. Both references need to be restudied. The large-sized classical *S. minutus* occurs also on the Iberian Peninsula (in Spain: see Pérez-Iñigo 1993; in Portugal: at the type locality of *S. mikoi* sp. nov.; further unpublished Portuguese records by the author).

3.2. *Scheloribates (Euscheloribates) algarvensis* sp. nov. (Scheloribatidae)

The generic position of this new species is problematic because of the different taxonomic concepts in literature, which will be discussed below in more detail in the section 'remarks'. Most taxonomically relevant characters support the close relationship to species of *Scheloribates* Berlese, 1908 (*Scheloribates* s. str. in the concepts of Weigmann & Miko 1998, cf. Weigmann 2006). But the species is monodactylous, a diagnostic character of *Euscheloribates* Kunst, 1958. The typical species *Euscheloribates samsinaki* Kunst, 1958, differs from the new species by the presence of 3 pairs of genital setae, rather than 4 pairs. In the following diagnosis of *S. (Euscheloribates) algarvensis* sp. nov. the characteristics are compared exclusively to the type species *S. latipes* (C. L. Koch, 1844), of *Scheloribates* s. str., and the type species *E. samsinaki* of *Euscheloribates*.

Material examined

Holotype: Adult female. Portugal, sample Po62, 29 April 1971, collected by the author from a salt-marsh scrub site in Lagoon of Faro; preserved in ethanol, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG), Germany. Paratypes: one specimen each from the samples Po59 and Po67, deposited in the collections of the author. Maximum distance between the sampling points about 100 m.

Diagnosis

Characters in common with the type species of *Scheloribates* s. str. and *Euscheloribates*: Lamellar complex of prodorsum with ridgelike lamella and prolamella from lamellar to rostral seta, sublamella as narrow blade. Pteromorphs well developed, immovable; 10 pairs of notogastral setae; 4 pairs of multiporous notogastral sacculs. Epimeral formula 3-1-3-3; anogenital setation 1 *ag*, 2 *an*, 3 *ad*; lyrifissure *iad* closely adjacent and aligned with anal plate.

Character in common with *Euscheloribates*: Claws of legs monodactylous.

Specific characters: Body length about 480 µm, maximal notogaster width about 250 µm (pteromorphs not included). Prodorsal setae *ro*, *le* and *in* long, nearly smooth (rostral seta with very short setulae). Sensillus moderately long, head slender fusiform with long acute tip and with short setulas. Dorsosejugal line convex, protruding the bothridium; pteromorph a distinct convex blade, length less than one third of the notogaster length. Notogastral setas fine and smooth, about 30 µm in length; all sacculs of the octotaxic system multiporous, the pores more or less in line, each. Four pairs of genital setae. Pedotectum II in ventral aspect with small posterior dens.

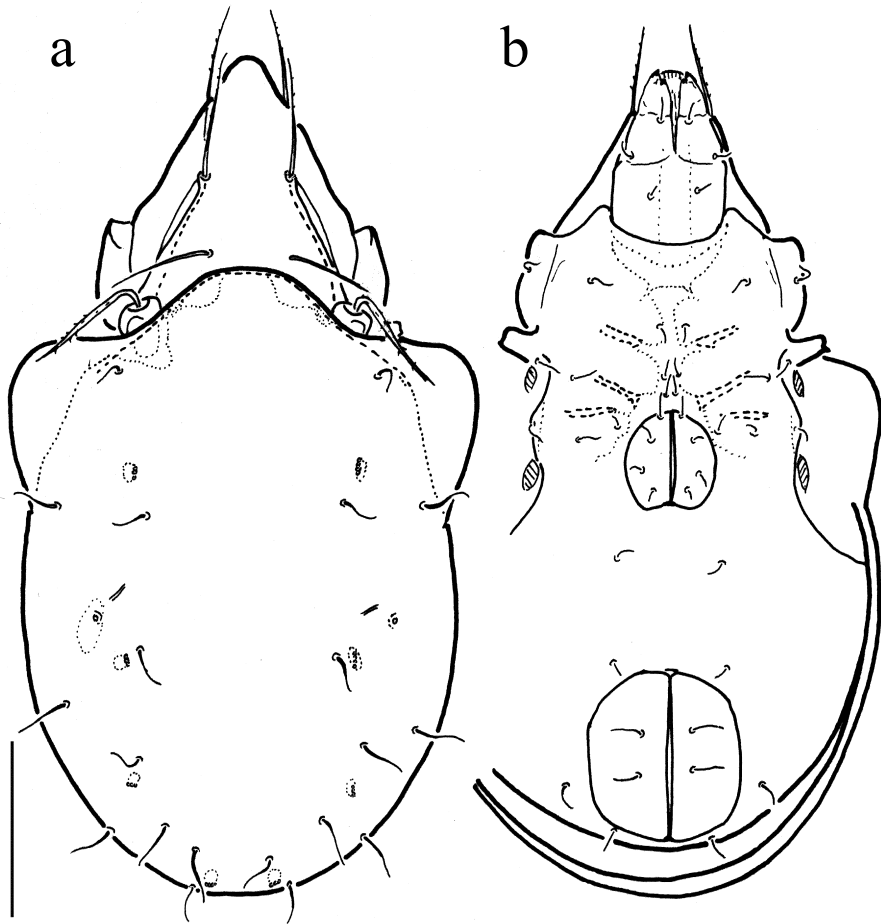


Fig. 4 *Scheloribates (Euscheloribates) algarvensis* sp. nov. (legs removed): a: dorsal aspect; b: ventral aspect. Scale bar 100 μ m.

Description

General characters: Body length 457–505 μ m (mean length 481 μ m, mean width of notogaster 253 μ m; n = 3 females). Body colour yellow-brown, cuticle smooth, cerotegument not obviously developed.

Prodorsum: Rostrum rounded; lamellar complex of *Scheloribates*-type: with lamellar ridge, sublamella and prolamella, the latter from lamellar seta to rostral seta and ending near rostral edge (Fig. 5); lamellar and interlamellar setae long, nearly smooth. Sensillus with slender fusiform head, long tip, shortly barbed; bothridium with dorsal scale. Prodorsum laterally with rounded macula, sublamellar porose area ovoid; exobothridial seta about 50 μ m long.

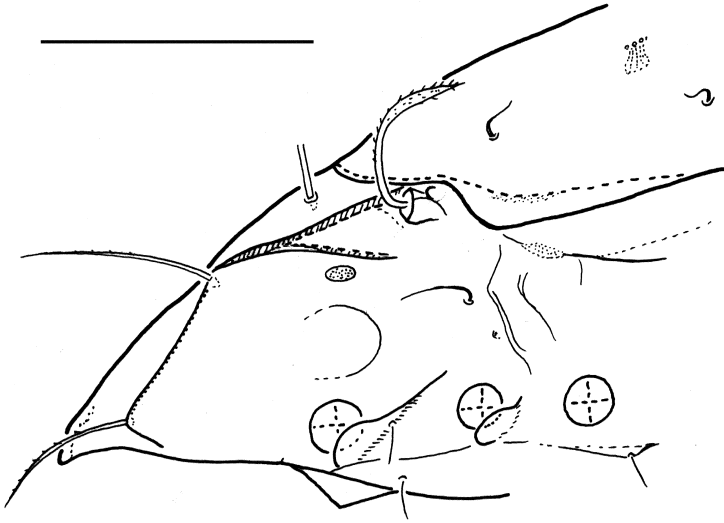


Fig. 5 *Schelorbates (Euschelorbates) algarvensis* sp. nov.: lateral aspect of anterior body. – Scale bar 100 μ m.

Notogaster: Ovoid in shape (pteromorphs not considered), dorsosejugal line convex, protruding between bothridias (Fig. 4a); pteromorph as distinct convex blade, directed laterally and only slightly ventrally, length less than one-third of the notogaster length. 10 pairs of notogastral setae fine and smooth, about 20–30 μ m in length; all saccules of the octotaxic system multiporous, the pores more or less in line, each. Opisthonotal glands and four visible pairs of lyrifissures as typical.

Ventral region: Structures as normal for *Schelorbates* sensu lato. All ventral setae small and smooth; epimeral setal formula 3-1-3-3; 4 pairs of genital setae, 1 pair of aggenital, two pairs of anal setae; three pairs of adanal setae (Fig. 4b). Discidium a slender blade; pedotectum II in ventral aspect with small posterior dens. Cuticle of ventral plate smooth.

Legs: Shapes as usual in Schelorbitidae (cf. Fig. 6). All tarsi with one claw. Setation of legs as follows (famulus included, solenidia not included and given in brackets):

leg I: 1-5-3(+1)-4(+2)-17(+2)

leg II: 1-5-2(+1)-4(+1)-15(+2)

leg III: 2-3-1(+1)-3(+1)-14

leg IV: 1-2-2-3(+1)-12

Distribution and ecology: The species was found in the coastal region of South Portugal. Three samples with one specimen each from the intertidal lower salt marsh zone, in the western (inner) part of the Lagoon of Faro. Obviously, the species is halophilous.

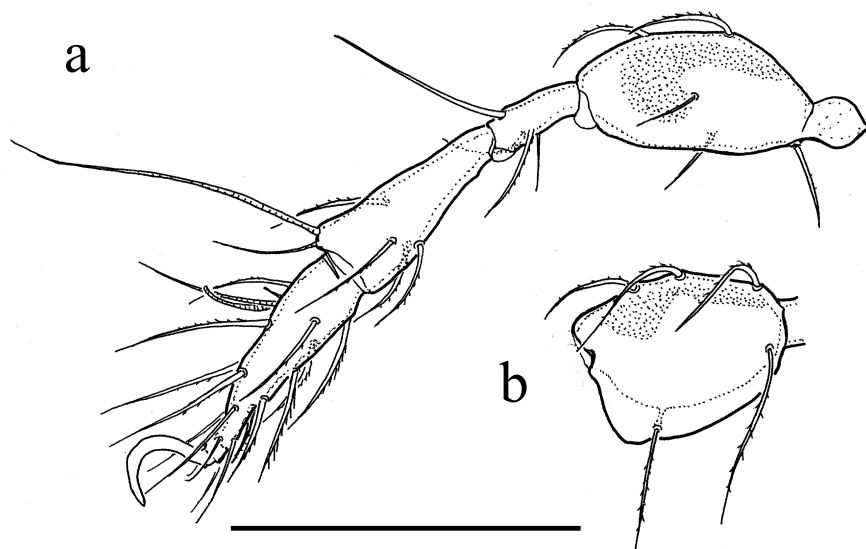


Fig. 6 *Schelorbates (Euscheloribates) algarvensis* sp. nov.: a: left leg I; b: femur of leg II. Scale bar 100 μ m.

Remarks

Up to now there are only two European scheloribatid species known with monodactylous legs: *Euscheloribates samsinaki* Kunst, 1958, from the Czech Republic and *Schelorbates monodactylus* Morell, 1987, from Spain. At the species level, both species are easily distinguished from *Schelorbates (E.) algarvensis* sp. nov.: *Euscheloribates samsinaki* has a smaller body length of 340–365 μ m, three pairs of genital setae, shorter notogastral setae, and a different shape of the pteromorph, along with other details (Kunst 1958). *Schelorbates monodactylus* has a smaller body length of 330–340 μ m [the indication of 330–480 μ m in Morell (1987) is wrong, following Pérez-Iñigo (1993: p. 264)], a different shape of the sensillus without a terminal filum, and shorter notogastral setae.

Worldwide, the family Scheloribatidae s. lat. (in the sense of Grandjean 1954, 1958) includes several genera that collectively have many species. There are four genera with monodactylous legs that could be considered for the new species: *Euscheloribates* Kunst, 1958, with the type species *E. samsinaki* from the Czech Republic; *Monoschelobates* Balogh & Mahunka, 1969, with the type species *M. parvus* Balogh & Mahunka, 1969, from Brazil; *Perscheloribates* Hammer, 1973, with the type species *P. clavatus* Hammer, 1973, from Samoa Islands; *Ischelorbates* Corpuz-Raros, 1980, with the type species *I. quezonensis* Corpuz-Raros, 1980, from the Philippines. Some of the species of these genera, as listed in the world index of Subías (2004; cf. Subías 2008), are poorly described and have questionable generic status; therefore the following comparative discussion deals specifically with the type species of the each genus and its characters, but additionally with *Schelorbates monodactylus*.

Monoschelobates was erected originally as genus of Oribatulidae, positioned by Balogh & Balogh (1984) and by Subías (2004) in the questionable family Hemileiidae Balogh & Balogh, 1984. The type species *M. parvus* has no distinct pteromorphs, similar to *Hemileius initialis* (Berlese, 1908) (following the concept of Weigmann & Miko 1998, *Hemileius initialis* is a scheloribatid species with the same lamellar complex as *Scheloribates* s. str.); the lamellar complex of *M. parvus* is not described, the prolamella may be absent. In consequence, *M. parvus* is a species inquirenda with uncertain familial position. There is no good argument to regard *S. (E.) algarvensis* sp. nov. as a *Monoschelobates* species. Yet, Pérez-Iñigo (1993) reported *Scheloribates monodactylus* from Spain as *Monoschelobates monodactylus* within the family Scheloribatidae, although it differs from *M. parvus* in having well-developed pteromorphs. Probably *Scheloribates monodactylus* is related to *S. (E.) algarvensis* sp. nov.; it has also a lamellar complex of the *Scheloribates*-type, i.e. with well-developed sublamella and prolamella; it seems reasonable to remove *S. monodactylus* from *Monoschelobates*, as was done by Subías (2004), who declared the species as member of *Perscheloribates* s. str. within Scheloribatidae.

Using the determination keys of Balogh & Balogh (1984: p. 275) for Scheloribatinae, *S. (E.) algarvensis* sp. nov. should be an *Ischeloribates* species. But most of the characters used in that publication to characterise families, subfamilies and genera seem to me not well suitable for a phylogeny-based taxonomy [see discussion in Weigmann & Miko 1998, who do not agree with the taxonomical concepts of Balogh & Balogh (1984, 1992)]. *Ischeloribates* was established by Corpuz-Raros (1980) for some Philippine Scheloribatidae 'resembling *Scheloribates*' with the following main character combination: (1) prolamellar ridge present; (2) sensillus long, club spindle-shaped and with apex extended into a thin thread; (3) genital setae 4 pairs, (4) all legs monodactylous (further listed characters in Corpuz-Raros (1980: p. 180) are not genus-specific; presence of a sublamella is not mentioned). Characters (1) and (3) can be observed in all *Scheloribates* s. str. species. A sensillus-like character (2) can be observed also in the Palaearctic *Scheloribates fimbriatus* Thor, 1930, in the Iberian *S. minifimbriatus* Minguez, Subías & Ruiz 1986, and others; this sensillus type is not restricted to *Ischeloribates*, and therefore it is questionable to establish a new genus on the basis of this character. The remaining main character (4), monodactyly, also is not restricted to *Ischeloribates*, as discussed above. Probably, these arguments were regarded by Subías (2004) who synonymised *Ischeloribates* with *Perscheloribates*. I agree with Subías at least in the opinion that *Ischeloribates* is not a well-separated genus.

Perscheloribates was created by Hammer (1973) for the type species *P. clavatus* from Samoa Islands, 'closely related to *Scheloribates*'. Basing on the type species, the genus is characterised by (1) prolamellar ridge absent; (2) sensillus club-shaped; (3) four pairs of genital setae; (4) all legs monodactylous [further listed characters in Hammer (1973: p. 45) not genus-specific; sublamella present]. Subías (2004) listed 40 species for *Perscheloribates* (with 3 subgenera), including e.g. all *Ischeloribates* species and *Scheloribates monodactylus*. Subías presented no new genus definition, but in consequence of the included species, it should be as follows:

- Habitus as *Scheloribates*;
- legs monodactylous;
- four pairs of genital setae;
- prolamella present or absent;
- sensillus club-shaped to fusiform with tip.

For several species in this list of Subías (2004) no lateral illustrations are available, nor a verbal description of the lamellar complex, especially the distinct presence or absence of prolamella and sublamella. Therefore *Perscheloribates* (as also *Ischeloribates*) is a poorly founded taxon with similar species, a provisory genus with some simple and typological characters in common instead of apomorphic characters with phylogenetic relevance.

Reduction of the prolamella (cf. *Scheloribates minifimbriatus*: in Minguez et al. 1986) occurs in some other Scheloribatidae and is apparently not a strong character within *Perscheloribates* sensu Subías. Numerical reduction of the genital setae is quite common within e.g. some Ceratozetidae, Haplozetidae, Oripodidae and Scheloribatidae; it is a general tendency within Higher Oribatida and should not define a genus, alone by itself. As a provisional solution for the genus membership of the new species – pending a phylogenetic analysis of Scheloribatidae – I propose to include the species in *Euscheloribates*, the oldest of the described monodactylous scheloribatid genera. This taxon is closely related to *Scheloribates* s. str. Berlese, 1908, as characterised by Weigmann & Miko (1998: p. 254) and Weigmann (2006). It should be regarded as a subgenus of *Scheloribates*, discussed in the following.

As discussed by Weigmann & Miko (1998), there are characters in some *Scheloribates* species (as in several other Scheloribatidae) that cannot substantiate separated genera, because the characters are very doubtful as apomorphies, as is discussed above: extension of pteromorphs, numbers of notogastral setae between 10 and 14 pairs, reduction of notogastral saccules (or porose areas) from four to three pairs; reduction of genital setation to fewer than four pairs. The same problem regards the number of claws from three (as basically present in adult Scheloribatidae) to one, a character which can be observed with mosaic-like occurrence in several families of Poronotae. The argumentation in relation to a phylogenetic taxonomy is presented in Weigmann & Miko (1998) and will not be repeated here (cf. also the problem of atavistic regressions, discussed in Weigmann 2009a).

In consequence, species groups within *Scheloribates* s. lat., which are differentiated from *Scheloribates* s. str. only by single characters of uncertain phylogenetic value, are declared provisionally as subgenera of *Scheloribates* s. lat., which is characterised mainly by the special construction of the lamellar complex – with lamella, sublamella and normally with prolamella:

Scheloribates (*Scheloribates*) Berlese, 1908: Pteromorphs well developed, ten pairs of notogastral setae, legs with three claws;

Scheloribates (*Hemileius*) Berlese, 1916: Pteromorphs reduced;

Scheloribates (*Topobates*) Grandjean, 1958: 11-14 pairs of notogastral setae;

Scheloribates (*Euscheloribates*) Kunst, 1958 (**new status**): Legs with one claw.

New diagnosis of subgenus *Euscheloribates* Kunst, 1958

Adults. Characteristic morphology of lamellar complex: with lamellar ridge from lamellar seta to upper side of bothridium, distinctly bladelike sublamella running from lamellar seta to a region below bothridium, prolamella expressed as ridge running from lamellar seta to rostral seta. Octotaxic system of notogaster with saccules; 10 pairs of well-developed notogastral setae; 3–4 pairs of genital setae; legs monodactylous. Pteromorphs well-developed in currently known species. Juveniles: not known.

Described species: *Euscheloribates samsinaki* Kunst, 1958; *Euscheloribates monodactylus* Morell, 1987 (comb. nov.); *Scheloribates* (*Euscheloribates*) *algarvensis* sp. nov.

3.3. *Micropirnodus longissimus* gen. nov, sp. nov. (Scheloribatidae s. lat.)

From supralittoral shrubby environment in the estuary region of Ribeiro de Aljezur (Algarve), a new species with elongated and flattened body was collected. It has some similarity with the males of *Pirnodus detectidens* Grandjean, 1956, the genus type species that was redescribed in detail by Travé (1958). Yet, the new species lacks the obvious sexual dimorphism of *P. detectidens*, and there are some very special characters that are incongruent with all known species of *Pirnodus*, including some that also lack sexual dimorphism, such as: *Pirnodus soyeri* Travé, 1969; *Pirnodus andinus* Baranek, 1985; c.f. *Cryptoribatula taishanensis* Jacot, 1934; and *C. euaensis* Hammer, 1973). Subías (2004) listed all these in the family Pirnodidae Grandjean, 1956. *Pirnodus* species and the closely related Oripodidae are generally characterised by notogastral saccules, whereas the new species has notogastral porose areas. This and some other characters represent remarkable similarities to *Parapirnodus*, a genus with some convergences to *Pirnodus* and some *Oripoda* species, and which was transferred by Behan-Pelletier et al. (2002) to the family Scheloribatidae. In Subías (2004), *Parapirnodus* is listed as the nominate genus of a separate family, Parapirnodidae Aoki & Ohkubo, 1974.

Following the phylogenetic arguments of Behan-Pelletier et al. (2002), the new species is probably related to *Parapirnodus*. Nevertheless, it has some special characters not found in currently described *Parapirnodus* species (these include the type species *P. longus* Balogh & Mahunka, 1968; *P. prosopis* Martinez, Fernandez & Monetti, 1996; *P. coniferinus* Behan-Pelletier, Clayton & Humble, 2002; *P. hexaporus* Behan-Pelletier, Clayton & Humble, 2002). Most obvious differences are: lack of carinas of the lamellar complex; special morphology of the anterio-lateral notogaster edge; 14 pairs of notogastral setae; tridactylous legs. These characters justify the proposal of a new taxon, *Micropirnodus* gen. nov. Its systematic position will be discussed below in the remarks section.

Micropirnodus gen. nov.

Diagnosis

Characters in common with *Parapirnodus*. Flat and slender body. No strong sexual dimorphism in body shape. Rostrum more or less short, not fully covering mouthparts in dorsal aspect (in *P. longus* mouthparts are covered). No tutorium present; with rostral, lamellar and interlamellar setae in longitudinal row. Dorsosejugal line interrupted, i.e. the anterior notogastral part fused with the prodorsum. Fewer than four pairs of notogastral porose areas. Genital plates far removed from anal plates; with one pair of genital setae, one pair of aggenital setae, two pairs of anal setae, three pairs of adanal setae.

Special characters of *Micropirnodus* gen. nov. Lamella, prolamella and sublamella absent. Anterior part of notogaster strongly protruded forward to level of interlamellar seta, forming a strong carina dorsomedial to bothridium, which it more or less protects in dorsal view. Notogaster with more than ten pairs of setae. Legs heterotridactylous.

Type species: *Micropirnodus longissimus* sp. nov.

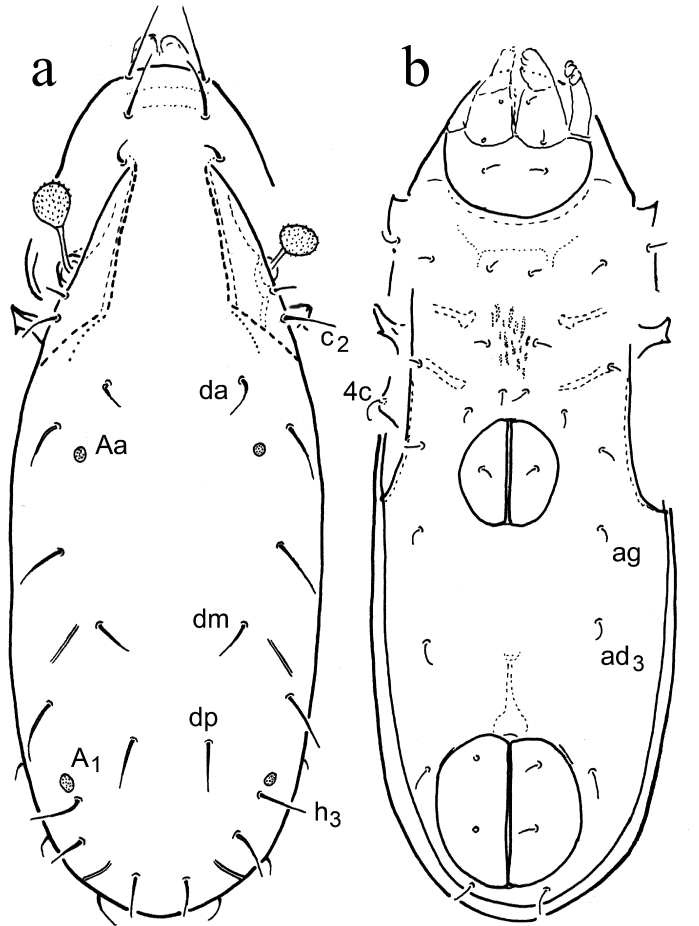


Fig. 7 *Micropirnodus longissimus* sp. nov., female (legs removed): a: dorsal aspect; b: ventral aspect. Abbreviations: *Aa*, *A₁*: notogastral porose areas; ; *c₂*, *da*, *dm*, *dp*, *h₃*: notogastral setae; *4c*: epimeral seta; *ag*: aggenital seta; *ad₃*: adanal seta. Scale bar 100 μ m.

Description of *Micropirnodus longissimus* sp. nov.

Material examined

Holotype: Adult female. Portugal, sample Po144, sampled by the author from the estuary region of Ribeiro de Aljezur (Algarve), 2 November 2008; deposited on a microscopic slide in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG), Germany. Paratypes: One adult male, sample Po144, on a microscopic slide deposited at SMNG. Five adult males, from samples Po144 and 145; all from the same locality, deposited in the collections of the author.

Diagnosis

Body slender and flat, notogaster elongated; body length (mouthparts not included) of female 233 μm , males about 210 μm . Sensillus broadly claviform, slightly flattened, with fine granulation. Rostral seta about 20–30 μm , lamellar and interlamellar setae shorter. Part of notogaster anterior of *c*-seta prolonged forwards to about half the distance of bothridium to anterior rostral edge; 14 pairs of smooth notogastral setae short to moderately long (up to 18 μm); 2 pairs of small round porose areas in anterior (*Aa*) and posterior position (*A₁* ?); one pair of short genital setae.

Description

General characters: Body shape elongated ovoid, ratio of notogaster length to width in female 2.4, in males about 2.0; total length (incl. mouthparts): female type specimen 233 μm ; males 200–225 μm (mean 211 μm , $n = 6$); maximal notogaster width: female 87 μm , males about 90 μm ; dorso-ventral thickness at epimeral region about 50 μm . Body colour pale yellow-brown, cuticle smooth, cerotegument not obviously developed.

Prodorsum: Rostrum broadly rounded; rostral seta about 20–30 μm long on anterior edge of prodorsum, lamellar seta about 15 μm long, inserted in the middle between *ro-in*; interlamellar seta shorter, aside the anterio-lateral notogaster edge ending. Sensillus broadly claviform, slightly flattened, with fine granulation. Pedotectum I well developed. Sublamellar porose area *A₁* not observed. (Figs 7a, 8a).

Notogaster: Lateral notogaster edge forming a strong lamella-like carina from behind the bothridial region to the anterior point, partly protecting the bothridium; without humeral projection (Figs 7a, 8a). 14 pairs of fine notogastral setae, at most about 15 μm long; setae *c₁* and *c₂* behind the bothridial region near the lateral notogastral edge. Two pairs of small round notogastral porose areas, *Aa* behind seta *da*, second area (*A₁* ?) near seta *h₃*. Four pairs of lyrifissures found: small *ia* near *c*-setae (lateral view, Fig. 8c), *im* and *ip* large; *ips* visible in lateral view near seta *p₃*; *ih* absent. Opisthonotal gland opening present, but difficult to discern.

Ventral region: Ventral setation small and smooth. Epimeral formula 3-1-2-3; epimeres medially with longitudinal pattern of small ridges, one genital seta in the middle of genital plate; aggenital seta lateral from posterior edge of genital orifice; seta *ad₃* in the middle region of ventral plate. Lyrifissure *iad* closely adjacent and aligned with anal plate. (Figs 7b, 8b).

Gnathosoma: Infracapitulum, chelicera and palps normal for Scheloribatidae, as far as observable (cf. Behan-Pelletier et al. 2002). Chelicera with 2 setae, cheliceral digits toothed; palp tarsus with double-horn.

Legs: Shapes similar to those of *Parapirnodus coniferinus* (see Behan-Pelletier et al. 2002). Tarsi in both sexes longish, not truncated; tibial solenidions of legs III and IV without terminal expansion. All legs hetero tridactylous. Setation not studied in detail.

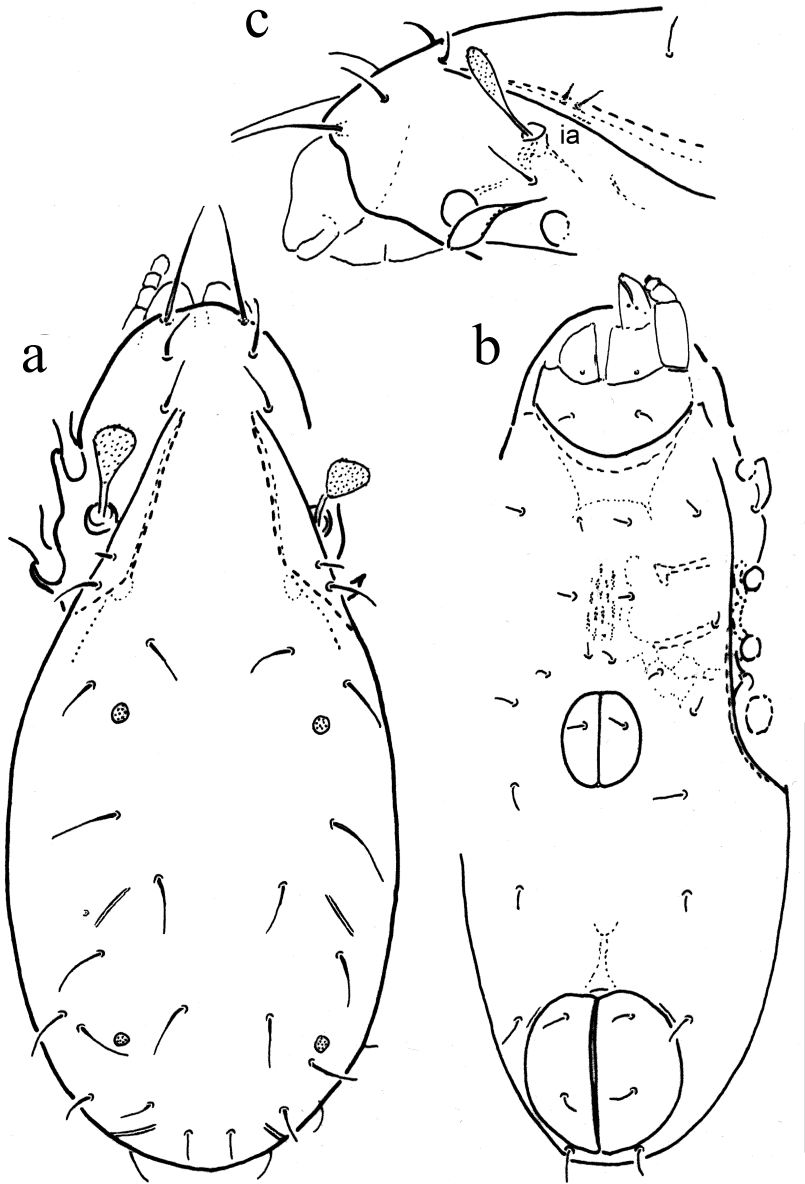


Fig. 8 *Micropirnodus longissimus* sp. nov., male (legs removed): a: dorsal aspect; b: ventral aspect; c: lateral aspect of anterior body. Abbreviations: *ia*: anterior notogastral lyrifissure, covered by notogastral border. Scale bar 100 μ m.

Distribution and ecology: The species was found in the coastal region of South Portugal within the Parque Natural da Costa Vicentina at Praia de Amoreira about one km from the mouth of Ribeira de Aljezur. The site is adjacent to a coastal dune complex on a rocky hill with semi-natural vegetation of the community *Oleo-Ceratonion* Braun-Blanquet 1936 (Rivas-Martinez 1987), which is characterised as a community on rocky substrate near the shore, exposed to strong winds and occasional salt-water spray. The samples were taken from litter under low bushes of *Ulex* and *Pistacia lentiscus* and from sparsely covered soil area between bushes.

Taxonomical remarks on family and genus position

At first view, *Micropirnodus longissimus* sp. nov. looks similar to the male of *Pirnodus detectidens*: flattened body, notogastral-prodorsal fusion, truncated rostrum, no lamella, bothridial region covered by lateral notogaster edge in dorsal view, one pair of genital setae, adanal seta ad_3 far in front of anal plates. But within the genus *Pirnodus* the first two of these characters are unique to males. All *Pirnodus* females have more rounded bodies, as do males of some species other than *P. detectidens*, e.g. *Pirnodus soyeri* and *Pirnodus andinus* (cf. Travé 1969, Baranek 1985). Within the oripodid nominate genus *Oripoda* Banks, 1904, most species have normal rounded body shape; the type species *O. elongata* Banks & Pergrande, 1904, re-described by Woolley (1966), is one of the exceptions with an elongated, slender and flat body (other exceptions are published in literature but will not be discussed here). Such body shapes can be found as convergences within other families than Oripodidae s. lat., e.g. in Scheloribatidae s. lat. and Haplozetidae, each regarded as specialised ‘life-form types’ within basically ‘normal-shaped’ relatives. In consequence, the *Parapirnodus* species with elongated body in both sexes may also represent convergence. This hypothesis is supported by the fact that family-diagnostic characters are maintained in each of the various flattened species in question. In oribatid mites with a flattened body there is a tendency to fuse the prodorsum with the notogaster (in contrast to non-flattened relatives), which I consider a constraint related to structural stabilisation of the dorsum of the body. In this sense both characters (flattened body and prodorsal-notogastral fusion) are occasionally correlated and then linked with each other as morphological adaptation.

Behan-Pelletier et al. (2002) discussed the assumed convergences between oripodoid genera and *Parapirnodus*, including a reduced genital setation, short prodorsum, absent or weakly-developed pedotecta, and reduction of sublamella. The presence of a sublamella in at least on species of *Parapirnodus* (*P. prosopis*; see Martinez et al. 1996) confirms its relationship to the scheloribatids as well as the hypothesis of convergent sublamellar reduction. Obviously, the presence of a sublamella is a basic character of *Parapirnodus*; loss of sublamella is no apomorphy of *Parapirnodus* in toto but is evolved within the genus.

The main differential characters of *Parapirnodus* in contrast to Oripodidae s. lat. (including Pirnodidae) are presented by Behan-Pelletier et al. (2002): (a) chelicera with two setae (one seta in Oripodidae); (b) adult tarsal segments longish (truncated anteriorly in Oripodidae); (c) octotaxic system as 2–3 pairs of porose areas (sacculae in Oripodidae, without known exception); (d) legs monodactylous (tridactylous in Oripodidae). *Micropirnodus longissimus* sp. nov. has the characters (a)–(c) in common. Without doubt, it is a scheloribatid mite most closely related to *Parapirnodus*. In both genera there is no conspicuous sexual dimorphism, as can be observed in *Pirnodus*: *P. detectidens* males differ strongly in body shape from

females; in *P. soyeri* the body shape of both sexes is similar, but the genital aperture of males is in contact with the anal aperture (in *Pirnodus andinus* Baranek, 1985 no males are described). Among *Parapirnodus*, weak sexual dimorphism is known only in *P. coniferinus*, regarding size and position of notogastral porose areas and gradual differences in lamella and insertion of lamellar seta. This is no justification for a close phylogenetic relationship to *Pirnodus* or other Oripodidae, as was postulated by Aoki & Ohkubo (1974), who proposed Parapirnodinae as a subfamily of Oripodidae.

Tab. 1 Diagnostic characters of *Parapirnodus* and *Micropirnodus* species
(measures in μm ; abbreviations: L: length, W: width; lam: lamella).

	<i>Parapirnodus longus</i>	<i>Parapirnodus prosopis</i>	<i>Parapirnodus coniferinus</i>	<i>Parapirnodus hexaporus</i>	<i>Micropirnodus longissimus</i> n. sp.
body length range	292–347	249–341	260–312	296–340	200–233
♀ mean L (index L:W)	♀+♂: ~ 320	♀+♂: ~ 294	298 (1.8)	338 (2.2)	233 (2.7)
♂ mean L (index L:W)	(2.2)	(2.1)	271 (1.9)	312 (2.0)	211 (2.2)
notogaster index L:W	1.9	1.65	1.5	1.6	♀ 2.4; ♂ 2.0
rostrum	not truncate	truncate	truncate, with medial projection	truncate, with medial projection	truncate
lamella	well-developed	well-developed	♀: weak to absent ♂: well- to weak-dev.	well-developed	absent
prolamella	?	well-developed	well- to weak-dev.	weak-dev.	absent
sublamella	?	well-developed	absent	absent	absent
latero-anterior edge of notogaster	long carina not fused with lam; weak humeral blade	long carina fused with lam; distinct humeral blade	small carina not fused with lam; no humeral blade	small carina not fused with lam; ± humeral blade	strong carina; no humeral blade
pairs of notog. setae	9 ?	10	10	10	14
pairs of porose areas	3 *	2 **	2	3	2
genital seta position	anterior	anterior	anterior	anterior	median
carina circumpedalis	?	?	absent	± absent	strongly developed
claws on legs	1	1	1	1	3

* after Balogh & Mahunka (1968): ‘sacculi, resembling areae porosae’;
after Behan-Pelletier et al. (2002): true areae p. (restudied by Norton)

** after Martinez et al. (1996): ‘sacculi... semblable à une aire poreuse’;
after drawing probably areae porosae

Comparative remarks on *Parapirnodus* and *Micropirnodus*

A close systematic relationship of the new species to *Parapirnodus* is probable. But there are some specific characters of *Micropirnodus longissimus* sp. nov. which are presented comparatively in Tab. 1. As alternative characters of *Micropirnodus* gen. nov. in contrast to those of *Parapirnodus* Tab. 1 lists the following: (1) lamellar complex absent; (2) latero-anterior edge of notogaster forming a strong lamella-like carina; (3) 14 pairs of notogastral setae; (4) strongly developed circumpedal carina; (5) legs heterotridactylous. These characters serve as provisional diagnosis for the subgenus (provisional because of monotypy).

The diagnostic characters of the homologous structures in *Parapirnodus* s. str. are: (1') lamella present, pro- and sublamella present or weakly developed or reduced; (2') latero-anterior edge of notogaster forming no strong carina; (3') 10 pairs of notogastral setae; (4') reduced circumpedal carina; (5') legs monodactylous.

Common characters of both genera are listed above in the diagnosis of *Micropirnodus* gen. nov., which indicate a phylogenetic connection with *Parapirnodus* as sister taxon.

Within the genus-group *Parapirnodus-Micropirnodus*, a regressive trend in the lamellar complex is observable (Tab. 1): (a) lamella well-developed with pro- and sublamella in *P. prosopis*; (b) weakly developed and partly reduced in *P. coniferus* and *hexaporus*; (c) all parts absent in *Micropirnodus longissimus* sp. nov. The latter species is the smallest, with the mostly elongated body, especially in the female. The reduced lamellar complex with its structurally stabilising function (in species with 'normal' body shape) may be substituted by the described lateral lamella-like carina of the latero-anterior notogaster edge, which is anteriorly protruded. The strongly developed circumpedal carina may serve as a ventral stabiliser in the same context, i.e., both as assumed adaptative characters of the elongated and flat body shape.

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