

## Oribatid mites (Acari: Oribatida) from the coastal region of Portugal. I.

### *Peloptulus sacculiferus* n. sp., an aberrant species of Phenopelopidae compared with similar European species of the genus

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#### Abstract

A new species of oribatid mites, *Peloptulus sacculiferus* n. sp., was found in coastal meadows adjacent to salt marshes and is described in this paper. The species has notogastral sacculi instead of areae porosae, which is unique within the family. The new species is distributed in Portuguese coastal habitats of the Minho River, of the Lagoon of Aveiro and in the south-western Algarve at Cabo São Vicente, but it avoids the salt marsh area. A related species, *Peloptulus reticulatus* Mihelčič, 1957, occurs at the border of salt marshes in the Lagoon of Faro in southern Portugal. This species is re-described, and *P. trinacriae* Arcidiacono, 1975, from coastal dunes in Sicily is declared a new junior synonym of *P. reticulatus*.

**Keywords:** Taxonomy, systematics

#### Zusammenfassung

Eine neue Hornmilbenart, *Peloptulus sacculiferus* n. sp., wurde in Wiesen, die an Küsten-Salzwiesen angrenzen, gefunden und wird in diesem Artikel beschrieben. Die Art zeichnet sich durch Sacculi anstatt von Areae porosae auf dem Notogaster aus, was einzigartig in der Familie ist. Die neue Art kommt in Portugal bisher an drei küstennahen Orten vor: in Uferwiesen am Minho Fluß in Nordportugal, an der Lagune von Aveiro und am Cabo São Vicente in der südwestlichen Algarve, jedoch meidet die Art die eigentlichen Salzwiesen. Eine verwandte Art, *Peloptulus reticulatus* Mihelčič, 1957 fand sich oberhalb von Salzmarsh-Flächen in der Lagune von Faro in Südportugal. Diese Art wird neu beschrieben, und *P. trinacriae* Arcidiacono, 1975 aus Küstendünen auf Sizilien wird als neues Synonym dazu deklariert.

#### 1. Introduction

In the course of ecological studies on the oribatid mite fauna in Portuguese salt marshes and in its adjacent habitats two species of *Peloptulus* were found. One of these species differs from all known species of the family Phenopelopidae in regard to the octotaxic system of the notogaster, which is expressed as sacculi instead of areae porosae, as being typical for all other members of the family. This species is described as *Peloptulus sacculiferus* n. sp. in this

contribution. The second species with normal notogastric areae porosae has an obvious mesh-like notogastric pattern, as described for *Peloptulus reticulatus* Mihelčič, 1957 from Spain and for *P. trinacriae* Arcidiacono, 1975 from Sicily; yet the same notogastric pattern can be observed in *Peloptulus sacculiferus* n. sp. Both collected species are described or re-described in the following and are compared with each other and with European congeners.

## 2. Materials and methods

The samples from Portugal were collected in April and May 1971. The sample codes with *Peloptulus sacculiferus* n. sp. are Po21, Po24, Po49. The sample code with *P. reticulatus* is Po71.

Po21: Between the cities Caminha and Seixas at the Minho river shore, about 5 km from the mouth of the river. Salt marsh, upper salt vegetation with *Festuca*, *Armeria maritima*, *Plantago coronopus* and others. 15 April 1971.

Po24: Near Lanhas at Minho River, 4 km stream-upwards from Po21. River shore meadow, Wet place with *Phragmites*, sample between grasses, *Bellis perennis* and others. 15 April 1971.

Po49: In the lagoon of Aveiro ('Ria de Aveiro'), near Quintas de Norte. Locality with brackish water and salt marsh vegetation. Sample in the adjacent salt-tolerant meadow, with *Trifolium repens*, *Plantago major*, *Bellis perennis* and others. 17 April 1971.

Po71: Lagoon of Faro ('Ria Formosa'), western part. Embankment of a moderately dry dam above salt marsh vegetation. 1 May 1971.

The samples were taken semi-quantitatively with a special shovel, about 250 cm<sup>2</sup>, 1 – 2 cm depth. The mites were extracted using a modified Tullgren apparatus. The specimens were stored in ethanol and after clearing they were studied in lactic acid in concave microscopic slides.

## 3. Results

### *Peloptulus sacculiferus* n. sp.

Figs 1 – 3

'*Peloptulus phaenotus*': sensu Gil & Subias (1990).

### Material examined

**Holotype:** Adult female. Portugal, sample Po49, 17 April 1971, shore of the lagoon of Aveiro, geographic coordinates 40°46'N, 08°41'W; preserved in ethanol, deposited in the collections of the Staatliches Museum für Naturkunde Görlitz (SNMG), Germany. Paratypes: three specimens from the same sample are deposited in SNMG; two specimens in the collections of the author. Other material: seven specimens, sample Po 21; four specimens, sample Po24; from Portugal, shore of river Minho; all in the collections of the author.

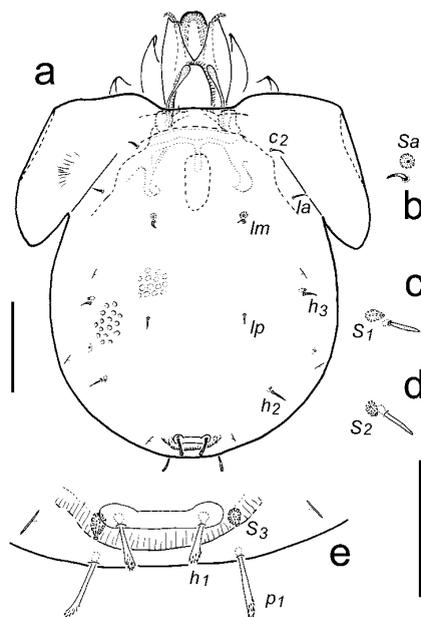


Fig. 1 *Peloptulus sacculiferus* n. sp.: a. dorsal aspect; – b. Sacculus *Sa* with seta *lm*, enlarged; – c. Sacculus *S1* with seta *h3*, enlarged; – d. Sacculus *S2* with seta *h2*, enlarged; – e. Posterior notogastral region with sacculus *S3* and setae *h1*, *p1*, enlarged. – Left scale bar for a: 100  $\mu$ m; right scale bar for b – e: 50  $\mu$ m.

**Diagnosis:** Body length 460 – 510  $\mu$ m; rostrum narrow, rounded; lamellae broad, as typical, with strong outer dens and with or without small inner dens at cusp tip, interspace between cusps narrow triangular. Sensillus claviform with long stalk, head granulated; interlamellar setae small. Notogastral setae dimorphic: anterior 6 pairs short spiniform, mostly 10 – 17  $\mu$ m long, posterior two pairs (*h1*, *p1*) bacilliform, slightly thickened towards tips barbed, *h1*-setae on transverse cuticular plate, posterior to this a transverse ridge present. Octotaxic system formed by four pairs of small sacculi. Notogastral cuticle with foveolae, the interspace of these forming a net-like pattern.

**General characters:** Body length 460 – 510  $\mu$ m (mean length 485  $\mu$ m, mean width of notogaster 315  $\mu$ m; n = 7). Notogastral cuticle with foveolae with indistinct rims, the interspaces of these forming a net-like darker pattern; body colour brown, cerotegument not obviously developed.

**Prodorsum:** Rostrum narrow rounded; dorsolaterally with longitudinal ridges which may cause a slightly concave contour in the middle part of the rostrum as seen in dorsal aspect (Figs 1, 3a). Lamellae broad as typical, with strong outer dens and with or without small inner dens at cusp tip; insertion of distinctly barbed lamellar setae ventrally at inner anterior edge of cusps; interspace between cusps narrow, V-shaped with angular to rounded translamellar ridge. Rostral setae moderately long, slender, barbed; interlamellar setae small (8 – 16  $\mu$ m),

inserted on a transverse ridge, weakly developed in the middle. Sensilli claviform with long stalk, head granulated. Tutorium fused with genal tooth, large with two large teeth distally, covering insertion of rostral seta in lateral aspect. Pedotectum I large, with concave upper edge, with typical pedotectal carina (pd.c. in Fig. 3b).

**Notogaster:** Typical shape of notogaster, with longish clear spot, with broad bridge between pteromorphs, anterior margins of movable pteromorphs protruding the bridge. Notogastral setae dimorphic (Fig. 1; morphometric details in Tab. 1): anterior 6 pairs ( $c_2$ ,  $lm$ ,  $la$ ,  $lp$ ,  $h_3$ ,  $h_2$ ) more or less spiniform with indistinct fine granules, mostly 10 – 17  $\mu\text{m}$  in length ( $c_2$  exceptionally longer, up to 26  $\mu\text{m}$ ); posterior two pairs ( $h_1$ ,  $p_1$ ) bacilliform, 12 – 30  $\mu\text{m}$  long, slightly thickened towards spinulated tips;  $h_1$ -setae on transverse cuticular plate, posterior to this a transverse ridge (Fig. 1e); setae  $p_2$  and  $p_3$  absent. Octotaxic system formed by four pairs of small sacculi:  $Sa$  near setae  $lm$ ,  $S1$  near  $h_3$ ,  $S2$  near  $h_2$ ,  $S3$  in a short distance latero-posterior to  $h_1$  at the posterior transverse ridge. Opisthonotal glands and four visible pairs of slit-like organs as typical.

Tab. 1 Morphological characters of Portuguese *Peloptulus reticulatus*, compared with indications in Perez-Iñigo (1972) and Arcidiacono (1975). Morphological characters of *P. sacculiferus* n. sp., compared with German *P. phaenotus*. – All values in  $\mu\text{m}$ .

Characters	<i>P. reticulatus</i>	<i>P. reticulatus</i>	<i>P. trinacrae</i>	<i>P. sacculiferus</i>	<i>P. phaenotus</i>
	[Portugal] <sup>1</sup>	(Perez-I. 1972)	(Arcidiacono 1975)	n. sp. <sup>2</sup>	[Germany] <sup>3</sup>
body length	515 – 595	520 – 595	550 – 624	460 – 510	420 – 480
lamellar cusp	outer dens +	outer dens –	outer dens –	outer dens +	outer dens +
translamella	+ or –	–	+	+	+
octotaxic system	areae porosae	areae porosae	areae porosae	sacculi	areae porosae
NG structure	mesh pattern	mesh pattern	mesh pattern	smooth	smooth
length ng-setae:					
$c_2$	35 – 43	60	42	14 – 26	14
$la$	30 – 46		58	12 – 17	22
$lm$	22 – 40	55	48	10 – 17	17
$lp$	31 – 51	60	46	11 – 16	22
$h_3$	28 – 37		53	10 – 16	23
$h_2$	32 – 43	70	58	13 – 17	31
$h_1$	33 – 47	70	51	12 – 14	36
$p_1$	29 – 43		30	15 – 30	22

<sup>1</sup> This study, lengths of notogastral setae in four specimens

<sup>2</sup> This study, lengths of notogastral setae in six specimens

<sup>3</sup> Coll. Weigmann, lengths of notogastral setae in one specimen

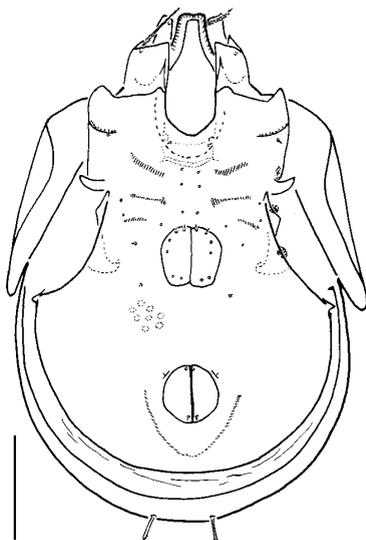


Fig. 2 *Peloptulus sacculiferus* n. sp.: ventral aspect. – Scale bar 100  $\mu$ m.

**Gnathosoma:** Cheliceres forceps-like, as typical; no specific characters observed.

**Ventral region:** Structures as normal for the genus (Fig. 2). All ventral setae minute; epimeral setal formula 3-1-3-2(?); 6 pairs of genital setae, 1 pair of aggenital, two pairs of anal setae; adanal setae missing. Behind and around anal plates with indistinct parabolic ridge. Discidium with short acute custodium. Cuticula of ventral plate with indistinct concavities.

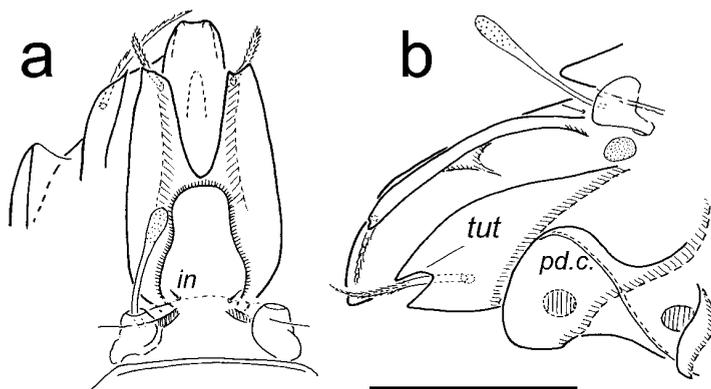


Fig. 3 *Peloptulus sacculiferus* n. sp.: **a.** Prodorsum, dorsal aspect; – **b.** Prodorsum, lateral aspect. – Abbreviations: *in* – interlamellar seta; *tut* – tutorium; *pd.c.* – carina of pedotectum I. – Scale bar 50  $\mu$ m.

**Legs:** All legs heterotridactylous; no specific characters observed.

**Distribution and ecology:** The species occurs in the coastal region of Portugal only. (1) Shore of Rio Minho, northern border of Portugal; (2) meadow at the shore of the Lagoon of Aveiro, Portugal; (3) soil at the sea shore of Cabo de São Vicente, Southwest Portugal, sampled by L. S. Subías (Gil & Subías 1990). All findings are made in habitats adjacent to the sea or river shore, but in supra-littoral habitats with meadow or shrub vegetation, probably with occasional salt water spray influence.

### Remarks

The octotaxic system of the notogaster with sacculi instead of small areae porosae in the new species is unique within the family. In Weigmann (2008) a single specimen of *Peloptulus phaenotus* (C. L. Koch, 1844) is described which has areae porosae in all notogastral positions but the right *Aa* position where a sacculus is developed. This aberrant phenomenon was assumed to be an atavistic reminiscence of the character status of the octotaxic system in phylogenetic ancestors of Phenopelopidae with notogastral sacculi. The same explanation may be applicable for the sacculonotic *P. sacculiferus* n. sp., where this character is constantly expressed in two studied populations in Portugal. This interpretation characterises the occurrence of sacculi in the genus and family as reappearance of a plesiomorphous character expression and not as a new apomorphic character. That is the reason to reject an establishment of a separate new genus for *P. sacculiferus* n. sp.

A second obvious character of the new species is the cuticular structure of the notogaster and the ventral plate with regular concavities, forming a net-like pattern. Such a structure can be observed in *P. reticulatus* Mihelčič, 1957 and in *P. trinacriae* Arcidiacono, 1975. Both species can be differentiated from *P. sacculiferus* n. sp. by uniformity of the bacilliform notogastral setae, by the lack of a cuticular plate around setae  $h_1$ , by a non-angular translamellar line and by true notogastral areae porosae. These species are discussed in more detail in a following section on *P. reticulatus*.

Gil & Subías (1990) described a species from the Western Algarve in Portugal as *Peloptulus phaenotus*, which resembles *P. sacculiferus* n. sp. in nearly all relevant described characters: notogastral setation, cuticular structure with concavities on notogaster and ventral plate, cuticular plate around  $h_1$ , transversal ridge behind  $h_1$  setae. The authors did not mention sacculi or areae porosae on the notogaster, but the single depicted pair of the octotaxic system (*Aa* resp. *Sa*) may indicate sacculi indeed. This finding of Gil & Subías (1990) is most probably identical with *P. sacculiferus* n. sp. in morphological characters and additionally in the ecological occurrence, both from the coastal area of Portugal. The reference of '*P. phaenotus*' in Gil & Subías (1990) is not identical with Central European *P. phaenotus* populations (Willmann 1931, Weigmann 2006), for sure. *Peloptulus phaenotus* from the type locality region in Germany do not show dimorphic notogastral setations as observed in *P. sacculiferus* n. sp., the notogastral setae are partly larger (see Tab. 1); the posterior setae  $h_1$  are not associated with a cuticular plate or ridge, the notogaster and ventral plate are smooth, and there are true areae porosae on the notogaster. The incomplete descriptions of '*P. phaenotus*' in Perez-Iñigo (1972, 1993), partly based on material of the Mihelčič collections from Spain and partly on the mentioned paper of Gil & Subías (1990), support the assumption that his references really report *P. sacculiferus* n. sp.

***Peloptulus reticulatus* (Mihelčič, 1957)**

Fig. 4

*Peloptulus reticulatus* (Mihelčič 1957): Zool. Anz. 158: 62*Peloptulus reticulatus*: (Perez-Iñigo 1972), 1993*Peloptulus trinacriae* (Arcidiacono 1975): Animalia 2: 16. (syn. nov.)**Material examined**

Portugal, sample Po71, shore of the Lagoon of Faro. 3 specimens deposited in the collections of the Staatliches Museum für Naturkunde Görlitz (SMNG), Germany; 12 specimens in the collections of the author.

**Diagnosis:** Body length 515 – 595  $\mu\text{m}$ ; rostrum narrow, rounded; lamellae broad as typical, with or without outer dens and without inner dens at cusp tip, interspace between cusps narrow, basically rounded, mostly with distinct translamellar line, but exceptionally interrupted. Sensillus claviform with long stalk, granulated; interlamellar setae moderately short. Notogastral setae bacilliform, slightly thickened tips spinulated. Octotaxic system formed by four pairs of small areae porosae, as typical in Phenopelopidae. Notogastral cuticle with concavities, the interspace between them forming a net-like pattern.

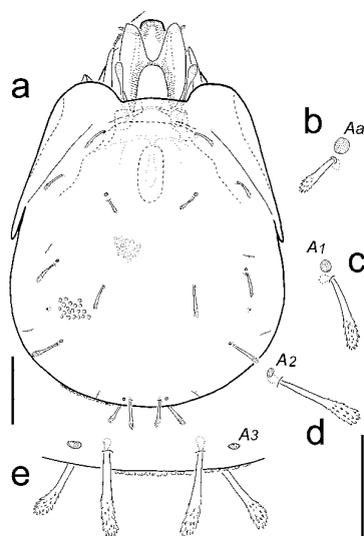


Fig. 4 *Peloptulus reticulatus*: a. dorsal aspect; – b. Area porosa Aa with seta  $l_m$ , enlarged; – c. Area porosa A1 with seta  $h_3$ , enlarged; – d. Area porosa A2 with seta  $h_2$ , enlarged; – e. Posterior notogastral region with area porosa A3 and setae  $h_1$ ,  $p_1$ , enlarged. – Left scale bar for a: 100  $\mu\text{m}$ ; right scale bar for b–e: 50  $\mu\text{m}$ .

### Redescription

**General characters:** Body length 515 – 595  $\mu\text{m}$  (mean length 566  $\mu\text{m}$ ;  $n = 8$ ). Notogastral cuticle with concavities and indistinct rims, the interspace of the concavities forming a net-like darker pattern; colour brown, cerotegument strongly granulated or prismatic.

**Prodorsum:** Rostrum narrow, rounded in dorsal aspect (Fig. 4). Lamellae broad as typical, with or without small outer dens, without inner dens at cusp tip; insertion of distinctly barbed lamellar setae ventrally at inner anterior edge of cusps; interspace between cusps narrow, with rounded translamella which may be either moderately small, a fine line or interrupted, exceptionally (in the Portuguese population in one out of eight studied specimens). Rostral setae large, barbed; interlamellar setae moderately small, about 10  $\mu\text{m}$ , on a transverse ridge weakly developed in the middle. Sensilli claviform with long stalk, granulated. Tutoria fused with genal tooth, distally with two large teeth, covering insertion of rostral seta in lateral aspect. Pedotectum I large, with concave upper edge, with typical pedotectal carina.

**Notogaster:** Typical shape of notogaster, with longish clear spot, with broad bridge between pteromorphs; anterior margins of movable pteromorphs strongly protruding the bridge. Notogastral setae bacilliform, 22 – 51  $\mu\text{m}$  long (details in Tab. 1), distinctly thickened distal part spinulated; setae  $p_2$  and  $p_3$  absent. Octotaxic system formed by four pairs of small areae porosae:  $Aa$  near setae  $lm$ ,  $A1$  near  $h_3$ ,  $A2$  near  $h_2$ ,  $A3$  near  $h_1$  (Fig. 4). Opisthosomal glands and four visible pairs of slit-like organs as typical.

**Gnathosoma:** Cheliceres forceps-like, as typical; no specific characters observed.

**Ventral region:** Structures as normal for the genus. Genal teeth rounded. Most ventral setae minute to small, setae 3b longer than others; epimeral setal formula 3-1-2-2. With 6 pairs of genital setae, 1 pair of aggenital, two pairs of anal setae; adanal setae missing. Discidium with short custodium with rounded tip. Cuticula of ventral plate with distinct concavities.

**Legs.** All legs heterotridactylous; no specific characters observed.

**Distribution and ecology:** The species was found in different European countries: Spain (references in Perez-Iñigo 1993), mostly in moderately dry meadows; Portugal at the shore of the Lagoon of Faro, dry dam adjacent to a salt marsh (this study); Sicily, Italy, coastal dunes (Arcidiacono 1975); Caucasian region (Ghilarov & Krivolutsky 1975); Western Poland (Olszanowski et al. 1996).

### Remarks

In the Mediterranean-Atlantic region, there are two similar species with cuticular concavities and other similarities to the population described in this section: *Peloptulus reticulatus* (Mihelčič 1957) from Spain and *P. trinacriae* (Arcidiacono 1975) from Sicily. At first sight, the above-described species in question could be conspecific with each of these two species. Still the junior synonymy of *P. trinacriae* to *P. reticulatus* seems possible. Tab. 1 refers to the main characters, as being available from the literature. The data for *P. reticulatus* are taken from Perez-Iñigo (1972), who studied the material of Mihelčič and declared the body size indications (up to 700  $\mu\text{m}$ ) in the originally poor description of Mihelčič (1957) as erroneous.

Perez-Iñigo (1972, 1993) re-described shortly *Peloptulus reticulatus* by means of Mihelčić material from moderately dry meadows in Central Spain. Arcidiacono (1975) described *P. trinacriae* from coastal dunes in Sicily. Both descriptions lack some morphological details, which are described above for the Portuguese specimens. Arcidiacono indicates as differentiating characters of *P. trinacriae*: (1) a distinct translamellar line (interrupted in *P. reticulatus* sensu Perez-Iñigo); (2) all notogastral setae shorter, e.g.  $c_2$  with 42  $\mu\text{m}$  instead of 60  $\mu\text{m}$  (as indicated for *P. reticulatus*),  $h_1 - 51$ ,  $h_2 - 58$   $\mu\text{m}$  instead of  $h_1 - 70$ ,  $h_2 - 70$   $\mu\text{m}$  in *reticulatus* (other measures in Tab. 1); (3) the body length of 550 – 624  $\mu\text{m}$  instead of 520 – 595  $\mu\text{m}$  in *P. reticulatus*. The named differences are morphometric data with poor reliability if not presented with ranges of variability (setal lengths with single measures each in both papers) and with statistically assured differences. The differences in the translamellar structure are not a convincing contrast either, regarding Fig. 17 (in Perez-Iñigo 1972) and Fig. 4 (in Arcidiacono 1975); the herewith described Portuguese population with moderately small to linear translamella also includes a specimen with interrupted translamella.

The presented description of the Portuguese form of *P. reticulatus* includes differences to both taxa, *P. reticulatus* sensu Perez-Iñigo and *P. trinacriae*: (1) cuspis of lamella with lateral dens; (2) partly shorter notogastral setae in comparison with both taxa. Some characters support a closer relation to *P. trinacriae*: (3) mostly non-interrupted translamellar line; (4) more similarity of the lengths of notogastral setae. (5) The range of the body length supports a closer relation to *P. reticulatus* sensu Perez-Iñigo. All these characters are somewhat variable and thus of minor importance and not applicable for a valid species differentiation. In regard of the lateral dens of the lamellar cusp, we should take into account that the cuspis tip is bent downward, and the dens may be visible only in dorso-anterior aspect, if present; i.e. the dens may not be visible in straight dorsal view.

In consequence, the differentiation into two distinct species is doubtful. Therefore, I propose the synonymisation of *P. trinacriae*, at most representing a regional form of *Peloptulus reticulatus*.

#### 4. Discussion

Some differentiating characters of *Peloptulus* species used in keys (cf. Perez-Iñigo 1993) are gradual characters, partly measured values taken by chance out of a variability range, partly subjective shape indications as ‘long, narrow, rounded’, which may be reasonable at best in relation to values of different species. Other characters, e.g. the presence of a distinct translamella or an interrupted one, seem to be alternative characters, but indeed they may be continuously variable as discussed above for *Peloptulus reticulatus*.

One problematic character is the rostrum outline, (1) whether being broad or narrow, (2) rounded, undulated or quadrangular in shape from dorsal aspect. *Peloptulus sacculiferus* n. sp., *P. reticulatus* and *P. phaenotus* have a clearly narrow rostrum shape. In contrast, *P. latirostris* Perez-Iñigo, 1969 (see Perez-Iñigo 1993) has a clearly broad rostrum; other species are intermediate, as *P. denticuspidatus* Bayartogtokh & Aoki, 1999. Some species have longitudinal ridges along the dorsal and frontal part of the rostrum. In *P. phaenotus* these two ridges are strongly developed and cause a quadrangular outline in dorsal aspect. In *P. sacculiferus* n. sp. the ridges are weakly developed, and it is a question of view to see a continuously rounded outline or a medially depressed (concave) outline. In

*P. denticuspidatus*, there are three longitudinal ridges (Bayartogtokh & Aoki 1999) causing a triplet of 'notches', i.e. an undulating outline.

Length values of setae are likewise problematic, if not taken with care. A seta, which is inclined upward looks too short from straight dorsal aspect. Therefore, length values are often underestimated if not taken from lateral view or from another perspective with the seta in a correct level. This source of error and additionally the natural variability of size values demand critical care in using such values for species diagnoses. Nevertheless, I present some comparative data in Tab. 1 for the described species and for *Peloptulus phaenotus*.

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Accepted: 28 April 2008