SOIL ORGANISMS Volume 81 (1) 2009 pp. 85–105

ISSN: 1864 - 6417

Oribatid mites (Acari: Oribatida) from the coastal region of Portugal. II. The genera *Zachvatkinibates* and *Punctoribates* (Mycobatidae).

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Abstract

Two known species of the genus *Zachvatkinibates* were found in marine salt-marshes of Portugal and are redescribed in this paper. *Zachvatkinibates quadrivertex* (Halbert, 1920) is distributed in the lower tidal level of salt marshes from northern to southern Portugal. Up to now only known from the type locality of the sea shore of Croatia, *Z. eoeryi* (Mahunka, 1972) was found in the Lagoon of Faro, inhabiting predominantly marine littoral debris. A new halophilous species, *Punctoribates aveiroensis* sp. nov. is described from the marine salt meadows in the upper tidal level in the Lagoon of Aveiro. These three mycobatid species differ in their ecological preferences within the marine salt marshes, nevertheless *Z. quadrivertex* is syntopic with *Z. eoeryi* in the Lagoon of Faro and with *P. aveiroensis* sp. nov. in the Lagoon of Aveiro.

Keywords: taxonomy, systematics, Mycobatidae, salt-marsh fauna

1. Introduction

The Northern European salt-marsh fauna of Oribatida is comparatively well known by extensive ecological studies of Luxton (1964, 1967a, 1967b) in South England, Weigmann (1973) in North Germany and other literature. The only species of the family Mycobatidae with preference for littoral salt marshes in North-West Europe is *Punctoribates quadrivertex* (Halbert, 1920), recently transferred to *Zachvatkinibates*. Yet, oribatid mites of salt marshes of the Iberian coasts are more or less unknown. This taxonomical contribution deals with two species of *Zachvatkinibates* Shaldybina, 1973 and one species of *Punctoribates* Berlese, 1908, which were found in littoral habitats from coasts of Portugal.

The genus *Zachvatkinibates* Shaldybina, 1973 includes about 16 species. Critical revisions and descriptions of some new species by Behan-Pelletier (1988) and Behan-Pelletier & Eamer (2005), mostly from the north-eastern Palaearctic and Nearctic regions, led to a modern definition of the genus and presented a comparative overview about the main genera of the family Mycobatidae (cf. Behan-Pelletier & Eamer 2008). In these revisions, the widespread species *Zachvatkinibates quadrivertex* (Halbert, 1920), transferred from *Punctoribates* by Weigmann (2006) with marine littoral occurrence on European coasts was not included.

For the Iberian Peninsula, only *Zachvatkinibates perlongus* (Balogh, 1959) was reported (Subías & Minguez 2001). Pérez-Iñigo (1993) listed this species as *Punctoribates perlongus* and redescribed it as type species of *Schweizerzetes* Mahunka, 2001. This species differs well from the other *Zachvatkinibates* species (rostral indention, monodactylous legs and other characters). The species lives in non-littoral habitats in Hungary, the Swiss Alps and north-western Spain, as cited in Pérez-Iñigo (1993) and Mahunka (2001), and is not discussed further herein. Recently, Subías (2008) regarded *Schweizerzetes* as a junior synonym of *Zachvatkinibates*.

During my ecological studies of oribatid mites in salt-marshes of the Portuguese coasts, *Zachvatkinibates quadrivertex* was found in several localities. Most surprisingly, another species was found on the shore of the Lagoon of Faro, living especially in the marine debris of rotting *Zostera*. After the study of a paratype specimen, deposited in the Museum of Natural History Geneva, the latter species was determined as *Zachvatkinibates eoeryi* (Mahunka, 1972). This species was synonymised erroneously with *Z. quadrivertex* (in Weigmann 2006). Both species are redescribed below.

Punctoribates Berlese, 1908 is a species-rich genus with some subgenera (according to Subías 2008), and most known species are distributed in the Holarctic region. Records of the species of *Punctoribates* s. str. in the Iberian Peninsula are *P. punctum* (C. L. Koch, 1839) and *P. sellnicki* Willmann, 1928 (Pérez-Iñigo 1993, Subías & Gil-Martin 1997). Iberian species of the subgenus *Minguezetes* Subías, Kawash & Ruiz, 1990, are *P. conjunctus* Subías, Kawash & Ruiz, 1990, and *P. hexagonus* Berlese, 1908; the latter with the junior synonym *P. hygrophilus* Miheleie, 1957 (cf. Subías 2008; as species dubia in Pérez-Iñigo 1993, p. 155). Weigmann (2006) regarded *Minguezetes* as a junior synonym of *Punctoribates*, which was confirmed and substantiated by Behan-Pelletier & Eamer (2008).

In the salt marshes of the Lagoon of Aveiro, a new species of *Punctoribates* was found, which is described in this contribution.

2. Materials and methods

The samples from Portugal were collected by the author in April and May 1971 from Rio Minho at the northern border to Spain, from the estuary of Rio Cavado, from the Lagoon of Aveiro and from the Lagoon of Faro in the south of Portugal.

Po 19–24: Samples in salt-marsh meadow between Caminha and Seixas (41°53’N, 8°50’E) on the shore of Rio Minho, 15 April 1971. From lower level with *Puccinellia* grass up to upper salt meadow with *Festuca* and *Armeria maritima*.

Po 13–16: Samples in salt-marsh meadow near Fão (41°30.40’N, 8°46’E) on the estuary shore of Rio Cavado, 14 April 1971. Lower level with *Puccinellia* grass, median level with *Festuca*, *Armeria maritima* and *Plantago coronopus.*

Po 35–51: Samples in the Lagoon of Aveiro, 21 April 1971, in the northern part from Quintas de Norte to Torreira (40°46.30’N, 8°41.35’E), in the southern part near the opening to the Atlantic at Costa Nova (40°37.30’N, 8°44.45’E). Salt-marsh meadows, in the north of the lagoon with brackish water, in the south with full saline water.

Po 58–83: Samples in the Lagoon of Faro (‘Ria Formosa’), western part (37°01’N, 7°59.30’E). salt marshes with halophilous scrubs, dominated by perennial vegetation of the Chenopodiaceae (*Sarcocornia*, *Arthrocnemum*, *Atriplex, Suaeda*). 29 April–1 May 1971.

The samples were taken semi-quantitatively with a special shovel, about 250 cm², 1–2 cm depth. 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 on cavity slides.

3. *Zachvatkinibates* Shaldybina, 1973

Differential diagnosis

According to Behan-Pelletier and Eamer (2005) the adults of this genus are unique among the Mycobatidae in having the following combination of character states: rounded, convex medial process on anterior tectum of notogaster; pair of thickened bands on notogaster bordering medial process; posterior notogastral tectum incomplete medially, indicated by a wide emargination or a narrow slit bordered by overlapping tectal lobes; subcapitulum without mental tectum; lenticulus absent; octotaxic system expressed as porose areas, sexually dimorphic or not. General diagnostic characters of Mycobatidae (Grandjean 1954, Behan-Pelletier & Eamer 2008) are not repeated in the following descriptions.

Zachvatkinibates quadrivertex (Halbert, 1920)

Oribata quadrivertex Halbert, 1920: Proc. r. Ir. Acad. 35B: 131
Punctoribates quadrivertex: Willmann (1937)
Zachvatkinibates quadrivertex: Weigmann (2006)

Material examined

Portugal. From salt-marsh meadows in the estuary of Rio Cavado (near Faro), samples Po 13–16; 5 from 93 collected specimens. – From salt-marsh meadows in the estuary of Rio Minho (near Caminha), samples Po 19–24; 5 from 19 collected specimens. – From salt-marsh meadows in Lagoon of Aveiro, samples Po 35–51; 20 from 212 collected specimens. – From salt-marsh scrub site in Lagoon of Faro, samples Po58–83; 15 from 46 collected specimens.

Germany. From salt-marsh meadows of Isle of Sylt (near List): 20 from 51 collected specimens; 7 July 1968.

Diagnosis: Body length 415–500 μm. Rostrum with small dens laterally, slightly convex or undulating medially. Cusp of lamella narrow, about 18 μm long; distance between cusps (translamellar length) about 30 μm. Sensillus short claviform, flattened dorsoventrally. Tutorium with broadly rounded to triangular free tip, with two to six small dens. Pedotectum I distally very broad, with concave dorsal margin. Octotaxic system with slight sexual dimorphism: *Aa* enlarged with irregular longish shape in males, oval in females. Postanal porose area narrow transversal ribbon.

Redescription

General characters: Body length 415–500 µm; females 450–500 µm, mean length 472 µm (n = 10); males 415–480 µm, mean length 445 µm (n = 8). Body colour brown, cerotegument not obviously developed, notogastral cuticular surface more or less smooth in light microscopical aspect, with indistinct paving-stone pattern in SEM picture (see Fig. 4d).

Prodorsum: Rostrum broad, flattened, with small dens laterally, slightly convex or undulating medially (Figs 1, 4a). Prodorsum laterad and anteriad of lamellae with lateral slopes, upper part below lamella looking like ridges (Fig. 4a). Rostral seta curved, strongly barbed, inserted at base of tutorium, extending near tip of rostrum. Cusp of lamella narrow, about 18 µm long; distance between cusps (translamellar length) about 30 µm; translamella well developed, about 8 mm wide (Fig. 1). Lamellar seta long (65–80 µm), barbed, acuminate, extending beyond tip of rostrum. Interlamellar seta *in* strong, barbed, acuminate, about 100 µm long, inserted under anterior notogastral tectum. Seta *ex* about 8 µm length, inserted on small tubercle. Sensillus short claviform, flattened dorsoventrally (i. e. broader in dorsal than in lateral aspect; confer Figs 1, 2, 4c), head slightly spiculated; bothridium covered by anterior edge and tectum of notogaster. Between alveoli of setae *in* present small transversal ridge. Tutorium broad, variable with broadly rounded to triangular free tip, with two to six small dens (Figs 2, 4b). Genal tooth broad, acute. Pedotectum I distally very broad, with concave dorsal margin (Fig. 2).

Notogaster: Typical shape of notogaster, anterior tectum convex; anterior edge of notogaster with thin ridge. Pteromorphs with line of desclerotisation. Ten pairs of fine notogastral setae 15–25 µm long. Octotaxic system with slight sexual dimorphism: Four pairs of areae porosae oval in females, among them *A1* largest (Fig. 1); in males area porosa *Aa* enlarged with irregular longish shape, *A2* and *A3* longish oval (Figs. 3, 4d). Posterior notogastral tectum with overlapping lobes (Fig. 3c).

Gnathosoma: Subcapitulum diarthric, as typical; no specific characters observed.

Ventral region: Structures as normal for the genus (cf. Fig. 7). Discidium with acute custodium. All ventral setae small and smooth, anal and adanal setae moderately longer; Postanal porose area (*A.p.a.* in Fig. 3c) a narrow transversal ribbon in both sexes (visible in caudal view).

Legs: All legs heterotridactylous; femora I and II with 4 setae, genua I and II with 3 setae.

Distribution and ecology: The species occurs in the Atlantic coastal regions of Europe from Denmark to South Portugal: Ireland (Halbert 1920); South England (Luxton 1967a, 1967b); Germany (Willmann 1937, 1952, Strenzke 1952, Knülle 1957, Weigmann 1973, Koehler et al. 2008); Denmark (Weigmann 1973, Polderman 1974b); The Netherlands (Polderman 1974a); Portugal (several records from the North to the South; this work). Published records of this species from Alaska (cit. in Marshall et al. 1987) were misidentifications (Behan-Pelletier pers. comm.), and represented *Z. maritimus* Shaldybina (Behan-Pelletier 1988). Published records from Canada (cit. in Marshall et al. 1987) may also represent this species, but specimens are not available in the Canadian National Collection to corroborate this. *Zachvatkinibates quadrivertex* was not referred in Behan-Pelletier & Eamer (2005).

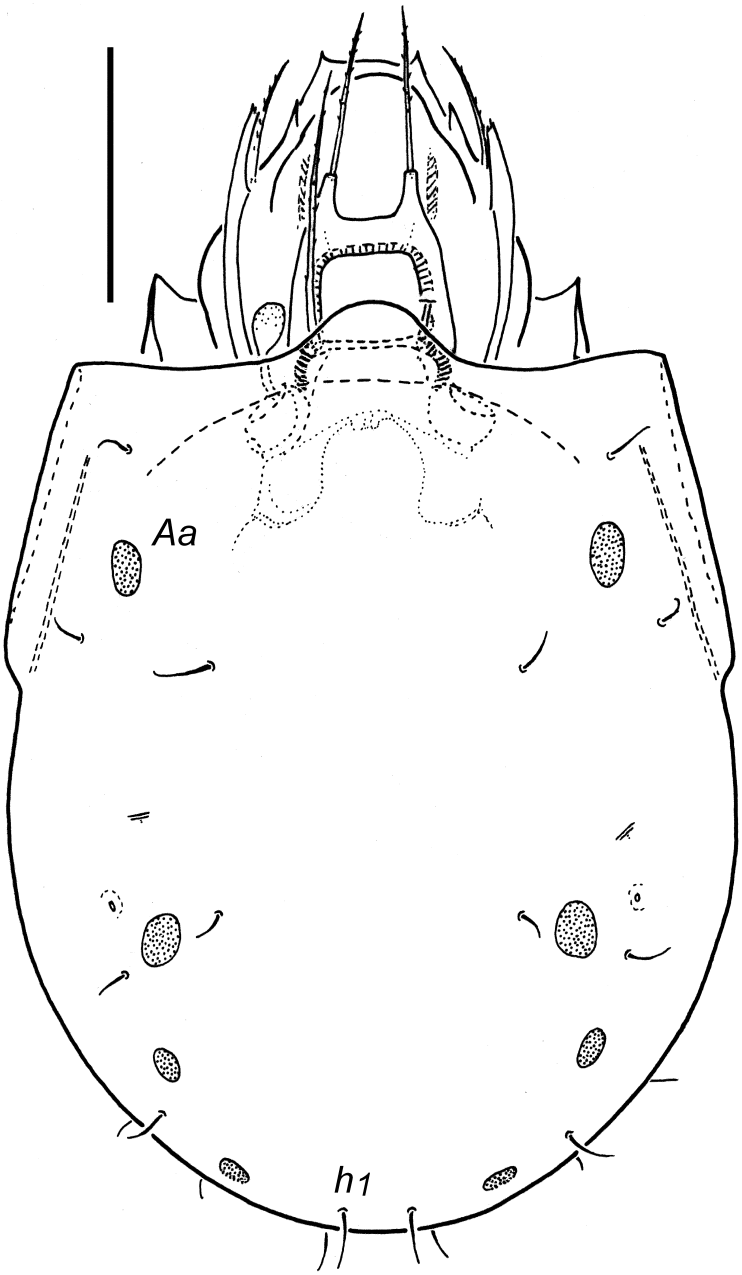

Fig. 1 *Zachvatkinibates quadrivertex*: dorsal aspect of a female. Abbreviations: *Aa*: Area porosa adalaris; h_1: notogastral seta. Scale bar 100 μm.

The species is stenotopically specialised on marine salt marshes of the lower terrestrial vegetation zone. The preferred topographic level is the semiterrestrial eulittoral zone with regular tidal inundations by marine salt water of the Atlantic and North Sea; records in Weigmann (1973) indicate about 220 inundations per year at a site of the *Puccinellia-maritima*-zone in North Germany where the species has its population optimum. Higher topographic levels in the salt marsh are less frequented. In localities on the Baltic Sea shore of Germany, *Z. quadrivertex* prefers a similar vegetation zone in the lower salt-marsh, although with irregular inundation and a lower salt content in the soil. The hydrographic situation in the Aveiro lagoon may be similar to that in the Baltic Sea, because the tidal activities are reduced at greater distance from the lagoon opening to the Atlantic.

In the Faro lagoon, the vegetation aspect differs from that of the northern Portuguese and northern European sites. In the moderately warm climate of South Portugal the salt marshes are classified as 'Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)', dominated by perennial vegetation of the Chenopodiaceae (*Sarcocornia*, *Arthrocnemum*, *Atriplex, Suaeda*), The studied salt marshes in the north of Portugal are classified as 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', dominated by rush and grass species (*Juncus*, *Puccinellia*, *Festuca*) (European Commission 2003). Obviously, there is no difference in the ecological preference of the lower salt-marsh zone of the studied Atlantic regions from Southern Portugal to Northern Germany by *Z. quadrivertex* despite the differences of the vegetation type as halophilous scrubs in Southern Portugal and as grassy salt meadows from Northern Portugal up to Northern Germany.

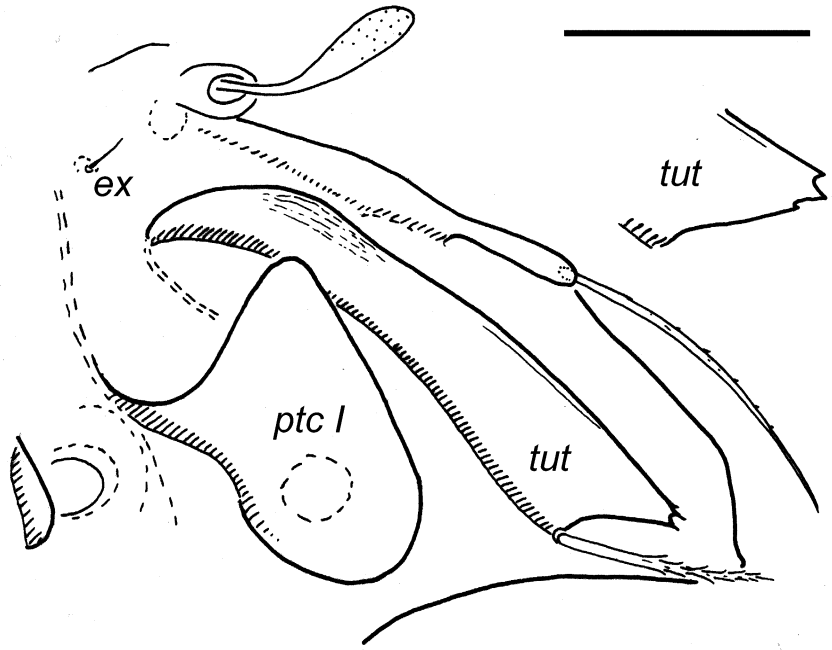

Fig. 2 *Zachvatkinibates quadrivertex*: lateral aspect of prodorsum. Abbreviations: *ex*: exobothridial seta; *ptc I*: pedotectum I; *tut*: tutorium. Scale bar 50 µm.

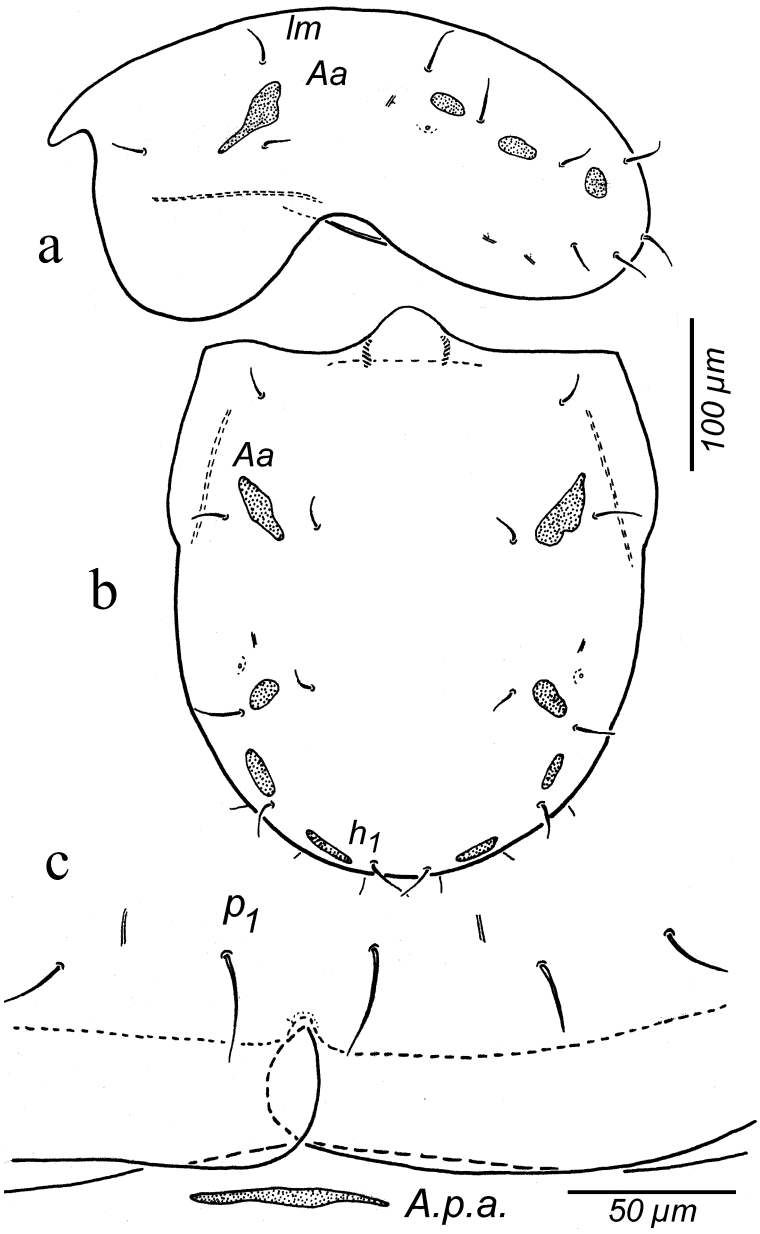

Fig. 3 *Zachvatkinibates quadrivertex*: a: lateral aspect of a male notogaster; b: dorsal aspect of a male notogaster; c: caudal aspect, devided posterior notogastral tectum with overlapping lobes and postanal area porosa. Abbreviations: *Aa*: Area porosa adalaris; *A.p.a.*: Area porosa postanalis; *lm, p_1*: notogastral setae.

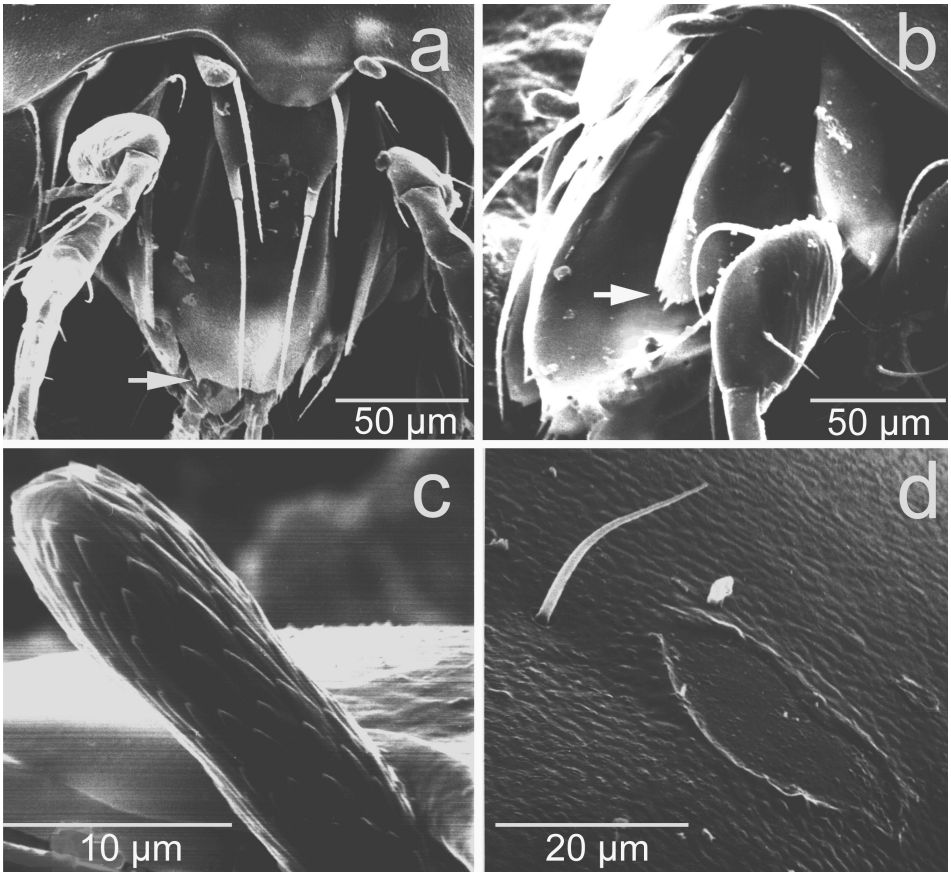

Fig. 4 *Zachvatkinibates quadrivertex,* SEM pictures: a: dorsal aspect of prodorsum and anterior tectum of notogaster (arrow – rostral dens); b: lateral aspect of prodorsum (arrow – dens of tutorial cuspis); c: lateral aspect of sensillus; d: left area porosa *Aa* on a male notogaster.

Remarks

Zachvatkinibates quadrivertex is the first described species of the genus, described as *Oribata quadrivertex* by Halbert (1920) from the Irish sea shore. Since Willmann (1937), it has been included in the genus *Punctoribates*, but after morphological studies of material from the German sea shore (Weigmann 2006), the species was transferred to *Zachvatkinibates*. The genus includes about 16 species, which may be split into two species groups: The first group has a posterior notogastral tectum with overlapping lobes in the middle (most species, also *Z. quadrivertex*); the second group has an incomplete posterior notogastral tectum with a gap in the middle (up to now only with *Z. nortoni* Behan-Pelletier & Eamer, 2005); *Z. interlamellatus* Bayartogtokh & Aoki, 1998 represents an intermediate status, with lobes at the posterior notogastral tectum which do not overlap.

Sexual dimorphism in the octotaxic system can be observed in several *Zachvatkinibates* species (as far as described in detail): *Z. maritimus* Shaldybina, 1973 (Behan-Pelletier 1988); *Z. nortoni*; *Z. schatzi* Behan-Pelletier & Eamer, 2005; *Z. shaldybinae* Behan-Pelletier & Eamer, 2005, and *Z. quadrivertex*. All sexual dimorphic species have the following character combination in common: (1) posterior notogastral tectum with overlapping lobes; (2) sensillus short, claviform; (3) pedotectum I distally very broad, with concave dorsal margin. The shape of widened porose area *Aa* in the males is unique in *quadrivertex* and less extensive than in the other species showing dimorphism. In *Z. schatzi* the males differ strongly from all other species by a posterio-dorsal notogastral swelling. *Zachvatkinibates quadrivertex* differs additionally from *Z. nortoni* and *Z. shaldybinae* by smaller body length, from the latter species by shorter lamellar cusps, from *Z. maritimus* by the narrow lamellar cusps.

Zachvatkinibates eoeryi (Mahunka, 1972)

Punctoribates eoeryi Mahunka, 1972: Ann. hist.-nat. Mus. Hung. 64: 355

Material examined

Croatia. One paratype specimen from the collections of the Museum d'Histoire Naturelle, Genève. Sampled by M. Eöry, 25 August 1971, near Split at the sea shore in algal debris.

Portugal. From salt-marsh scrub site in Lagoon of Faro, in rotting marine debris, mostly from *Zostera*, sample Po 64; 20 from 543 collected specimens. Ten specimens in ethanol, deposited in the collections of the Museum d'Histoire Naturelle, Genève; the other specimens in the collections of the author.

Diagnosis: Body length 395–465 µm. Rostrum with small dens laterally, convex and undulating medially. Cusp of lamella narrow, about 35 µm long; distance between cusps (translamellar length) about 30 µm. Sensillus fusiform, head granulated, slightly flattened dorso-ventrally, distally rounded or acute. Tutorium with broadly rounded cuspis, with four to six small dens. Pedotectum I broad, with concave dorsal margin. Octotaxic system with no sexual dimorphism, areae porosae rounded. Instead of an area porosa a postanal sacculus present, shape funnel-like or sacculus with large orifice.

Redescription

General characters: Body length 395–465 µm; females 430–465 µm, mean length 442 µm (n = 8); males 395–435 µm, mean length 418 µm (n = 8). Body colour brown, cerotegument not obviously developed.

Prodorsum: Rostrum broad, flattened, with small dens laterally, convex and undulating medially (Figs 5, 7). Rostral seta curved, barbed, inserted at base of tutorium, not extending to tip of rostrum. Cusp of lamella narrow, about 35 µm long; distance between cusps (translamellar length) about 30 µm; translamella well developed, about 8 µm wide (Fig. 5). Lamellar seta moderately long (about 50 µm), barbed, acuminate, extending to tip of rostrum.

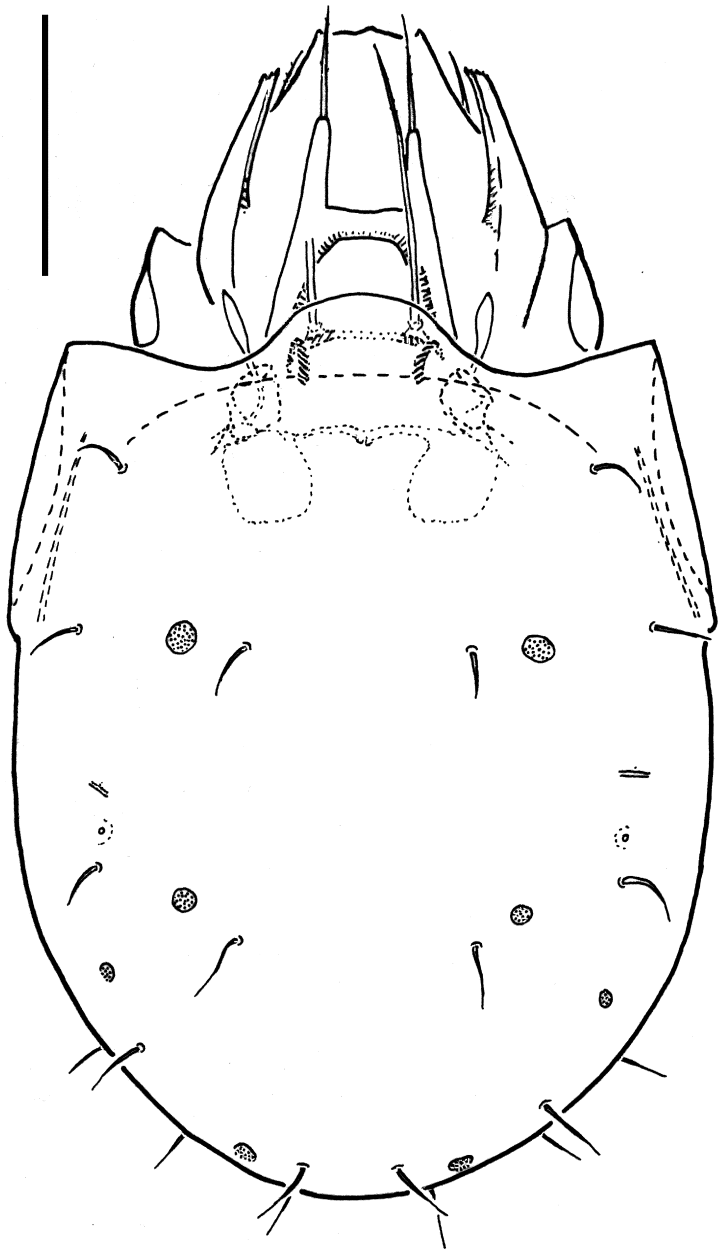

Fig. 5 *Zachvatkinibates eoeryi*: dorsal aspect of a female. Scale bar 100 µm.

Interlamellar seta *in* strong, barbed, acuminate, about 90 µm long, inserted under anterior notogastral tectum. Seta *ex* about 25 µm length. Sensillus fusiform, slightly flattened dorsoventrally, head granulated, distally rounded or acute; bothridium covered by anterior edge and tectum of notogaster. Between setae *in* with small transversal ridge. Tutorium with broadly rounded cuspis, with four to six small dens (Fig. 6a). Genal tooth acute. Pedotectum I broad, with concave dorsal margin.

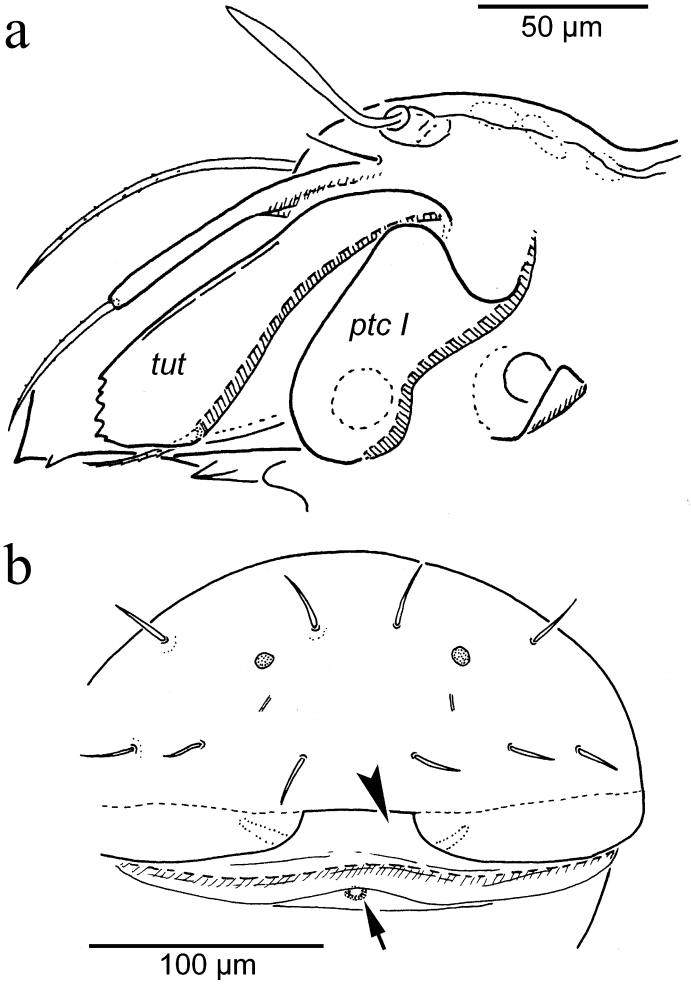

Fig. 6 *Zachvatkinibates eoeryi*: a: lateral aspect of prodorsum; b: caudal aspect, interrupted posterior notogastral tectum (arrow head) and opening of postanal sacculus (arrow). Abbreviations: *ptc I*: pedotectum I; *tut*: tutorium.

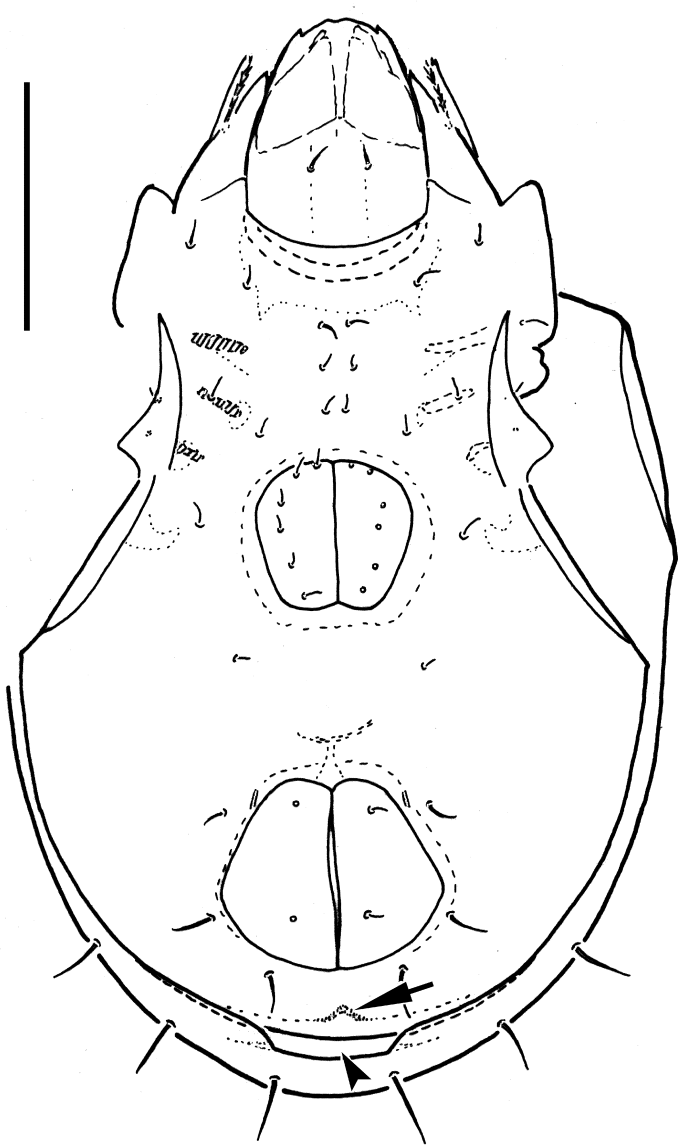

Fig. 7 *Zachvatkinibates eoeryi*: ventral aspect of a female; interrupted posterior notogastral tectum (arrow head) and optical transection of postanal sacculus (arrow). Scale bar 100 µm.

Notogaster: Typical shape of notogaster, anterior tectum convex. Pteromorphs with line of desclerotisation. Ten pairs of fine notogastral setae 20–30 µm long. Octotaxic system without sexual dimorphism: four small pairs of areae porosae round, *Aa* the largest (Fig. 5). Posterior notogastral tectum incomplete, broadly interrupted in the middle (Fig. 6b).

Gnathosoma: Subcapitulum diarthric, as typical; no specific characters observed.

Ventral region: Structures as normal for the genus (Fig. 7). Discidium with acute custodium. Six pairs of small genital setae, one pair of small aggenital, two pairs of small anal setae; three pairs of longer adanal setae (about 15 μm). In both sexes, instead of an areae porosa a postanal sacculus present, funnel-like or sacculus with large orifice (Figs 6b, 7).

Legs: All legs heterotridactylous; femora I and II with 5 setae, genua I and II with 3 setae.

Distribution and ecology: The typical records are from the sea shore near Split, Croatia (Mahunka 1972), in algal debris. As far as I know, the Portuguese occurrence is the only one besides the locus typicus.

The ecological situation is very special: more than 500 specimens of *Z. eoeryi* were collected from one sample (Po 64) of rotting marine debris, mostly from *Zostera*, at the base of an embankment adjacent to the salt marsh. Only one specimen each was collected in two further samples (Po 60, 65) from the normal salt marsh with halophilous scrubs vegetation, where the surface was also covered by debris. All adjacent samples contained with *Zachvatkinibates quadrivertex* and *Ameronothrus schneideri* (Oudemans, 1903), but did not contain *Z. eoeryi*. The Portuguese micro-habitat in marine debris resembles that of the locus typicus in Croatia and may indicate the very special ecological niche of *Z. eoeryi*.

Remarks

Together with *Z. nortoni*, the species *Z. eoeryi* belongs to the species group within *Zachvatkinibates*, which is characterised by an interrupted posterior notogastral tectum (see above, discussion on *Z. quadrivertex*). *Zachvatkinibates nortoni* differs in larger body size, strong sexual dimorphism in respect of the octotaxic system, and in shorter lamellar cusps in relation to translamellar length.

After comparing the paratype from the Croatian locus typicus with the specimens from the Faro Lagoon, there is no doubt that *Z. eoeryi* is a good species, well separated from *Z. quadrivertex* by the smaller body size, longer lamellar cusp, an octotaxic system without sexual dimorphism and a variably formed postanal saccule in *Z. eoeryi* instead of a porose area in *Z. quadrivertex*. Comparable differentiations between species were observed also in *Punctoribates*: *P. palustris* (Banks, 1895) with true area porosa; *P. weigmanni* Behan-Pelletier & Eamer, 2008, with concave funnel-shaped area porosa; *P. punctum* (C. L. Koch, 1839) with distinct sacculus (cf. Behan-Pelletier & Eamer 2008).

4. *Punctoribates* Berlese, 1908

Differential diagnosis

Behan-Pelletier and Eamer (2005) defined this genus as follows: Adults of this genus are unique among the Mycobatidae in having the following combination of character states. Distinct convex to concave medial process on anterior tectum of notogaster. Pair of thickened bands associated with medial process. Tubercles present between base of setae *in* and bothridia. Seta *in* setiform, borne on ridge extending between tubercles. Tutorium with large triangular cusp, closely adpressed to prodorsum. Pedotectum I with proximal one-third concave, expressed as narrow ridge, strongly convex medially. Semicircular carina present close to margin of ventral plate, between circumpedal carina and porose area *Ah*. Custodium

short or absent. Circumpedal carina not merging with custodium or discidium. Octotaxic system expressed as four pairs of porose areas. Posterior notogastral tectum undivided. Subcapitulum with mental tectum, General diagnostic characters of Mycobatidae (Grandjean 1954, Behan-Pelletier & Eamer 2008) are not repeated in the following description.

***Punctoribates aveiroensis* sp. nov.**

Material examined

Holotype: Adult female. Portugal, upper salt meadow, sample Po 50, 17 April 1971; shore of the lagoon of Aveiro, near Torreira, geographical coordinates 40°46'N, 08°41'W; preserved in ethanol, deposited in the collections of the Senckenberg Museum für Naturkunde Görlitz (SMNG), Germany. Paratypes: three specimens from the same sample are deposited in SMNG; 67 specimens in the collections of the author. Other material: two specimens each, samples Po 46, Po 51 from the typical locality; one specimen, sample Po 45, from the shore of the lagoon of Aveiro near Costa Nova; all in the collections of the author.

Diagnosis: Body length 320–370 µm. Rostrum rounded, with distinct longitudinal dorsolateral ridge (c.l.r. in Fig. 9) and longitudinal median ridge. Cusp of lamella narrow, about 22 µm long; mutual distance between cusps about 25 µm, translamella distinct. Sensillus narrow claviform, head granulated. Tutorium with broad cuspis, distally mostly with four small dens; pedotectum I broad, with concave dorsal margin. Anterior tectum of notogaster small, convex; pteromorphs with distinct hinge; octotaxic system normal in both sexes, areae porosae rounded; notogastral setae small, mutual distance h_1–h_1 short. Custodium tip rounded; postanal area porosa a narrow transversal ribbon.

Description

General characters: Body length 320–370 µm; females 345–370 µm, mean length 355 µm (n = 8); males 320–340 µm, mean length 334 µm (n = 6). Body colour brown, cerotegument not obviously developed.

Prodorsum: Rostrum rounded, with three longitudinal ridges, the median ridge less distinct than the dorsolateral ones (Fig. 8), which give outline of an undulating impression (Fig. 10). All prodorsal setae long, extending beyond rostrum tip. Rostral seta curved, barbed, inserted at base of tutorium, about 30 µm long. Cusp of lamella narrow, about 22 µm long; mutual distance between cusps about 30 µm; translamella distinct, about 3–4 µm wide (Fig. 8). Lamellar seta moderately long (about 30 µm), barbed, acuminate. Interlamellar seta *in* strong, barbed, acuminate, about 80 µm long. Seta *ex* about 4 µm long. Sensillus narrow claviform, head granulated; bothridium covered by anterior edge of notogaster. Tutorium with broad cuspis, with three to five small dens (Fig. 9). Genal tooth small. Pedotectum I broad, with strongly concave dorsal margin.

Notogaster: Typical shape of notogaster, medial part of anterior tectum small, convex. Pteromorphs with line of desclerotisation, anterior part with fine transversal striation. Ten pairs of fine notogastral setae 5–10 μm long, mutual distance h_1–h_1 short. Octotaxic system without sexual dimorphism: four pairs of small areae porosae round, *Aa* the largest (Fig. 8).

Gnathosoma: Mentum of subcapitulum with tectum, as typical in the genus; no specific characters observed.

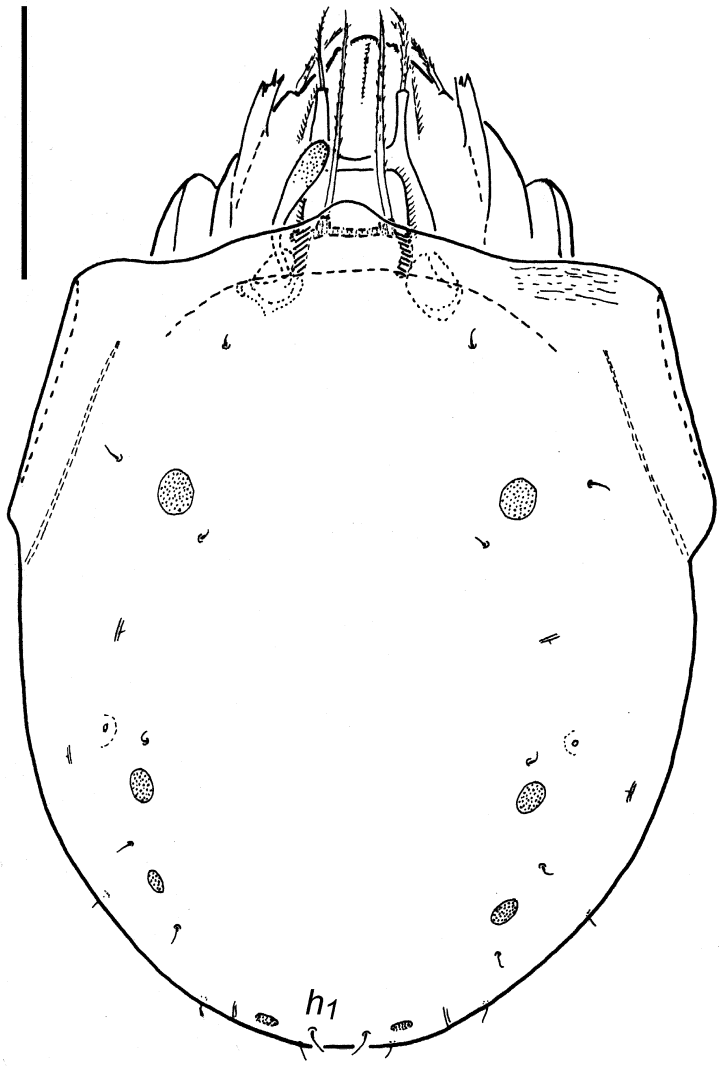

Fig. 8 *Punctoribates aveiroensis* sp. nov.: dorsal aspect of a female. Abbreviation: h_1: notogastral seta. Scale bar 100 μm.

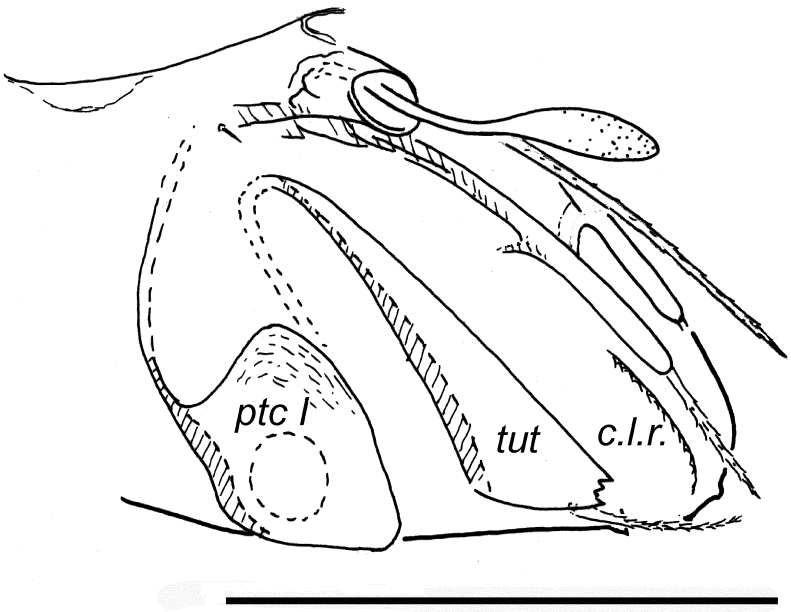

Fig. 9 *Punctoribates aveiroensis* sp. nov.: lateral aspect of prodorsum. Abbreviations: *c.l.r.*: lateral ridge (carina) of rostrum; *ptc I*: pedotectum I; *tut*: tutorium. Scale bar 100 μm.

Ventral region: Discidium with large and distally rounded custodium, curved sidewards (Fig. 10). Ventral setae small and smooth. Postanal area porosa very narrow transversal ribbon.

Legs: All legs heterotridactylous; no specific characters observed; tarsus II without dorsal apophysis, tibia II with acute distal apophysis; femora I and II with 4 setae, genua I and II with 3 setae.

Distribution and ecology: Known only from the typical region, the Lagoon of Aveiro; (1) from the northern part of the lagoon (called 'Ria de Aveiro') between Torreira and Quintas do Norte, with reduced salinity and tidal activities; (2) from the southern part (called 'Ria da Costa Nova') near Costa Nova. All sampling sites are salt-marsh meadows in the upper tidal level, inside of the sandy dune complex between the lagoon and the Atlantic. The species seems to be halobiontic.

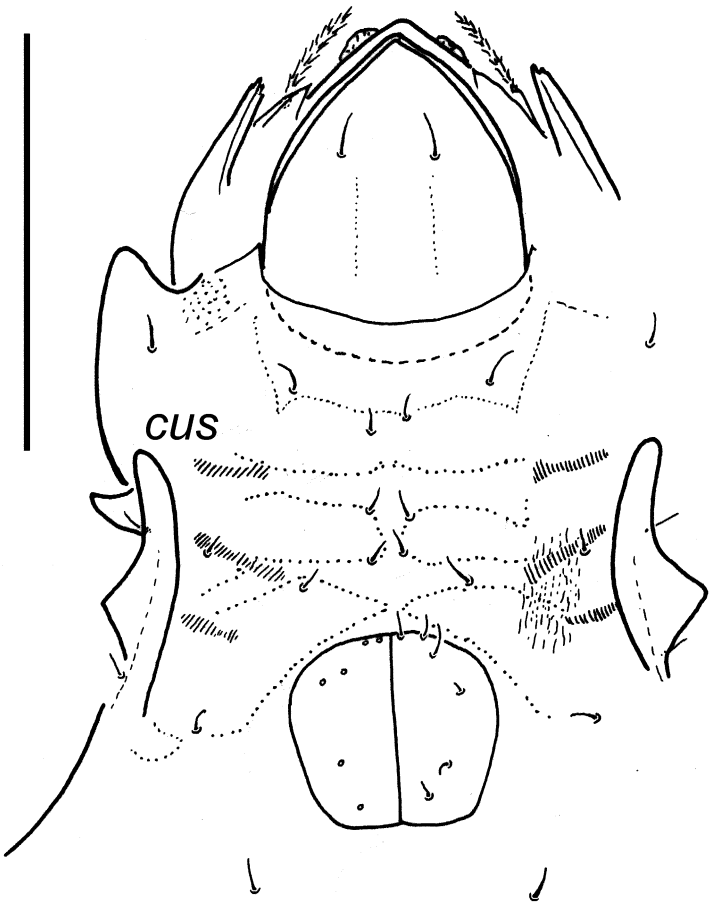

Fig. 10 *Punctoribates aveiroensis* sp. nov.: ventral aspect of a female. Abbreviation: *cus*: custodium. Scale bar 100 μm.

Remarks

Punctoribates aveiroensis sp. nov. resembles most *P. sellnicki* Willmann, 1928, in respect to the lamellar complex and the anterior tectum of notogaster with a small convex medial projection (cf. Weigmann 2006, Fig. 219 a–c, where an erroneous remark on the occurrence of *P. sellnicki* in South-European salt-marshes refers to the new species). Further similarities are: a similar size range, area porosa *Aa* the largest, three longitudinal rostal ridges. Yet, *Punctoribates aveiroensis* sp. nov. is characterised by important differences (contrasting characters of *P. sellnicki* in brackets): (1) notogastal setae 5–10 μm long, but distinctly observable (in *P. sellnicki* vestigial to very small); (2) mutual distance between h_1–h_1, p_1–p_1 and areae *A3–A3* on notogaster remarkably small (in *P. sellnicki* with long distances of more

than 50 µm); (3) the large and distally rounded custodium of the discidium (in *P. sellnicki* large with acute tip); (4) the postanal area porosa as a narrow transversal ribbon of about 10–15 µm length (in *P. sellnicki* small oval, less narrow, but shorter; hardly visible in both species, in caudal view only).

The biogeographical and ecological preferences of *Punctoribates aveiroensis* sp. nov., living in Portuguese marine salt marshes, seem to be quite different from those of *P. sellnicki*, a Palaearctic species which prefers acidic *Sphagnum* bogs in Central Europe, secondarily occurring in fresh or wet meadows and in acidic heather habitats (Strenzke 1952, Knülle 1957, Rajski 1968, Weigmann & Kratz 1982). The records *P. sellnicki* from Spain in more or less dry habitats (referred to in Pérez-Iñigo 1993, p. 153) need taxonomical reinvestigation because the description and Fig. 56A in Pérez-Iñigo (1993) do not correspond well with *P. sellnicki* Willmann, 1928, according to Willmann (1931), Weigmann (2006) and Seniczak & Seniczak (2008).

5. Comparative remarks on postanal porose organs in Mycobatidae

In a table with the character states of adults of North American genera of Mycobatidae, Behan-Pelletier & Eamer (2008; Tab. 3) present their results on the postanal porose organ in the genera, a structure which has considered in few descriptions. This porose organ is situated at the posterior border of the ventral plate where its surface is oriented vertically. That is why the postanal porose organ is difficult to observe as a porose area, and is best observed from a caudal view, though it is often being protected by the posterior notogastral tectum or by the folded connecting membrane between notogaster and ventral plate ('peau de liaison dorso-ventrale' after Grandjean 1934). If the postanal porose organ is expressed as sacculus it is best observed in optical transection from a ventral aspect. After Behan-Pelletier & Eamer (2008), the postanal porose organ is present in all studied genera of Mycobatidae except *Guatemalozetes*. Normally, the postanal porose organ is represented by a porose area on the cuticular surface. The first stated exception as a postanal saccule is reported for *Punctoribates punctum* (C. L. Koch, 1839), studied in specimens from Europe and Canada (Behan-Pelletier & Eamer 2008). My recent reinvestigations on *P. punctum* from Germany confirm the cited results. A second exception was found in *P. weigmanni* Behan-Pelletier & Eamer, 2008, with a funnel-like concave indentation of the porose-area surface (the authors also report the case of a postanal saccule in *Naiazetes reevesi* Behan-Pelletier, 1996, belonging to Zetomimidae).

A postanal saccule is also found in *Zachvatkinibates eoeryi* as described above. The character state shows a slight variability between a true saccule and a funnel-shaped concave indentation of a porose area; the latter character expression must be regarded as intermediate between saccule and porose area. Other *Zachvatkinibates* species studied in respect of the postanal porose organ have normal porose areas (Behan-Pelletier 1988, Behan-Pelletier and Eamer 2005).

As discussed broadly, areae porosae and sacculi are homologous structures in many cases, if expressed alternatively at the same body place, especially in the section Poronota of the Oribatida (Alberti & Norton 1997). Weigmann (2009) discussed cases of an individual abnormal character state of the octotaxic system of poronotic Oribatida, mostly as abnormal sacculi where normally an porose area is observed in the species. This phenomenon is explained as individual regression from the derived (apomorphous) character state as porose

area to an atavistic (plesiomorphous) character state as sacculus. On the species level, this interpretation is supported by a recently described *Peloptulus sacculiferus* (in Weigmann 2008): the single species within the family Phenopelopidae with notogastral sacculi instead of areae porosae. Comparable examples may be: *Punctoribates zachvatkini* Shaldybina, 1969, and *Minunthozetes reticulatus* Pérez-Iñigo, 1969 (Mycobatidae), and *Trichoribates polaris* Hammer, 1953 (Ceratozetidae), exceptional species each with notogastral sacculi in a genus normally with notogastral porose areas. For each case of exceptionally sacculonotic mycobatid species, new genera were established (*Semipunctoribates* Mahunka, 1987, with 3 species; resp. *Inigozetes* Subías, 2000, with one species; see Subías 2008). I question this approach because the typical genus character is not an apomorphy in phylogenetical interpretation but a regression to a plesiomorphous character state that is still cryptically present in the genome, following this hypothesis (Weigmann 2009).

6. Acknowledgements

Best appreciation is due to Bernd Hauser and Peter Schwendinger, Museum of Natural History Geneva, for the loan of a type specimen. Many thanks are addressed to Valerie Behan-Pelletier, Agriculture and Agri-Food Canada in Ottawa, for many helpful comments on this manuscript.

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Accepted 29 December 2008