

RESEARCH PAPER

## First Sphaeroceridae (Diptera) endemic to Madeira – three new terricolous species of *Spelobia* and *Pullimosina*

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**Abstract.** Three new species of Diptera (Sphaeroceridae: Limosiniinae) from the Madeira Island (Portugal), viz. *Spelobia polymorpha* sp. nov., *Pullimosina (Pullimosina) kesoni* sp. nov., and *P. (P.) dorae* sp. nov. are described (both sexes), illustrated and their relationships, biology and distribution discussed. All these species are terricolous inhabitants of the leaf-litter stratum of the original Madeiran laurel forests (Laurisilva) and because of their poor flying ability they are considered endemic to Madeira. None of these species have relatives among endemic species of Sphaeroceridae known from other Macaronesian archipelagos inasmuch as the endemic species of Canary Islands and Azores belong to different genera of Limosiniinae.

**Key words.** Diptera, Sphaeroceridae, Limosiniinae, *Spelobia*, *Pullimosina*, biology, new species, relationships, taxonomy, distribution, Madeira

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### Introduction

As for other groups of two-winged flies (Diptera), the acalyptrate family Sphaeroceridae has also received some attention in the Madeiran archipelago (Portugal). Although no representative of this family has been recorded from islands Porto Santo, Desertas and/or Selvagens the sphaerocerid fauna of Madeira Is. is comparatively well known. BECKER (1908) was the first to report on Sphaeroceridae from Madeira, recording a total of 12 species from this island, two of which were described as new to science, viz. *Oolina ferruginea* Becker, 1908 and *Limosina eximia* Becker, 1908. However, DUDA (1918, 1925, 1938), who revised material in Becker's collection, subsequently synonymized these two species with *Lotophila atra* (Meigen, 1930) and *Trachyopella atomus* (Rondani, 1880) respectively. DUDA (1918) also rectified some other of Becker's misidentifications and recorded a few additional species from his material including *Spinilimosina brevicostata* (Duda, 1918), described also from a syntype from Madeira. FREY (1949) studied a rich collection of Diptera obtained on his expedition to Madeira and presented a list of 22 species of Sphaeroceridae based on his own material and BECKER's (1908) records but omitted those published by DUDA (1918). Much latter, some additional species of Sphaeroceridae were published from Madeira by ROHÁČEK

(1982, 1983a) and ROHÁČEK & MARSHALL (1986), largely resulting from revision of Frey's material now deposited in the Natural History Museum, Helsinki. *Trachyopella (Nudopella) hem* Roháček & Marshall, 1986 was partly described from Madeiran specimens (paratypes). A total of 27 valid species have been recorded from Madeira as catalogued by ROHÁČEK et al. (2001) and CARLES-TOLRÁ & BÁEZ (2002) but some of these records were considered doubtful (see ROHÁČEK et al. 2001). Although four species were described from Madeira none of them is endemic to the island and only two of them remain valid taxa, viz. *Spinilimosina brevicostata*, *Trachyopella hem*. Most recently, ROHÁČEK (2007) presented results of the study of material of Sphaeroceridae obtained on a collecting trip to Madeira in 2003. During this field work a total of 39 species were found; 20 species were added to the dipterous fauna of Madeira, but four of them, considered to be new, remain unnamed. Based on critical evaluation of all previous records ROHÁČEK (2007) deleted 4 species from the list of Sphaeroceridae of Madeira due to misidentification and confirmed a total of 43 species reliably occurring on the island.

The present paper is aimed at description of two new species (one of *Spelobia* and one of *Pullimosina*) recognized already by ROHÁČEK (2007) plus an additional new *Pulli-*



*mosina* species found in the material collected by means of pitfall traps during the research of the laurel forest fauna performed by the staff of the University of Madeira. All these species were only found in the Laurisilva ecosystem and all seem to be terricolous animals living under decaying fallen leaves of laurel trees. With addition of these species, the Madeiran fauna of Sphaeroceridae comprises now 44 species but 2 of them (one belonging to the subgenus *Kimosina* Roháček, 1983 of *Phthitia* Enderlein, 1938 and one to subgenus *Allolimosina* Roháček, 1983 of *Minilimosina* Roháček, 1983, see ROHÁČEK 2007) remain unnamed because the available material is insufficient for their description.

### Material and methods

**Material.** The material examined is deposited in three institutional collections as follows:

NMPC Národní muzeum, Praha, Czech Republic;  
SMOC Slezské zemské muzeum, Opava, Czech Republic;  
UMa Dpto. Biologie, Universidade da Madeira, Funchal, Madeira, Portugal.

**Methods.** Specimens have been studied, drawn and measured using two types of binocular stereoscopic microscopes (Reichert, Olympus). During the course of this work a series of specimens originally preserved in ethanol were dried and mounted on pinned triangular cards. Abdomens of a number of specimens were detached (indicated by “genit. prep.” in type material examined), cleared by boiling several minutes in a 10% solution of potassium hydroxide (KOH) in water, then neutralized in a 10% solution of acetic acid (CH<sub>3</sub>COOH) in water, washed in water and subsequently transferred to glycerine. Postabdominal structures were dissected and examined in a drop of glycerine under binocular microscopes, detailed examinations of genital structures were performed with a compound microscope (JENAVAL). After examination, all dissected parts were put into small plastic tubes containing glycerine, sealed with hot forceps and pinned below the respective specimen or put in a vial with the ethanol-preserved specimen.

**Drawing techniques and photography.** Legs were drawn on squared paper using a Reichert binocular microscope with an ocular screen. Details of the male and female genitalia were drawn by means of Abbe’s drawing apparatus on a compound microscope (JENAVAL) at larger magnification (130–500×). Wings were photographed on the same microscope with an attached digital camera (Nikon COOLPIX 4500). Whole adult specimens and their details were photographed by M. Tkoč (National Museum, Praha) using a Canon 5DSR digital camera with a Nikon CFI Plan 10×/0.25NA 10.5mm WD objective attached to an EF 70–200mm f/4L USM lens. The specimens were repositioned upwards between each exposure using a WeMacro Rail (<http://www.wemacro.com/>, each step was 5 or 10 μm) and the final photograph was compiled from multiple layers (50–150) using Helicon Focus Pro 5.3. The final images were edited in Adobe Photoshop CS6.

**Measurements.** Six main characteristics of the new species were measured: body length (measured from anterior margin of head to end of cercus, thus excluding

the antenna), index  $t_2 : mt_2$  (= ratio of length of mid tibia : length of mid basitarsus), wing length (from wing base to wing tip), wing width (maximum width), *C-index* ( $Cs_2 : Cs_3$ ) (= ratio of length of 2nd costal sector : length of 3rd costal sector) and index *rm/dm-cu : dm-cu* (= ratio of length of section between *rm* and *dm-cu* on discal cell : length of *dm-cu*). If available a total of 10 males and 10 females (3 smallest, 4 medium, 3 largest examined specimens of each sex) of each species were measured; in species with fewer specimens available, all were measured.

**Presentation of faunistic data.** Label data of primary-type specimens are presented strictly verbatim, including information on form and colour of all associated labels. Data from paratypes of the new species are standardized and presented in full. Phenological and other biological information obtained from the material examined are summarized in the Biology paragraph.

**Nomenclature** follows that used in the World catalog of Sphaeroceridae (ROHÁČEK et al. 2001) and its update (MARSHALL et al. 2011).

**Morphological terminology** follows that used for Sphaeroceridae by ROHÁČEK (1998) in the Manual of Palaearctic Diptera and, most recently, in ROHÁČEK (2016) including terms of the male hypopygium. The “hinge” hypothesis of the origin of the eremoneuran hypopygium, re-discovered and documented by ZATWARNICKI (1996), is followed here. Some of the alternate terms for parts of the male genitalia (emanating from other hypotheses) are as follows (the preferred terms are listed first): aedeagus (= phallus), ejacapodeme (= ejaculatory apodeme), epandrium (= perianthrium), gonostylus (= surstylus), medandrium (= bacilliform sclerite, subepandrial, intraepandrial or intraperianthrial sclerite), phallapodeme (= aedeagal apodeme), phallophore (= basiphallus), postgonite (= gonite, paramere). Morphological terms of the male terminalia are depicted in Figs 13–18, 32, those of the female terminalia in Figs 19, 21, 23, 46. Abbreviations of morphological terms used in text and illustrations are listed below.

Abbreviations of morphological terms used in text and/or figures:

<i>A</i> <sub>1</sub>	anal vein
<i>ac</i>	acrostichal (seta)
<i>ads</i>	additional (setulae) on frons
<i>asc</i>	additional sclerite
<i>C</i>	costa
<i>ce</i>	cercus
<i>Cs</i> <sub>2</sub> , <i>Cs</i> <sub>3</sub>	2 <sup>nd</sup> , 3 <sup>rd</sup> costal sector
<i>CuA</i> <sub>1</sub>	cubitus
<i>dc</i>	dorsocentral (seta)
<i>dm</i>	discal medial cell
<i>dm-cu</i>	discal medial-cubital (= posterior, tp) cross-vein
<i>dp</i>	distiphallus
<i>ea</i>	ejacapodeme
<i>ep</i>	epandrium
<i>f</i> <sub>1</sub> , <i>f</i> <sub>2</sub> , <i>f</i> <sub>3</sub>	fore, mid, hind femur
<i>g</i>	genal (seta)
<i>gs</i>	gonostylus
<i>hu</i>	humeral (= postpronotal) (seta)
<i>hy</i>	hypandrium
<i>ifr</i>	interfrontal (seta)
<i>M</i>	media
<i>mt</i> <sub>2</sub>	mid basitarsus

<i>oc</i>	ocellar (seta)
<i>occe</i>	outer occipital (seta)
<i>occi</i>	inner occipital (seta)
<i>ors</i>	fronto-orbital (seta)
<i>pg</i>	postgonite
<i>pha</i>	phallapodeme
<i>pp</i>	phallopore
<i>pvt</i>	postvertical (seta)
<i>R<sub>1</sub></i>	1 <sup>st</sup> branch of radius
<i>R<sub>2+3</sub></i>	2 <sup>nd</sup> branch of radius
<i>R<sub>4+5</sub></i>	3 <sup>rd</sup> branch of radius
<i>r-m</i>	radial-medial (= anterior, ta) cross-vein
<i>S1–S10</i>	abdominal sterna
<i>sc</i>	scutellar (seta)
<i>stpl</i>	sternopleural (= katepisternal) (seta)
<i>T1–T10</i>	abdominal terga
<i>t<sub>1</sub>, t<sub>2</sub>, t<sub>3</sub></i>	fore, mid, hind tibia
<i>va</i>	ventroapical seta on <i>t<sub>2</sub></i>
<i>vi</i>	vibrissa
<i>vte</i>	outer vertical (seta)
<i>vti</i>	inner vertical (seta)

## Results

### *Spelobia polymorpha* sp. nov.

(Figs 1–5, 8–25)

**Type material.** HOLOTYPE: ♂, labelled: “C. MADEIRA: Rabaçal env., 950 m, 5.9.2003, J. Roháček leg.”, “sifting leaves in laurel forest”, “Holotypus ♂ *Spelobia polymorpha* sp. n., J. Roháček det. 2018” (red label), “Mus. Silesiae Opava, Inv. č. d 097 4-2003”. The specimen (see Fig. 1) is intact, dry mounted on triangular pinned card (SMOC). PARATYPES: PORTUGAL: C. MADEIRA: Ribeiro Frio, 900 m, sifting leaves in laurel forest, 12.ix.2003, 2 ♀♀, J. Roháček leg. (SMOC). N. MADEIRA: Chão da Ribeira e do Seixal I, 32°47'37"N, 17°06'41"W, 570 m, 12.–19.ii., pitfall trap C<sub>8</sub>, ♂, 13.–20.iii.1997, pitfall traps B<sub>6</sub>, ♂, C<sub>4</sub>, 2 ♂♂, C<sub>11</sub>, ♂, all Dília Menezes leg.; Chão da Ribeira e do Seixal II, 32°48'12"N, 17°06'53"W, 462 m, 19.–26.i.1997, pitfall trap D<sub>4</sub>, ♂, Sérgio Teixeira & Fernando Nunes leg., 12.–19.ii., pitfall trap E<sub>6</sub>, ♂, 13.–20.iii., pitfall traps E<sub>1</sub>, ♀, E<sub>5</sub>, ♂, 7.–14.iv., pitfall trap E<sub>4</sub>, ♂, 2.–9.vi., pitfall trap E<sub>6</sub>, ♂, 25.viii.–1.ix.1997, pitfall traps E<sub>4</sub>, ♂, E<sub>12</sub>, ♂, all Dília Menezes leg., 21.–28.x., pitfall trap D<sub>4</sub>, ♀, 12.–24.xi.1997, E<sub>4</sub>, ♀, both Dília Menezes & Ysabel M. Gonçalves leg., 15.–22.xii.1997, pitfall trap F<sub>1</sub>, ♀, Ysabel M. Gonçalves & Fernando Nunes leg., 16.–23.iii.1998, pitfall trap F<sub>11</sub>, ♀, Dília Menezes leg. (UMa, but 4 ♂♂ 2 ♀♀ SMOC and 1 ♂ 1 ♀ in NMPC), some of above paratypes with genit. prep.

**Note.** The type locality is situated near the lonely forest house Rabaçal, about 32°45'43" N, 17°08'01" W (Fig. 31, for habitat see Fig. 30).

**Description. Male** (Fig. 1). Total body length 2.07–2.54 mm; general colour brown to blackish, subshining despite greyish brown microtomentum, distinctly duller on pleural part of thorax. Head somewhat higher than long (5:4 to 4:3), dark brown posteriorly to pale brown anteriorly. Frons brown to dark brown, but anteriorly pale brown to ochreous-orange, more or less microtomentose, partly subshining; occiput blackish brown and subshining despite dark greyish brown microtomentum. Orbits, interfrontalia and ocellar triangle with distinctly lighter grey microtomentum; orbit separated from interfrontalia by dark brown dull stripe (widened anteriorly); frontal triangle between interfrontalia narrow, subshining, and almost reaching to anterior margin of frons. Cephalic chaetotaxy: all macrosetae long and robust; *pvt* present as minute convergent setulae laterally between *occi*; *occe* and *occi* subequal and about two-thirds to three-fourth length of *vti*; *vti* robust and longest of frontal bristles; *vte* somewhat shorter than *vti* and *oc* slightly shorter than *vte*; 2 exclinate *ors* situated close

to each other, posterior as long as or slightly shorter than *vte* but much (almost twice) longer than anterior *ors*; 3–4 *ifr*, only middle pair robust (as long as *oc*) and strongly cruciate, 2–3 others minute, the 4th (posterior) *ifr* reduced to 1 microseta and often present only on one side of frons; 2–4 very minute *ads* inside and below *ors*; *g* proclinate, weak, hardly longer but thicker than anterior peristomal setula; 1–2 setulae behind *g* usually also well developed; *vi* strong, about as long as *vti* but thinner; peristomal setulae (5–8) smaller and finer than (6–7) postocular setae, the latter in single row continued ventrally by 3 postgenal setae, the distal being largest. Frontal lunule well developed, subtriangular, ochreous to pale brown, more or less concolorous with anterior margin of frons, greyish white microtomentose. Face brown to ochreous brown, normally darker than lunule; facial cavities below antennae subshining; medial carina well developed, dorsally most protruding (due to longer frontal lunule). Gena brown but sometimes ochreous, lighter anteriorly (at least on vibrissal angle), all greyish brown microtomentose. Eye subcircular to slightly suboval (10:9), of moderate size, with longest diameter about 3.4 times as long as smallest genal height. Antennae divergent, entirely brown; pedicel with relatively long marginal setae; 3rd antennal segment (1st flagellomere) transversely suboval (higher than long), somewhat shorter than scape + pedicel, with short grey ciliation on apex. Arista relatively long, 3.6–3.8 times as long as antenna, relatively shortly but densely ciliate.

Thorax blackish brown to brown (pleuron) and dark greyish brown microtomentose; mesonotum subshining, pleuron and scutellum with denser microtomentum and duller. Sutures between pleural sclerites ochreous. Scutellum large and relatively long, about 1.3 times as broad as long, subtriangular with apex rounded, flat on disc. Thoracic chaetotaxy: mesonotal macrosetae long and strong; 2 *hu* (the internal inclinate and short) and 1 microseta on humeral callus; 2 equally long and robust *dc*, anterior (in contrast to all congeners) presutural (Figs 1, 2), situated at level of presutural intraalar seta, posterior postsutural, situated in front of scutellar suture (Figs 1, 2); anterior postalar seta very long, longer than posterior *dc*; 6–8 rather irregular rows of *ac* microsetae on suture; medial prescutellar *ac* pair never enlarged; 2 strong and very long *sc*, laterobasal longer than scutellum and almost as long as anterior postalar seta, apical (longest thoracic seta) 1.4–1.5 times as long as laterobasal *sc*; only 1 long but relatively thin posterior *stpl* because anterior *stpl* reduced to minute, often hardly discernible, microseta.

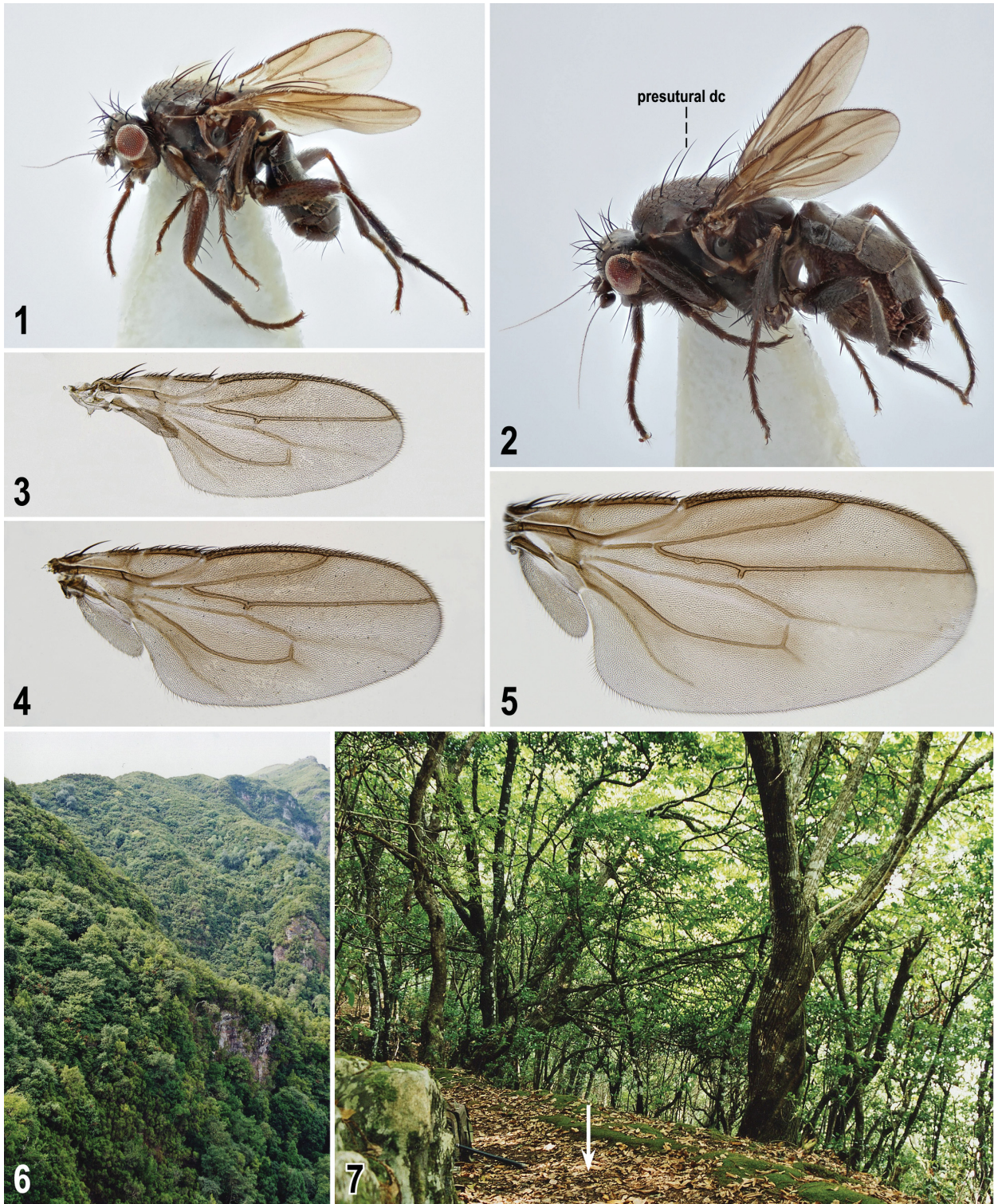
Legs relatively long, brown including all coxae and tarsi, only trochanters and knees slightly lighter. *f<sub>1</sub>* relatively robust but only with usual (rather fine) setae in posterodorsal and posteroventral rows. *t<sub>1</sub>* unmodified, slender. Mid leg chaetotaxy: *f<sub>2</sub>* with 1 strong anteropreapical seta and 2 shorter setae in front of it; posteropreapical seta also distinct but shorter. *t<sub>2</sub>* with very rich and strong setosity: both ventroapical and midventral seta robust and long (cf. Fig. 10); dorsal chaetotaxy of *t<sub>2</sub>* as in Fig. 8, with 3 anterodorsal (becoming longer distally) and 1 posterodorsal setae in proximal third and 6 setae (3 anterodorsal, 1 short dorsal



and 2 strong posterodorsal) in distal third, the most distal pair longest.  $t_3$  unusual in having 1 long dorsopreapical seta (cf. Figs 2, 11). Mid basitarsus ( $mt_2$ ) ventrally with anterior and posterior rows of short thicker setulae (similar to those of *S. luteilabris*).  $t_2 : mt_2 = 1.85\text{--}2.09$ .

Wing (Figs 3–5) variable in length and venation due to polymorphism. Alar membrane distinctly brownish

fumose, most darkened along dark brown veins. *C* ending at apex of  $R_{4+5}$ .  $R_{2+3}$  straight, very slightly sinuate or bent basally but apically distinctly upcurved to *C*;  $R_{4+5}$  straight or apically indistinctly bent and ending nearer apex of wing than venal fold of *M*. Discal cell (*dm*) rather variable in length, relatively large, more or less tapered distally, with short processes of *M* and  $CuA_1$  beyond *dm-cu* (that of  $CuA_1$



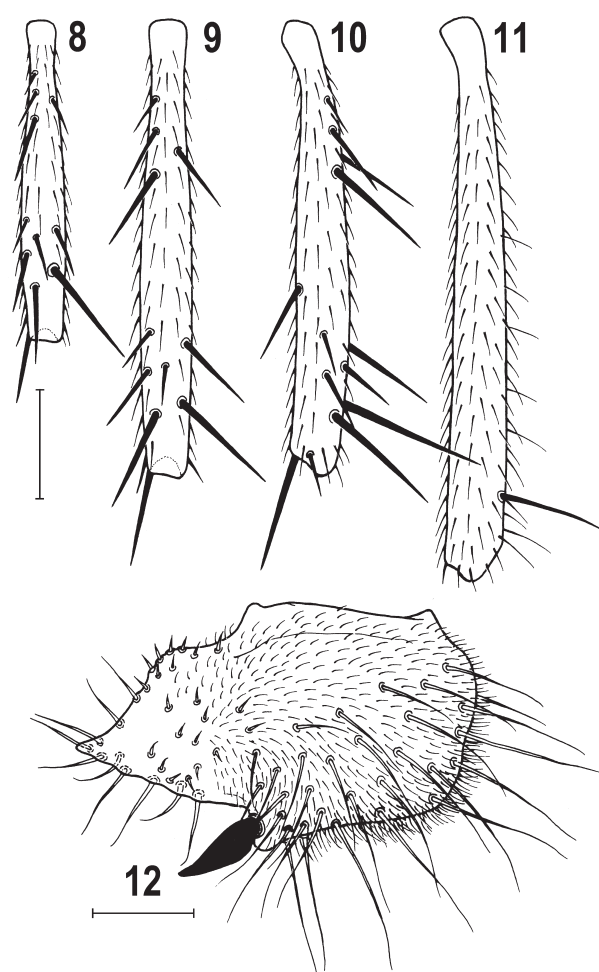
Figs 1–7. *Spelobia polymorpha* sp. nov. (Madeira) and its habitat. 1 – male holotype, laterally (body length 2.1 mm); 2 – female paratype, laterally (body length 2.9 mm); 3 – wing, f. brach., male paratype (length ca 1.3 mm); 4 – wing, f. brach., male paratype (length ca 1.6 mm); 5 – wing, f. submacropt., male paratype (length ca 2.3 mm); 6 – laurel forest on slopes near Ribeiro Frio; 7 – microhabitat in laurel forest, rotting fallen leaves on ground (arrow) in the same locality. Photo by M. Tkoč (1, 2) and J. Roháček (others).



usually longer); that of *M* continued by colourless fold to wing margin; anterior outer corners of *dm* cell regularly obtuse-angled but posterior corner variable, ranging from obtuse-angled to acute-angled. *A*<sub>1</sub> sinuate and relatively long but not reaching wing margin. Anal lobe large, well developed; alula large but narrow, particularly in more reduced wings. Wing measurements: length 1.31–2.35 mm, width 0.57–1.03 mm, *C-index* = 0.70–1.12,  $rm \setminus dm-cu : dm-cu = 1.47-2.70$ . Haltere with knob pale brown to brown and dirty yellow stem.

Abdomen largely blackish brown and dark greyish brown microtomentose. Preabdominal terga broad and subshining due to sparser greyish microtomentum. *T3–T5* not very densely but distinctly setose, with longest setae along lateral and posterior margins. *T1+2* longest tergum (but shorter than *T3* and *T4* together), somewhat paler but not desclerotized medially. *T3–T4* widest and most transverse terga; *T5* slightly shorter but much narrower than *T4* and somewhat tapered posteriorly. Preabdominal sterna: *S1+2* smallest, narrowest and distinctly paler than subsequent sterna, posteriorly widened, bare except for fine setulae at posterior margin; *S3* and, particularly *S4* large, both dark brown, heavily sclerotized and densely finely setose; *S3* transversely trapezoidal, narrower anteriorly and smaller than *S4*; the latter largest sternum, more transversely trapezoidal and posteriorly as wide as *S5*. Pregenital sternum (*S5*) transverse but not very short, slightly asymmetrical (Fig. 18), posteromedially with a comb of dense, pale and pointed spinulae and with a short, membranous, pale-pigmented area in front of the latter covered by 3–4 rows of minute pale tubercles. Disc of *S5* densely setose, setae surrounding central darkened area with hook-like apices; anterior marginal area of *S5* dark-pigmented. *S6+7* relatively short, strongly asymmetrical, shifted on left side of postabdomen, *S8* less asymmetrical and situated dorsally. *S6+7* with anterior dark-pigmented ledge projecting on ventral side of abdomen and with posteroventral dark projection bent inside postabdomen; *S6+7* with 4, *S8* with 7–8 distinct setae.

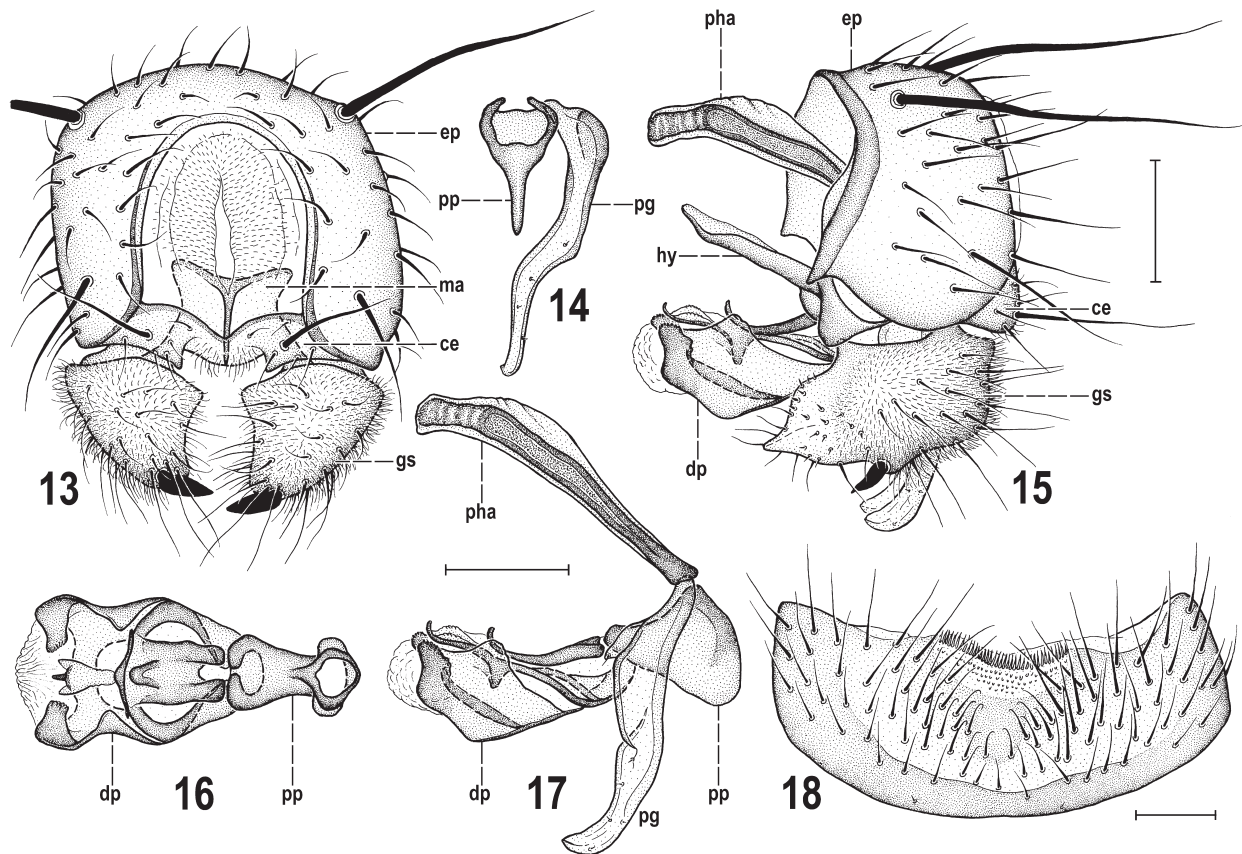
Genitalia: Epandrium (Figs 13, 15) of medium length and width, very slightly asymmetrical in caudal view (Fig. 13), with 1 robust and very long dorsolateral seta and 1 longer posterolateroventral seta, otherwise with a number of shorter finer setae. Anal fissure relatively large and high, suboval. Cerci short, dorsolaterally fused (fusion lines visible) with epandrium and medially forming subanal plate but each cercus with short acute corner in the middle of ventral margin (Fig. 13), with 1 long seta and several setulae. Medandrium relatively narrow, as high as broad, with usual medial keel, ventrolaterally connected with gonostyli (Fig. 13). Hyandrium roughly Y-shaped in dorsal view, with anteromedial rod-like apodeme relatively short and paired lateral sclerites well developed (cf. Fig. 15). Gonostylus (Figs 12, 13, 15) of shape typical for most of *Spelobia* species, relatively robust and large compared to epandrium, with anterior third projecting in acute corner, shortly setose but lacking micropubescence; posterior two-thirds of gonostylus robust, densely microtomentose and with numerous long but fine setae on outer side and ventrally armed by robust dark spine (see Fig. 12). Aedeagal complex (Figs 16, 17). Phallapodeme



Figs 8–12. *Spelobia polymorpha* sp. nov. (Madeira). 8 – male *t*<sub>2</sub> dorsally (holotype); 9 – female *t*<sub>2</sub> dorsally; 10 – ditto, anteriorly; 11 – female *t*<sub>3</sub> anteriorly (paratypes); 12 – gonostylus sublaterally (widest extension) (male paratype). Scales = 0.2 mm (Figs 8–11), 0.05 mm (Fig. 12).

not very large, somewhat longer and more robust than hypandrial apodeme, with moderate dorsal keel. Aedeagus (Figs 16, 17) with compact, ventrally laterally flattened but posterodorsally dilated phallosophore (Figs 14, 16) and relatively short distiphallus. Distiphallus symmetrical, basally formed by dorsal flat sclerite (Fig. 16) being narrowly incised posteriorly and having small dorsal projection anteriorly and by paired ventrolateral sclerites projecting as slender lateral bands dorsally (Fig. 17); distal part of distiphallus with large lateroventral sclerite and small narrow dorsal sclerite with three anterior teeth, the medial of which is curved and projecting dorsally (see Figs 16, 17). Postgonite relatively long (longer than distiphallus) but slender and flat, in caudal view distinctly sinuate (Fig. 14), with apex somewhat curved and with 4–5 microsetae in distal half of outer side (Fig. 17); minute pale sclerite (= remnant of pregonite) attached to anterodorsal part of postgonite with only 1 minute setula on apex (Fig. 17). Ejacapodeme inconspicuous, very minute (not illustrated on Fig. 17).

**Female** (Fig. 2). Similar to male unless mentioned otherwise below. Distinctly larger, total body length 2.70–3.30 mm. Mesonotum with *dc* microseta in front of anterior (pre-sutural) *dc* usually more enlarged, twice as long as other *dc*



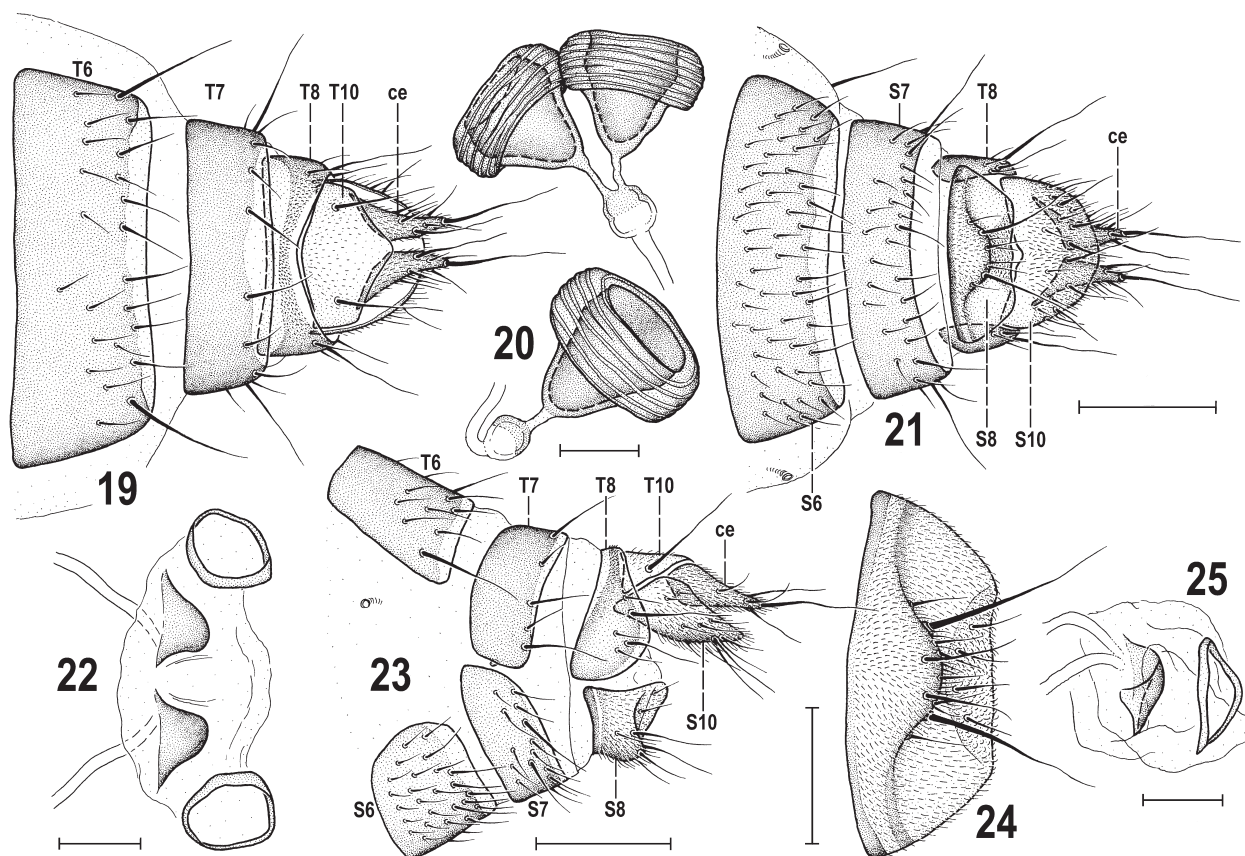
Figs 13–18. *Spelobia polymorpha* sp. nov., male paratype (Madeira). 13 – external genitalia, caudally (aegeal complex omitted); 14 – phallosome and right postgonite caudally; 15 – genitalia, laterally; 16 – aedeagus, dorsally; 17 – aedeagal complex, laterally; 18 – *S5*, ventrally. Scales = 0.1 mm. For abbreviations see pages 108–109.

microsetae;  $t_2$  ventrally with midventral seta usually longer than in male (Fig. 10), dorsal chaetotaxy as in male but most of macrosetae usually longer and more robust (Figs 8, 9);  $t_3$  longer but with dorsopreapical seta (Fig. 11) similar to that of male.  $t_2 : mt_2 = 1.88\text{--}2.03$ . No macropterous and/or submacropterous specimen examined.  $Cs_2$  often distinctly longer than  $Cs_3$ . Cell *dm* usually longer and its posterior outer corner often rectangular to acute-angled. Wing measurements: length 1.64–2.11 mm, width 0.67–0.93 mm, *C-index* = 0.81–1.28,  $rm\backslash dm-cu : dm-cu = 2.25\text{--}2.92$ . Preabdominal terga *T3* and *T4* distinctly more transverse; *T1+2* shorter than *T3* and *T4* together but posteriorly as wide as *T3*; *T3–T5* subequal in length but becoming narrower posteriorly, *T3* most transverse. Preabdominal sterna *S3–S5* similarly setose as *S3* and *S4* of the male. *S1+2* small, transversely suboblong, pale-pigmented, darker only along a row of small setae at posterior margin; *S3* transversely trapezoidal, narrower but slightly longer than *S4*; *S4* largest and widest sternum; *S5* unmodified, transversely suboblong, somewhat narrower and distinctly shorter than *S4*; all these sclerites dark brown-pigmented.

Postabdomen (Figs 19, 21, 23) relatively short and broad, with dark and well-sclerotized sclerites. *T6* transversely trapezoidal (slightly narrower posteriorly) but somewhat wider than *S6*, with pale posterior margin and setae in posterior half (Fig. 19); *T7* distinctly shorter than *T6* but more bent onto lateral side (see Fig. 23) and seemingly narrower in

dorsal view, with pale posterior margin and only single row of sparse setae in front of it. *T8* dorsomedially strongly shortened (Fig. 19), pigmented and distinctively microtomentose only in narrow stripe (thus posteriorly and anteriorly pale or unpigmented), with setae only on dilated lateral parts (Fig. 23), each with 1–2 long and a few small setae. *T10* relatively large, broad, transversely pentagonal, wider than long, pale-pigmented, sparsely finely micropubescent and with a pair of relatively long widely spaced setae in the middle (Fig. 19). *S6* much wider, longer and more densely setulose than *S7*, having posterior margin pale-pigmented (Figs 21, 23). *S7* simple, strongly transverse and bent onto lateral sides, with setae on most of surface and dark-pigmented as also is *S6*. *S8* (Figs 21, 23, 24) as wide as but shorter than *S10*, of rounded trapezoidal outline (see Fig. 24) but distinctly bulging in the middle and concavely depressed behind this bulge (see also Fig. 23), all densely micropubescent, with a pair of very long setae on posterolateral sides of the bulge and some shorter setae around and behind them. *S10* about 1.4 times as long as *S8*, flat, semicircular in ventral view (Fig. 21), pale pigmented, micropubescent except for anterior fourth and setose in posterior half, medial pair of setae longest (Fig. 21). Spectacles-shaped sclerite (= sclerotization of female genital chamber) relatively broad and transverse (Fig. 22), with relatively small widely spaced rings, and a pair of dark-pigmented basal sclerites between them (Figs 22, 25). Spermathecae 2+1 (Fig. 20) blackish brown, each





Figs 19–25. *Spelobia polymorpha* sp. nov., female paratype (Madeira). 19 – postabdomen, dorsally; 20 – spermathecae; 21 – postabdomen, ventrally; 22 – spectacles-shaped sclerite, ventrally; 23 – postabdomen, laterally; 24 – S8, ventrally; 25 – spectacles-shaped sclerite, laterally. Scales = 0.2 mm (Figs 19, 21, 23), 0.05 mm (others). For abbreviations see pages 108–109.

of robust tyre-shaped form, with strongly but sparsely ringed surface, very deep conical terminal invagination extended into conically dilated and strongly sclerotized terminal part of spermathecal duct; the latter also provided with a subterminal, partly sclerotized and pigmented subspherical vesicle. Cerci (Figs 19, 23) slender and relatively long, tapered towards terminal seta, dark-pigmented, densely micropubescent, each with 5 setae, the dorsopreapical, ventropreapical and apical long and sinuate, the latter longest, somewhat longer than length of cercus.

**Comments.** *Spelobia polymorpha* sp. nov. is externally a very distinctive species, differing markedly from all known congeners. Its unusual and strong chaetotaxy, including the presence of a robust presutural *dc* seta (unique within the genus), very rich and strong setae of  $t_2$  (see a group of 6 setae in distal third) and dorsal preapical seta on  $t_3$ , makes this species unmistakable. Its wing polymorphism is another uncommon character within *Spelobia*, hitherto known only in two species living on European continent (see ROHÁČEK 2012). Also the presence of a dorsal preapical seta is a rare phenomenon in *Spelobia*, occurring only in the New World *S. maculipennis* (Spuler, 1925), the Mexican *S. robinsoni* Marshall, 1985 (for both species see MARSHALL 1985), the Holarctic *S. pseudosetaria* (Duda, 1918) (only exceptionally, see ROHÁČEK 1983b: fig. 577) and the Mongolian *S. duplisetaria* (Papp, 1973) having a pair of setae in this position (cf. PAPP 1973).

Despite the above morphological peculiarities (and also different gonostylus) this new species seems to belong to the *S. pseudosetaria* alliance (group defined by MARSHALL 1985), particularly due to the construction of the male subanal plate, aedeagal complex (distiphallus, phallopore, postgonite), pattern and chaetotaxy of male *S5* and some sclerites of the female postabdomen (*S8* bulging ventrally in the middle, spectacles-shaped sclerite with a pair of small sclerites besides usual rings) and narrow alula, and particularly resembles in (most of) these structures *S. pseudosetaria*, cf. ROHÁČEK (1983b: figs 584, 586–590). The gonostylus of *S. polymorpha* sp. nov. is somewhat similar to that of the European *S. pseudonivalis* (Dahl, 1909) (cf. ROHÁČEK (1983b: fig. 525) but this species, although also wing-polymorphic, differs distinctly in structure and armature of male *S5*, distiphallus, female postabdominal sclerites as well as  $t_2$  chaetotaxy, cf. ROHÁČEK (1983b: figs 519, 520, 528, 529–531, 553–535).

**Etymology.** Named according to its wing polymorphism (in both sexes), a phenomenon formerly unknown in Sphaeroceridae occurring on islands of the whole of Macaronesia; adjective.

**Biology.** *Spelobia polymorpha* is a terricolous species confined to the Laurisilva ecosystem (Figs 6, 7, 30, 51), living under rotten leaves in detritus on the ground of the forest. This habitat association (the same as in both *Pullimosina* species described below) seems to influence its morpho-

gy, resulting in the tendency to wing reduction. The short-winged specimens (wings ending before tip of abdomen, Figs 2, 3, 4) prevail in populations; more rarely almost fully winged specimens (Fig. 5) occur among them and, consequently, the species displays pterygopolymorphism similar to that described in the European *S. pseudonivalis*, cf. ROHÁČEK (2012), although in the brachypterous form the latter species has the wing much more reduced. In *S. polymorpha* a few (sub)macropterous and intermediate specimens have only been detected among males while all examined females were (more or less distinctly) brachypterous. However, because in the material under study the series of females was much smaller we cannot exclude that macropterous specimens can also occur rarely in the female sex. Interestingly, all obtained females were gravid, containing mature eggs in their abdomens. Adults were recorded in January–June, August–December.

**Distribution.** Madeira (localities mapped in Fig. 69).

***Pullimosina (Pullimosina) kesoni* sp. nov.**

(Figs 26–29, 32–47)

**Type material.** HOLOTYPE: ♂, labelled: “C. MADEIRA: Rabaçal env., 950 m, 5.9.2003, J. Roháček leg.”, “sifting leaves in laurel forest”, “Holotypus ♂ *Pullimosina (Pullimosina) kesoni* sp. n., J. Roháček det. 2018” (red label), “Mus. Silesiae Opava, Inv. č. d 097 4-2003”. The specimen (see Fig. 26) is intact, dry mounted on triangular pinned card (SMOC). PARATYPES: PORTUGAL: C. MADEIRA: same data as for holotype, 23 ♂♂ 20 ♀♀ (SMOC, 2 ♂♂ 2 ♀♀ in NMPC); Ribeiro Frio, 900 m, sifting leaves in laurel forest, 12.ix.2003, 1 ♂ 1 ♀, J. Roháček leg. (SMOC). N. MADEIRA: Chão da Ribeira e do Seixal I, 32°47'37"N, 17°06'41"W, 570 m, 13.–20.iii.1997, pitfall traps A<sub>9</sub>, ♂, B<sub>11</sub>, 2 ♂♂, B<sub>12</sub>, ♂ ♀, all Dília Menezes leg.; 18.ii.–10.iii.1997, pitfall trap B<sub>1</sub>, 1 ♂ 4 ♀♀, no collector; Chão da Ribeira e do Seixal II, 32°48'12"N, 17°06'53"W, 462 m, 13.–20.iii.1997, pitfall traps D<sub>10</sub>, ♂, E<sub>1</sub>, ♂, F<sub>10</sub>, 2 ♀♀, Dília Menezes leg. (all UMa). Some of above paratypes with genit. prep.

**Note.** The type locality (the same as for *S. polymorpha* described above) lies close to the forest house Rabaçal, about 32°45'43" N, 17°08'01" W (Fig. 31, for habitat see Fig. 30).

**Description. Male** (Fig. 26). Total body length 1.62–1.95 mm; general colour brown to dark brown with greyish brown microtomentum, subshining dorsally (thorax, abdomen), duller laterally (thoracic pleuron) and ventrally (abdomen). Head (Fig. 28) somewhat higher than long (ca. 5 : 4), brown to blackish brown except for distinctly paler (ochreous to yellow) face. Frons dark brown, relatively sparsely microtomentose, partly shining; occiput blackish brown with similar microtomentum. Orbits, interfrontalia and ocellar triangle distinctly grey microtomentose; orbit separated from interfrontalia by blackish brown dull stripe (widened anteriorly); frontal triangle poorly delimited, long, reaching to anterior margin of frons and distinctly more shining than rest of frons. Cephalic chaetotaxy (Fig. 28): *pvt* absent, only minute divergent postocellar setulae laterally behind ocellar triangle; *occe* and *occi* subequal (or *occi* slightly longer) and about two-thirds to three-fourth length of *vti*; *vti* robust and longest of frontal bristles; *vte* and *oc* somewhat shorter than *vti*; 2 *ors*, posterior as long as *vte* (or *oc*) but much (twice) longer than anterior *ors*; 3 *ifr*, middle pair robust (sometimes almost as long as *oc*), 2 others fine, small, only about half length of the former, sometimes with 1 microseta in front of anterior

*ifr* in addition; 2–3 very minute *ads* inside and below *ors*; *g* weak, hardly longer than anterior peristomal setula; *vi* robust, about as long as *vti*; peristomal setulae (7–8) about as long as those in (single) postocular row; postgenal setae (3) relatively strong and curved. Frontal lunule short and wide, ochreous to yellowish ochreous, sparsely greyish microtomentose, contrasting with dark brown frons but concolorous with face. Face ochreous to dark yellow, usually darker dorsomedially and laterally; facial cavities below antennae relatively shining; medial carina developed, most distinct dorsally, below frontal lunule. Gena brown, paler anteriorly (with vibrissal angle ochreous), dark brown posteriorly, all greyish brown microtomentose. Eye subcircular (16:15), of moderate size, with longest diameter about 3.0 times as long as smallest genal height. Antenna brown to dark brown; 3rd segment (1st flagellomere) relatively short (not longer than scape + pedicel), suboval, with greyish white ciliation on apex distinctly longer than cilia on arista. Arista relatively long, about 4.1 times as long as antenna, shortly but densely ciliate.

Thorax dark brown to brown (pleuron) and dark greyish brown microtomentose; mesonotum subshining, pleuron and scutellum with denser microtomentum and duller. Sutures between pleural sclerites pale brown to ochreous. Scutellum large and flat on disc, transversely (5:3) rounded trapezoidal. Thoracic chaetotaxy: mesonotal macrosetae relatively short but robust; 1 *hu* and 2 microsetae on humeral callus; 3 postsutural *dc* but the most anterior small (but distinctly thicker and about 3 times as long as *dc* microsetae), two posterior *dc* robust but relatively short (the longer hindmost *dc* shorter than basal *sc*); 6 (rarely 7) rows of *ac* microsetae on suture; medial prescutellar *ac* pair prolonged, about as long as anterior *dc*; 2 long *sc*, laterobasal about as long as scutellum, apical (longest thoracic seta) 1.6–1.7 times as long as laterobasal; 2 *stpl* but anterior reduced to small and fine setula.

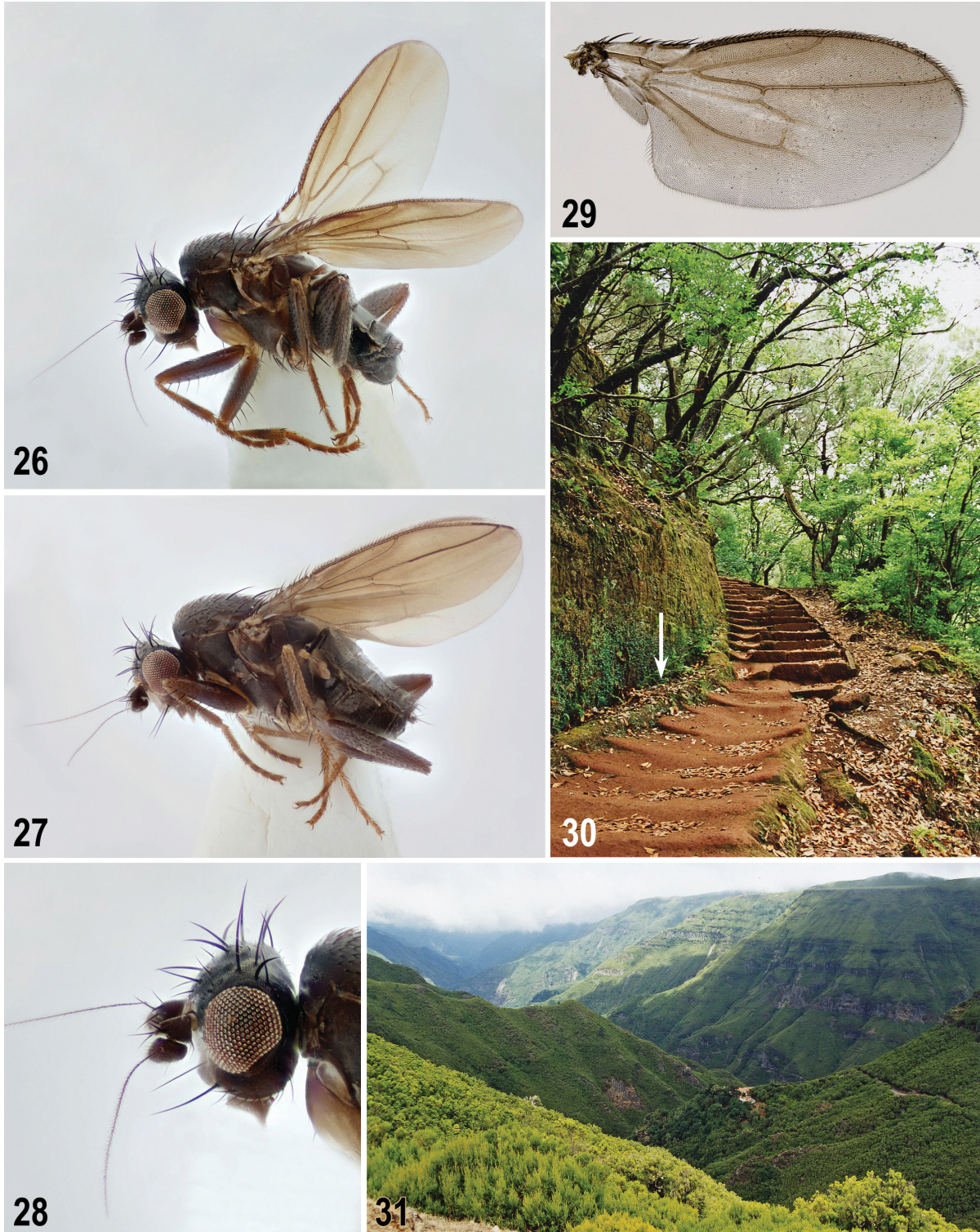
Legs brown to dark brown, only coxae, trochanters, knees and tarsi pale brown to ochreous; fore coxa lightest, yellowish ochreous. Mid leg chaetotaxy: *f*<sub>2</sub> with 2 rows of short but slightly thickened (antero- and postero-) ventral setae (6–8 setae in each row) in proximal two-thirds. *t*<sub>2</sub> (contrary to that all European congeners except for *P. dorae* sp. nov.) ventrally with a long row of small dense spines and distinct (although shorter than in female) ventroapical seta and 1 small anteroapical seta (see Fig. 44; dorsal chaetotaxy of *t*<sub>2</sub> as in Fig. 40: 1 anterodorsal seta in proximal fourth surmounted by 1–2 setulae, 1 anterodorsal seta in distal third (also surmounted by a shorter seta), 1 long dorsal seta in distal fifth and 1 shorter posterodorsal seta in distal fourth. *f*<sub>3</sub> somewhat thickened and shorter than in female. Ratio *t*<sub>2</sub> : *mt*<sub>2</sub> = 1.83–1.91.

Wing (Fig. 29) with distinctly brownish fumose membrane (darkest along veins) and brown to dark brown veins. *C* produced far beyond apex of *R*<sub>4+5</sub>. *R*<sub>2+3</sub> very slightly sinuate but apically distinctly upcurved to *C*; *R*<sub>4+5</sub> basally almost straight, distally slightly upcurved to *C* but diverging from and ending distinctly farther from apex of wing than venal fold of *M*. Discal cell (*dm*) rather short, distally broad, with short to minute processes of *M* and



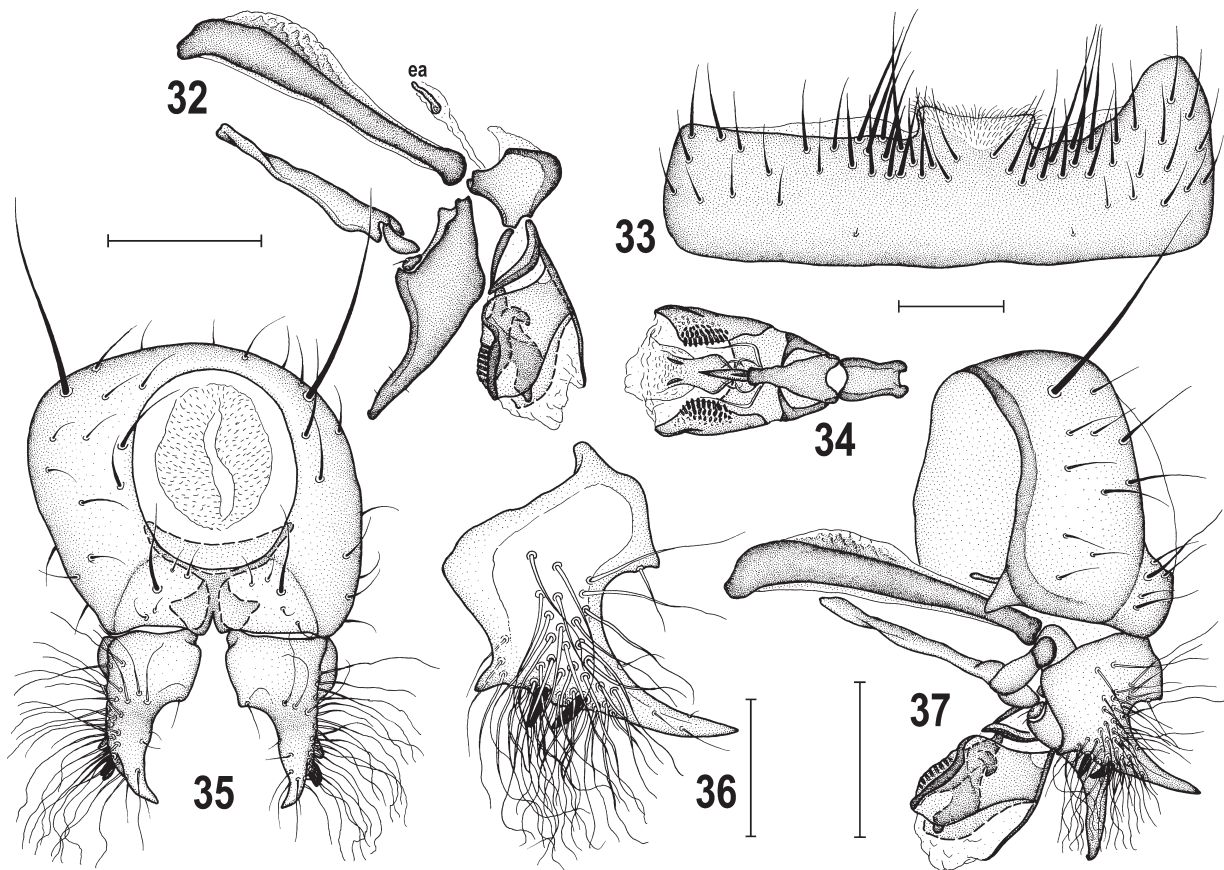
$CuA_1$  beyond  $dm-cu$  (that of  $CuA_1$ , longer) which continue by colourless folds; both outer corners of  $dm$  cell obtuse-angled.  $A_1$  reduced, short. Anal lobe large, well developed; alula relatively small and narrow. Wing measurements: length 1.54–1.71 mm, width 0.68–0.77 mm,  $C$ -index = 0.95–1.08,  $rm/dm-cu : dm-cu = 1.25$ –1.60. Haltere pale brown to brown, with ochreous stem.

Abdomen blackish brown dorsally, brown ventrally. Preabdominal terga broad and relatively shining because of sparse greyish microtomentum,  $T2$ – $T5$  sparsely and relatively shortly setose, with longest setae in posterior corners.  $T1+2$  largest tergum (somewhat longer than  $T3$  and  $T4$  together), not desclerotized and/or depressed medially but paler brown on original  $T1$  (lightest medially) being



Figs 26–31. *Pullimosina (Pullimosina) kesoni* sp. nov. (Madeira) and its habitat. 26 – male holotype, laterally (body length 1.7 mm); 27 – female paratype, laterally (body length 1.8 mm); 28 – head, laterally, male holotype; 29 – wing, male paratype (length ca 1.7 mm); 30 – microhabitat, rotting leaf litter in ditch (arrow) along path in laurel forest nr. Rabaçal; 31 – upper part of valley of Ribeira de Janella nr. Rabaçal (type locality of both *S. polymorpha* and *P. kesoni*). Photo by M. Tkoč (26–28) and J. Roháček (others).





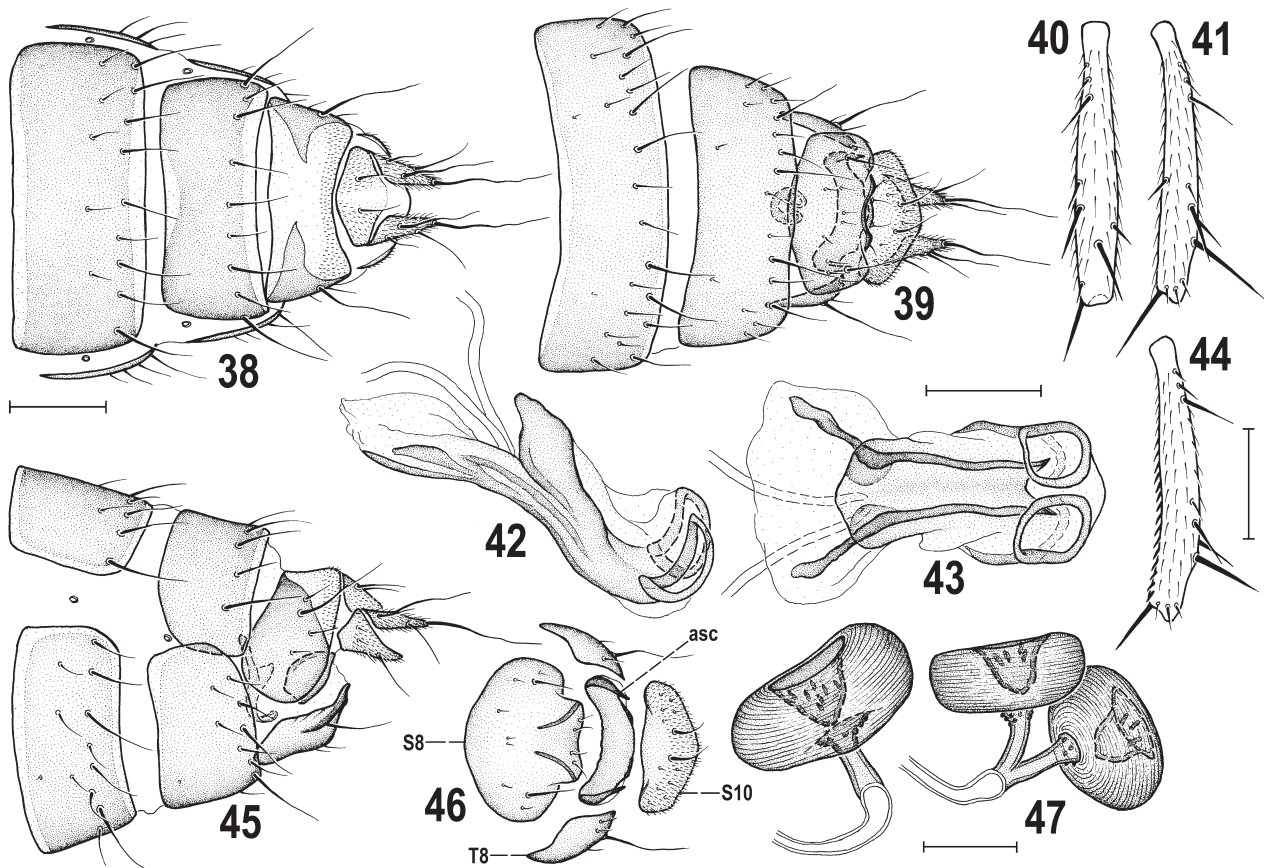
Figs 32–37. *Pullimosina (Pullimosina) kesoni* sp. nov., male paratype (Madeira). 32 – aedeagal complex, laterally; 33 – *S5*, ventrally; 34 – aedeagus, dorsally; 35 – external genitalia (aedeagal complex omitted), caudally; 36 – gonostylus, sublaterally (widest extension); 37 – genitalia, laterally. Scales = 0.05 mm (Fig. 36), 0.1 mm (others). For abbreviations see pages 108–109.

delimited from original *T2* by a transverse wrinkle. *T3–T5* becoming narrower posteriorly, *T5* smallest. Preabdominal sterna: *S1+2* small, reduced to inconspicuous, very pale (submembranous) and bare sclerite; *S3* and, particularly *S4* large, broad, brown and heavily sclerotized; *S3* transversely trapezoidal, narrower anteriorly and smaller than *S4*, the latter the largest sternum, transversely suboblong and distinctly longer than (equally broad) *S5*. *S3* and *S4* with shorter and finer setae than adjacent terga. *S5* (Fig. 33) transverse, slightly asymmetrical, with short postero-medial submembranous and finely haired lappet and two groups of longer and denser setae laterally in front of the latter, otherwise relatively sparsely setose. *S6+7* strongly asymmetrical, shifted on left side of postabdomen, *S8* less asymmetrical and situated dorsally. *S6+7* with anterior dark-pigmented ledge and with posteroventral dark projection bent inside postabdomen; both *S6+7* and *S8* with only a few small setae.

Genitalia: Epandrium (Figs 35, 37) relatively short, of medium width but slightly asymmetrical in caudal view, more convex left dorsolaterally (Fig. 35), with 1 very long and robust dorsolateral seta, otherwise with sparse small setae, only some of them at margin of anal fissure longer. Anal fissure relatively large, broadly suboval. Cerci short, fused with epandrium and medially forming subanal (ventromedially acutely incised) plate but lines of fusion remain visible (Figs 35, 37); each cercus with 1 longer and several short setae. Medandrium somewhat X-shaped in

caudal view, hence broad dorsally and most narrowed in the middle, fused with cerci posteromedially and ventrally connected with gonostyli (Fig. 35). Hyandrium roughly Y-shaped in dorsal view, with anteromedial rod-like apodeme, smaller paired lateral sclerites, and more medially with minute sclerites connecting hyandrium with postgonites (cf. Fig. 32). Gonostylus (Figs 35–37) of distinctive shape, long acutely projecting posteroventrally and with smaller acute process also in the middle of anterior margin; outer side with very long sinuous setae on most of surface, and, in contrast to all congeners, with 1–2 short robust and dark spines between both above projections (see Fig. 36). Aedeagal complex (Figs 32, 34). Phallopodeme longer and more robust than hyandrial apodeme, with well-developed dorsal keel. Aedeagus with compact, laterally flattened phallopore (Figs 32, 34) and relatively short distiphallus. Distiphallus basally formed by a distally tapered dorsal plate (Fig. 34) and a pair of lateral slender sclerites (Fig. 32); its larger and wider distal part composed of wing-like (ventrally connected) lateral sclerites, each of which carries dorsally a group of small dark spinulae (Fig. 34). Dorsomedial sclerotization between the latter sclerites complex, with distinct medial spike-like process (not visible in lateral view); postgonite relatively large (longer than distiphallus), broad proximally, strongly tapered distally but with apex not acute, with a minute preapical tooth anteriorly, 2–3 microsetae (both anteriorly and posteriorly) in distal fourth and with minute sclerite (= remnant of pregonite)





Figs 38–47. *Pullimosina (Pullimosina) kesoni* sp. nov., female and male paratypes (Madeira). 38 – female postabdomen, dorsally; 39 – ditto, ventrally; 40 – female  $t_2$  dorsally; 41 – ditto, anteriorly; 42 – spectacles-shaped sclerite, laterally; 43 – ditto, posteroventrally; 44 – male  $t_2$  anteriorly; 45 – female postabdomen, laterally; 46 – sclerites of 8th segment and  $S10$ , ventrocaudally; 47 – spermathecae. Scales = 0.1 mm (Figs 38, 39, 45, 46), 0.03 mm (Figs 42, 43, 47), 0.2 mm (others). For abbreviations see pages 108–109.

with 2 setulae, inserted into anterodorsal emargination of postgonite (Fig. 32). Ejacapodeme reduced to very minute rod-like sclerite (see Fig. 32) attached to ejaculatory duct.

**Female** (Fig. 27). Similar to male unless mentioned otherwise below. Total body length 1.74–2.05 mm. *ifr* often more robust, particularly the anterior and 1 microseta in front of the latter more distinct and almost regularly present. Legs sometimes with tibiae pale brown to ochreous.  $f_2$  ventrally simply setulose, without two rows of thicker curved setae;  $t_2$  ventrally with 1 short ventral seta near middle and 1 long (longer than in male) ventroapical seta (Fig. 41); dorsal chaetotaxy as in male but some setae (the long distal dorsal seta in particular) often longer (Fig. 40); also small anteroapical seta usually somewhat longer.  $mt_2$  relatively longer, also  $f_3$  longer and less thickened than in male. Ratio  $t_2 : mt_2 = 1.64$ – $1.76$ . Wing measurements: length 1.62–1.87 mm, width 0.73–0.84 mm,  $C$ -index = 0.98–1.14,  $rm \setminus dm-cu : dm-cu = 1.27$ – $1.54$ . Preabdominal terga distinctly shorter, more transverse;  $T1+2$  shorter than  $T3$  and  $T4$  together;  $T3$ – $T5$  becoming narrower posteriorly, similarly setose as in male. Preabdominal sterna  $S3$ – $S5$  sparsely and shortly setose, subshining due to sparse microtomentum.  $S1+2$  very reduced, bare and submembranous as in male;  $S3$ – $S4$  large, similarly formed but more transverse than in male;  $S4$  largest and widest sternum, about as long as  $S3$ ;  $S5$  unmodified, transversely suboblong, narrower and distinctly shorter than  $S4$ ; all these sclerites dark brown, heavily sclerotized.

Postabdomen (Figs 38, 39, 45) relatively short and broad, with sparsely setose sclerites.  $T6$  transversely suboblong but narrower than  $S6$ , with both anterior and posterior margins pale and setae in posterior half (Fig. 38);  $T7$  slightly shorter than  $T6$  and bent farther onto lateral side (see Fig. 45) and seemingly narrower in dorsal view, with pale posterior margin and only single row of setae in front of it.  $T8$  dorsomedially membranous, unpigmented, appearing to be divided into two lateral sclerites (Figs 38, 45), each with 1 long and a few small setae.  $T10$  transversely subrhomboidal, distinctly wider than long, largely pale-pigmented, finely micropubescent and with a pair of relatively short setae in the middle (Fig. 38).  $S6$  much wider, more transverse and more setulose than both  $T6$  and  $S7$ , having all margins pale-pigmented (Figs 39, 45).  $S7$  simple, transversely suboblong, slightly wider than  $T6$ , with setae only at posterior margin.  $S8$  (Figs 39, 46) only slightly larger than  $S10$ , of suboval outline (in largest extension view, see Fig. 46), convex in the middle, posteriorly with a slightly projecting lobe provided with a pair of dark bent ledges, with only sparse setulae except for a pair of longer lateral setae. Additional sclerite between  $S8$  and  $S10$  (covered by  $S8$  in ventral view, Fig. 39) well developed and dark-pigmented, bare, bent, with slender, dark and posteriorly projecting lateral ledges (Fig. 46).  $S10$  about half-length of  $S8$ , transversely pentagonal, pale pigmented, micropubescent and setulose in posterior half, medially with a pair of longer setae (Fig. 46). Spectacles-shaped sclerite (=

sclerotization of female genital chamber) oriented vertically (see in situ, Fig. 45), elongate, with relatively small rings (Figs 42, 43). Spermathecae 2+1 (Fig. 47) blackish brown, each of relatively robust tyre-shaped form, with very finely densely ringed surface, deep subconical terminal invagination (with distinct spinule inside), terminal parts of ducts well-sclerotized, somewhat conically dilated towards insertion and provided with small dark tubercles. Cerci (Figs 38, 45) slender, tapered towards terminal seta, micropubescent, each with 4 setae, the dorsopreapical and apical long and sinuate, the latter longer than length of cercus.

**Comments.** *Pullimosina kelsoni* sp. nov. and its closest relative *P. dorae* sp. nov. are among the largest species of the genus. Both distinctly belong to the subgenus *Pullimosina* (s. str.) *antennata* group as delimited by MARSHALL (1986) because of possessing cruciate middle *ifr* setae, densely and long setose gonostylus, distiphallus with spinose or toothed distal sclerites and a well-developed additional sclerite between female *S8* and *S10*.

Because of its yellow to ochreous face *P. kelsoni* habitually most resembles *P. dorae* sp. nov. (Madeira, described below), *P. pullula* (Zetterstedt, 1847) (Holarctic), *P. mejerei* (Duda, 1918) (European), *P. geminata* Marshall, 1986 and *P. vockerothi* Marshall, 1986 (both Nearctic), but except for the first and perhaps the latter none of the remaining species seem to be its close relative. Based on structures of the male and female terminalia *P. dorae* is obviously the nearest ally of *P. kelsoni*. Surprisingly also the Mexican *P. mc Alpinei* Marshall, 1986 could be more related to *P. kelsoni*, resembling the latter in the shape of gonostylus, postgonite and apex of distiphallus (MARSHALL 1986: figs 69, 70) and in larger size of body while the formation of female postabdominal sclerites is very dissimilar in these two species. *Pullimosina kelsoni* seems to be unique among *Pullimosina* species in having a gonostylus ventrally armed by 1–2 robust spines (see Fig. 36) in addition to posterior and anterior acutely projecting corners. Note: a short thick spine-like seta (albeit much smaller) is also illustrated on the gonostylus of *P. meta* Su, 2011 on apex of anterior gonostylar projection (see Su 2011: figs 51e,f) but this was corrected subsequently by Su et al. (2013, fig. 4f) to be only a pointed apex of this projection.

The male pregenital sternum (*S5*) of *P. kelsoni* resembles most that of *P. dorae* but differs in having a posteromedial membranous lappet and less dense clumps of setae near the latter (Fig. 33). Although having a very similarly constructed distiphallus, these two species have a quite dissimilar postgonite (distally tapered and slender in *P. kelsoni* while dilated and robust terminally in *P. dorae*). Further distinct differences can be seen in the female postabdomen: *T8* is dorsomedially short and broadly desclerotized in *P. kelsoni* (Fig. 38) while continuous and robust in *P. dorae* (Fig. 58), *S8* is posteromedially abruptly narrowed and with a pair of dark strips in *P. kelsoni* (Fig. 46) but rounded and anteromedially with a ventrally protruding bulge in *P. dorae* (Fig. 62), additional sclerite short (transverse) and with marginal dark ledges laterally in *P. kelsoni* (Fig. 46) while longer and with 2 lobes posterolaterally in *P. dorae* (Fig. 61), also the spectacles-shaped sclerite (although with similarly elongate and vertically positioned medial

sclerite) is distinctly different in having small, closely situated rings in *P. kelsoni* (Fig. 43) and larger more separate rings in *P. dorae* (Fig. 64) and the spermathecae are rather tyre-shaped in *P. kelsoni* (Fig. 47) while more vesicular in *P. dorae* (Figs 59, 60).

**Etymology.** The species is dedicated to my friend from school-days, Ing. Antonín Nosek (Jihlava, Czech Republic), using his nickname from grammar-school “Keson” (= anagram of Nosek).

**Biology.** All studied specimens were collected in montane laurel forests (Figs 6, 31), either sifted from rotting leaves and detritus (microhabitat on Figs 7, 30) or captured into pitfall traps installed in the same habitat. Observation of living specimens showed that they practically do not fly, only run or skip among forest litter. Consequently, *P. kelsoni* seems to be a terricolous species living on the ground under the layer of decayed leaves of laurel trees. Adults were recorded in February, March and September

**Distribution.** Madeira, mainly recorded from localities with a well preserved Laurisilva ecosystem, more rarely (Chão da Ribeira e do Seixal II) in that partly degraded with some introduced exotic plants (all occurrence sites mapped in Fig. 69).

### *Pullimosina (Pullimosina) dorae* sp. nov.

(Figs 48, 52–68)

**Type material.** HOLOTYPE: ♂, labelled: “N. MADEIRA: Chão da Ribeira e do Seixal II, 32°48'12"N, 17°06'53"W, 462 m, Ysabel M. Gonçalves & Fernando Nunes leg.” (printed), “15-12/12/97, E, Pit” (handwritten), “Holotypus ♂ *Pullimosina (Pullimosina) dorae* sp. n., J. Roháček det. 2018” (red label). The specimen is intact, dried from ethanol and mounted on triangular pinned card (SMOC). PARATYPES: **PORTUGAL: N. MADEIRA:** Chão da Ribeira e do Seixal I, 32°47'37"N, 17°06'41"W, 570 m, 18.ii.–10.iii., pitfall trap B<sub>1</sub>, ♂, no collector; 18.ii.–10.iii., pitfall trap A<sub>3</sub>, ♂, 13.–20.iii., pitfall traps B<sub>9</sub>, ♂ 2 ♀♀, 7.–14.iv., pitfall trap C<sub>4</sub>, ♀, 14.–18.iv., pitfall trap C<sub>6</sub>, 2 ♂♂, 5.–12.v., pitfall trap A<sub>5</sub>, ♀, 30.vi.–7.vii., pitfall trap B<sub>5</sub>, ♂, 28.vii.–4.viii.1997, pitfall traps A<sub>4</sub>, ♀, B<sub>12</sub>, ♂, all Dília Menezes leg.; Chão da Ribeira e do Seixal II, 32°48'12"N, 17°06'53"W, 462 m, 12.–19.ii., pitfall trap D<sub>9</sub>, ♀, 19.ii.–10.iii. pitfall traps D<sub>1</sub>, 3 ♂♂, D<sub>2</sub>, ♂ ♀, D<sub>3</sub>, 2 ♂♂ 3 ♀♀, E<sub>1</sub>, ♂, E<sub>2</sub>, 2 ♂♂ ♀, 13.–20.iii., D<sub>6</sub>, 2 ♂♂ ♀, D<sub>9</sub>, ♂ 2 ♀♀, D<sub>10</sub>, 3 ♂♂ 2 ♀♀, D<sub>11</sub>, 2 ♂♂, E<sub>6</sub>, 1 ♂ 2 ♀♀, E<sub>7</sub>, 2 ♂♂ 3 ♀♀, E<sub>10</sub>, 2 ♀♀, 7.–14.iv., pitfall traps D<sub>3</sub>, ♀, D<sub>4</sub>, ♀, D<sub>5</sub>, ♂, D<sub>7</sub>, ♂, D<sub>10</sub>, ♀, E<sub>4</sub>, ♀, E<sub>6</sub>, ♂, E<sub>8</sub>, ♂, 2.–9.vi., pitfall traps D<sub>5</sub>, ♀, D<sub>6</sub>, ♀, D<sub>8</sub>, ♀, D<sub>11</sub>, ♀, E<sub>6</sub>, 2 ♀♀, 28.vii.–4.viii., pitfall traps D<sub>7</sub>, ♀, E<sub>3</sub>, ♀, E<sub>7</sub>, 2 ♀♀, F<sub>1</sub>, ♂, 25.viii.–1. ix.1997, pitfall traps D<sub>3</sub>, ♀, D<sub>6</sub>, ♂ ♀, D<sub>12</sub>, ♀, E<sub>1</sub>, ♂, E<sub>4</sub>, ♂, all Dília Menezes leg.; 22.–29.ix.1997, pitfall traps D<sub>6</sub>, ♀, D<sub>7</sub>, ♂, D<sub>9</sub>, ♀, Ysabel M. Gonçalves leg.; 21.–28.x., pitfall trap D<sub>8</sub>, ♀, 17.–24.xi.1997, pitfall traps D<sub>5</sub>, ♀, D<sub>12</sub>, 2 ♀♀, E<sub>7</sub>, ♀, F<sub>12</sub>, ♀, all Dília Menezes & Ysabel M. Gonçalves leg.; 19.–26.i.1998, pitfall trap E<sub>4</sub>, ♂, Dília Menezes, Ysabel M. Gonçalves & Fernando Nunes leg. (UMa, 10 ♂♂ 10 ♀♀ in SMOC, 2 ♂♂ 2 ♀♀ in NMPC; most specimens preserved in ethanol, some dried and mounted on pinned trinagular cards, some with genit. prep.). **S. MADEIRA:** Funchal-Monte, Ribeira de João Gómez, 450 m, under stones in mixed forest, 7.ix.2003, J. Roháček leg. (SMOC, genit. prep.).

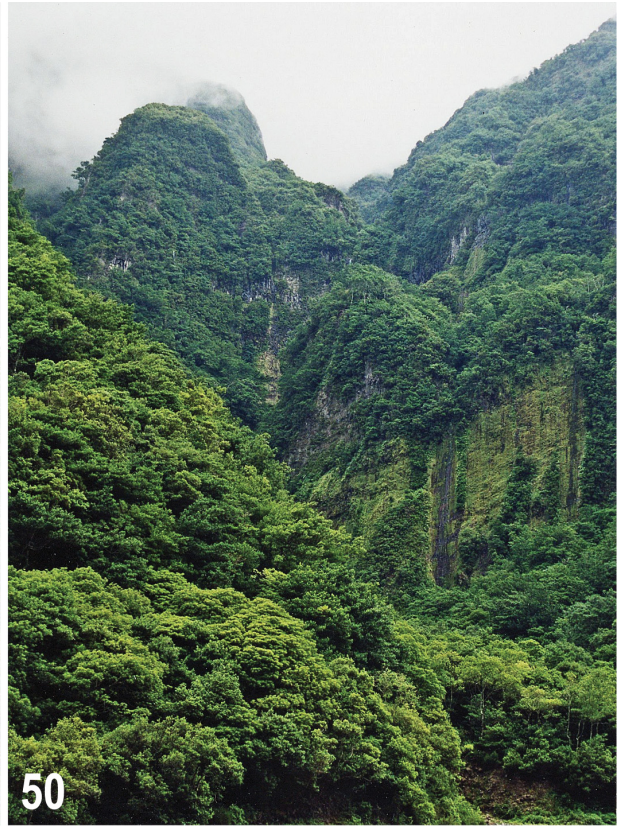
**Additional non-type specimens** (damaged specimens): **N. MADEIRA:** Chão da Ribeira e do Seixal II, 32°48'12"N, 17°06'53"W, 462 m, 13.–20.iii., pitfall traps E<sub>7</sub>, 4 ♀♀, E<sub>10</sub>, ♂, 7.–14.iv.1997, pitfall trap E<sub>2</sub>, ♀, all all Dília Menezes leg. (UMa).

**Description. Male.** Total body length 1.38–1.95 mm; general colour and microtomentum as in *P. kelsoni* including duller lateral and ventral portions of body. Head distinctly higher than long (about 3:2) but generally coloured as in *P. kelsoni*, brown to blackish brown except for distinctly paler (ochreous) face. Frons brown to blackish brown,



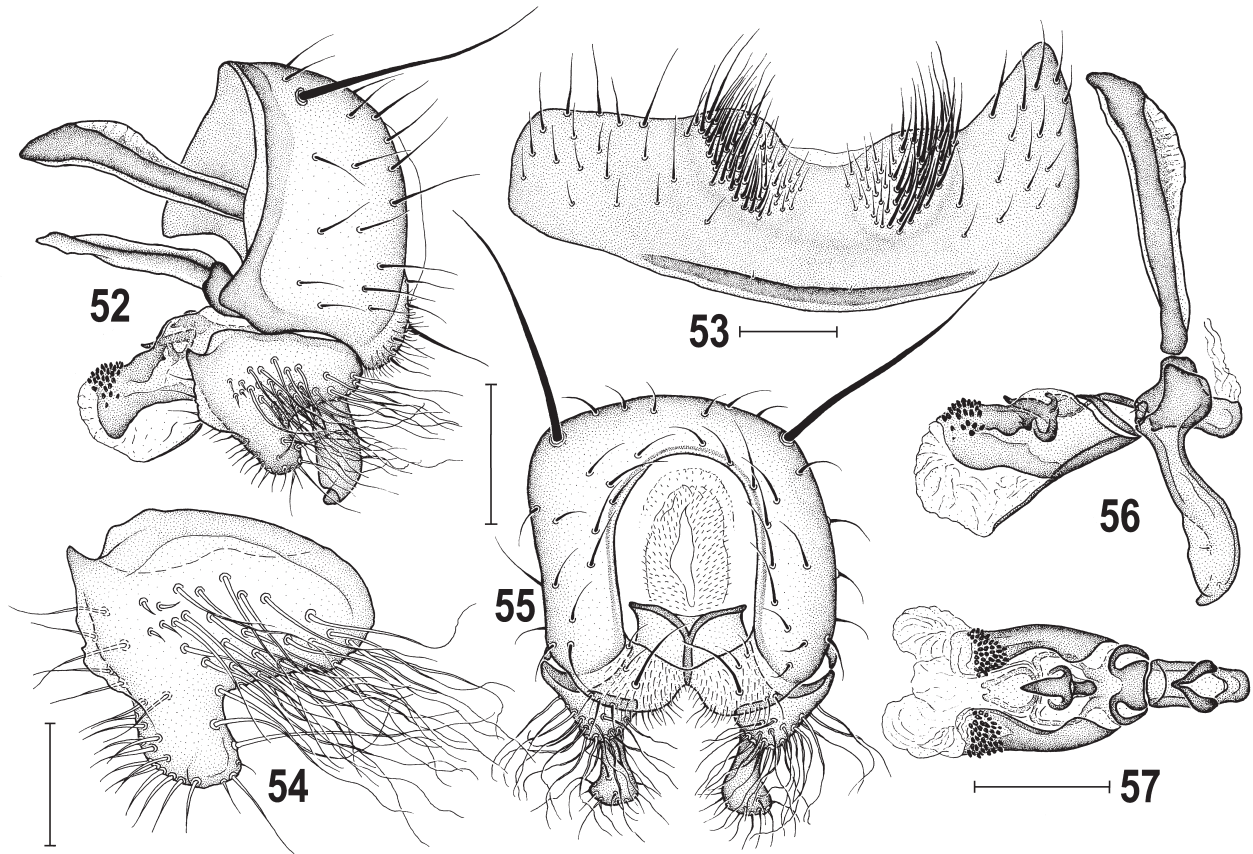
largely shining; occiput blackish brown with dark grey microtomentum. Orbits, interfrontalia and ocellar triangle distinctly silvery grey microtomentose; dull blackish brown stripe between interfrontalia and orbit distinct; frontal triangle broad and long, reaching to anterior margin of frons, shining (more than that of *P. kesoni*) and distinctly paler (brown) than rest of frons. Cephalic chaetotaxy closely resembling that of *P. kesoni* but differing as follows: *vte*

sometimes as long as *vti*; *ifr* more variable, in 3–4 pairs, often with 2 middle pairs robust and medially meeting or crossed, i. e. anterior microseta larger to form 4th *ifr* seta; *g* longer than in *P. kesoni* and also the smaller seta behind it as long as or longer than anterior peristomal setula. Frontal lunule darker than that of *P. kesoni*, dark ochreous to pale brown, not very contrasting with colour of anterior part of frons. Face normally also darker than in *P. kesoni*, ochreous



Figs 48–51. *Pullimosina (Pullimosina) dorae* sp. nov. (Madeira) and its habitat. 48 – wing, male paratype (length ca 1.6 mm); 49 – microhabitat, interior of laurel forest nr. Chão da Ribeira e do Seixal; 50 – same locality (type locality of *P. dorae*), laurel forest on right slopes of the valley; 51 – Ribero Frio env. (view from Balcões), laurel forests. Photo by J. Roháček.





Figs 52–57. *Pullimosina (Pullimosina) dorae* sp. nov., male paratype (Madeira). 52 – external genitalia, laterally; 53 – *S5*, ventrally; 54 – gonostylus, sublaterally (widest extension); 55 – genitalia (aedeagal complex omitted), caudally; 56 – aedeagal complex, laterally; 57 – aedeagus, dorsally; Scales = 0.05 mm (Fig. 54), 0.1 mm (others).

to pale brown (darkest dorsomedially). Gena relatively deep, brown anteriorly (distinctly darker than adjacent part of face), dark brown posteriorly. Eye not circular (18:15) or oval because broader dorsally and narrower ventrally, relatively smaller than in *P. kesoni*, with longest diameter about 4.0 times as long as smallest genal height. Antenna brown; 3rd segment (1st flagellomere) as short as that of *P. kesoni* with ciliation on apex slightly longer than longest cilia of arista. Arista 4.0–4.2 times as long as antenna, relatively shortly ciliate.

Thorax with same colouration and microtomentum as that of *P. kesoni*. Scutellum large, flat, transversely (3:2) rounded trapezoidal. Thoracic chaetotaxy closely resembling that of *P. kesoni* but foremost *dc* yet shorter (only twice or less as long as *dc* microsetae), 6–8 rows of *ac* microsetae on suture, medial prescutellar *ac* pair shorter than in *P. kesoni* (hardly longer than foremost *dc*), laterobasal *sc* slightly longer than scutellum, apical *sc* about 1.5 times as long as laterobasal; 2 *stpl* but anterior reduced to microseta (sometimes poorly visible).

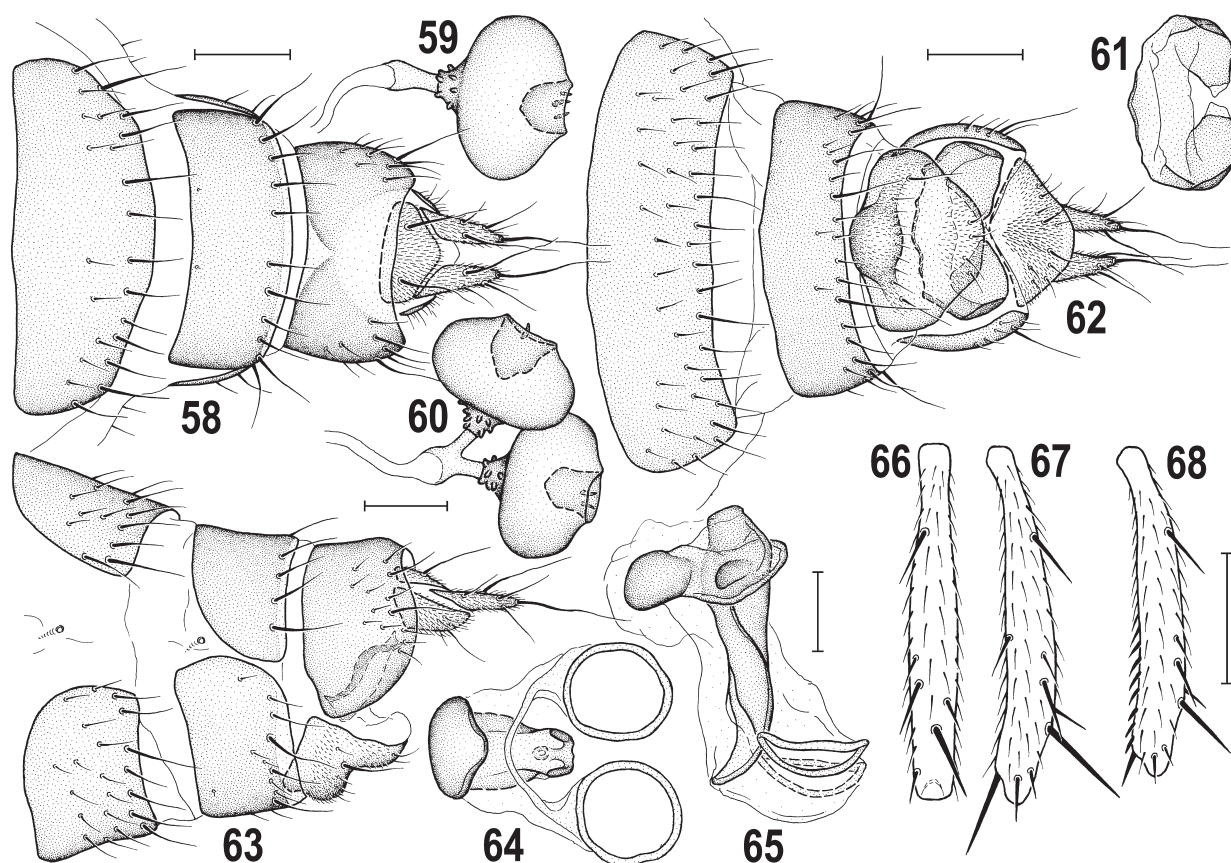
Legs brown to orange brown, femora darkest, coxae, trochanters, knees and tarsi palest (ochreous); fore coxa dirty yellow. Femora relatively robust, particularly hind femora distinctly thickened (more robust than those of *P. kesoni*). Mid leg chaetotaxy:  $f_2$  with 2 rows of short ventral setae less distinct than in *P. kesoni*.  $t_2$  ventrally with a row (shorter than in *P. kesoni*) of small dense spines and

short (much shorter than in female and also than in male *P. kesoni*) ventroapical seta and 1 small anteroapical seta (Fig. 68); dorsal chaetotaxy of  $t_2$  as in *P. kesoni* but short setae above anterodorsal seta in proximal fourth reduced or absent (Fig. 66).  $t_2 : mt_2 = 1.73–1.87$ .

Wing (Fig. 48) with venation and colouration of membrane very similar to those of *P. kesoni* and only slightly differing as follows:  $R_{2+3}$  more straight and only apically upcurved to *C*; cell *dm* short as that of *P. kesoni* but usually with longer venal processes of *M* and  $CuA_1$  beyond *dm-cu*. Wing measurements: length 1.25–1.63 mm, width 0.49–0.72 mm, *C-index* = 0.96–1.09,  $rm/dm-cu : dm-cu = 1.27–1.67$ . Haltere with brown knob and contrastingly pale ochreous stem.

Abdomen coloured, microtomentose and setose similarly to that of *P. kesoni*. Preabdominal terga *T2–T5* somewhat longer than those of *P. kesoni* and *T1+2* not longer than *T3* and *T4* together. *T3* as wide as *T1+2* posteriorly, *T3–T5* subequal in length but becoming distinctly narrower posteriorly. *S1+2* reduced and submembranous and also *S3* and *S4* resembling those of *P. kesoni* but *S3* narrower and *S4* only as long as and usually somewhat narrower than *S5*. Pregenital sternum *S5* (Fig. 53) resembling in shape and chaetotaxy that of *P. kesoni* but somewhat longer, with medial concavity being posteromedially emarginate (lacking submembranous lappet), and two groups (better tufts) of longer setae laterally in front of the latter very





Figs 58–68. *Pullimosina (Pullimosina) dorae* sp. nov., female and male paratypes (Madeira). 58 – female postabdomen, dorsally; 59 – spermatheca; 60 – paired spermathecae; 61 – female additional sclerite, posteroventrally; 62 – female postabdomen, ventrally; 63 – female postabdomen, laterally; 64 – spectacles-shaped sclerite, ventrally; 65 – ditto, laterally; 66 – female  $t_2$ , dorsally; 67 – ditto, anteriorly; 68 – male  $t_2$ , anteriorly. Scales = 0.1 mm (Figs 58, 61–63), 0.03 mm (Figs 59, 60, 64, 65), 0.2 mm (others).

dense, well visible also in lateral view even of dry mounted specimens; also other setae on lateral parts of  $S5$  more numerous than in *P. kesoni*.  $S6+7$  and  $S8$  generally formed and positioned as in *P. kesoni* but  $S6+7$  reaching farther dorsally where (on right side of postabdomen) somewhat widened and  $S8$  longer than  $S6+7$ .

Genitalia: Epandrium (Figs 52, 55) most similar to that of *P. kesoni* (including presence of 1 very long dorsolateral seta) but slightly longer and with more numerous setae. Anal fissure somewhat narrower and parallel-sided (Fig. 52). Cerci medially only narrowly fused (subanal plate ventromedially more incised) and in contrast to those of *P. kesoni* with more distinct micropubescence (see Fig. 55). Medandrium wider ventrally than dorsally, hence of more usual shape (Fig. 55). Hypandrium roughly Y-shaped in dorsal view as in relatives, with anteromedial rod-like apodeme longer compared to phallapodeme (cf. Fig. 52) than in *P. kesoni*. Gonostylus (Figs 52, 54, 55) markedly differing from that of *P. kesoni* although with similar dense, long, sinuous setae on outer side. It is characterized by an anterodorsal acute corner and a robust ventral thumb-shaped projection having a series of short setae on anterior margin; the latter projection with distinctly dilated and rounded apex in posterior view (Fig. 55). Aedeagal complex (Figs 56, 57). Phallapodeme similarly formed

as in *P. kesoni* including the well-developed dorsal keel. Aedeagus with compact but more elongate and posteriorly projecting phallopore (see Fig. 56). Distiphallus generally constructed as that of *P. kesoni* but the flat dorsal basal sclerite short, the main large (lateroventral) paired sclerite distinctly longer (Fig. 56) and having groups of small dark tubercle-like spinulae situated more apically (Fig. 57) and dorsomedial spike-like process (visible also in lateral view) more robust (Fig. 57). Postgonite very dissimilar to that of *P. kesoni*, elongate (as long as phallapodeme), somewhat sinuous in profile (Fig. 56), narrowest in proximal third, dilated both proximally and distally, with large blunt tooth on apex and microsetae reduced, poorly visible. Remnant of pregonite minute and with 2 setulae as in *P. kesoni*. Ejacapodeme minute, resembling that of *P. kesoni* (cf. Fig. 32).

**Female.** Similar to male unless mentioned otherwise below. Total body length 1.58–2.46 mm (gravid females largest). Femora more slender,  $f_3$  less thickened (but more robust than in female *P. kesoni*);  $f_2$  ventrally without rows of thicker curved setae;  $t_2$  chaetotaxy resembling that of *P. kesoni*, thus ventrally with 1 short ventral seta near middle and 1 long (longer than in male) ventroapical seta (Fig. 67), anteroapical seta also distinctly longer than in male; dorsal chaetotaxy as in male but long distal dorsal seta longer (Fig. 66).  $t_2 : mt_2 = 1.67–1.82$ . Wing measurements: length

1.11–1.81 mm, width 0.43–0.72 mm,  $C$ -index = 0.95–1.16,  $rm/dm-cu : dm-cu = 1.43$ –1.69. Preabdominal terga distinctly shorter, more transverse ( $T3$  in particular);  $T1+2$  distinctly shorter than  $T3$  and  $T4$  together;  $T3$ – $T5$  subequal in length but becoming narrower posteriorly. Preabdominal sterna similarly setose and micropubescent to those of *P. kesoni*.  $S1+2$  reduced, bare and submembranous as in male;  $S3$ – $S5$  subequal in length;  $S3$ – $S4$  large but distinctly ( $S3$ ) or slightly ( $S4$ ) narrower than associated terga, all more transverse than in male;  $S3$  more transversely trapezoidal and with corners more rounded than in male;  $S4$  largest and widest (most transverse) sternum;  $S5$  simple, transversely suboblong, narrower but not shorter than  $S4$ .

Postabdomen (Figs 58, 62, 63) somewhat longer and more elongate than that of *P. kesoni*.  $T6$  transverse, posteriorly somewhat rounded, markedly narrower than  $S6$  and with setae in posterior half (Fig. 58);  $T7$  almost as long as  $T6$  and bent farther onto lateral side (see Fig. 63) and seemingly narrower in dorsal view, with pale posterior margin and only single row of setae (as in *P. kesoni*).  $T8$  larger than that of *P. kesoni* and more sclerotized dorsomedially, pale-pigmented broadly posteromedially and narrowly anteromedially (Fig. 58), with dark and large lateral parts (Fig. 63), each with 1 long and a number of small setae.  $T10$  transversely pentagonal, wider than long, all finely densely micropubescent and with a pair of widely spaced setae (Fig. 58).  $S6$  much wider, more transverse and more setulose than both  $T6$  and  $S7$  and that of *P. kesoni* (Figs 62, 63).  $S7$  simple, darker than  $S6$ , transversely suboblong, slightly wider than  $T6$ , with setae only at posterior pale-pigmented margin.  $S8$  (Figs 62, 63) distinctive, much longer than  $S7$ , anteromedially distinctly bulging, posteriorly tapering, finely setose on bulge and at posterior margin but a pair of longer more lateral setae also present. Additional sclerite between  $S8$  and  $S10$  (Fig. 62) large, bare but longer than that of *P. kesoni*, differing from the latter by distinct posterolateral lobes (Fig. 61).  $S10$  less than half length of  $S8$ , transversely pentagonal but longer than that of *P. kesoni*, with distinctive micropubescent, setulose in posterior half, submedially with a pair of longer setae (Fig. 62). Spectacles-shaped sclerite oriented vertically as that of *P. kesoni*, elongate, but basally expanded anteriorly and hammer-like in lateral view (Fig. 65) and distally with much larger, almost circular rings (Fig. 64). Spermathecae 2+1 (Figs 59, 60) blackish brown, each less tyre-shaped and more vesicular and differing from those of *P. kesoni* also by almost smooth surface, smaller and distally narrower terminal invagination (with only 1–3 spinulae inside), terminal parts of ducts less sclerotized, but with distinct, separate, dark and heavily sclerotized, conical, tuberculate terminal part. Cerci (Figs 58, 63) similar to those of *P. kesoni* but longer and each with 5 setae, the dorsopreapical and apical long and sinuate, the latter slightly longer than length of cercus.

**Comments.** *Pullimosina dorae* sp. nov. seems to be the closest relative of *P. kesoni* sp. nov. (described above). The external morphological and colour differences of these two species are rather subtle (all enumerated in the above description of *P. dorae*) and usually do not enable them to be separated safely. It is therefore recommended to examine male and/or female postabdominal structures

of *P. dorae*, the most characteristic of which are the shape and setosity of male  $S5$  (Fig. 53), gonostylus (Fig. 54), postgonite (Fig. 56), female  $T8$  (Fig. 58),  $S8$  (Figs 62, 63), additional sclerite (Fig. 61) and spermathecae (Fig. 60). The differences in these structures are discussed in more detail above under *P. kesoni*.

**Etymology.** This new species is named in honour of Dr. Dora Aguiar-Pombo (Universidade de Madeira, Funchal, Madeira), who kindly provided logistic support during my collecting trip to Madeira in 2003 and enabled me to study material of Sphaeroceridae collected by the staff of the Dept. of Biology of the University in laurel forests at Chão da Ribeira.

**Biology.** Like *P. kesoni*, this species seems to be terricolous in the laurel forest leaf litter stratum. Almost all specimens were caught by means of pitfall traps operated in this forest ecosystem (Figs 49, 50), but, interestingly, the majority of them in the somewhat disturbed laurisilva area (Chão da Ribeira II) which also includes introduced tree species such as *Eucalyptus globulus*, *Pinus pinaster*, etc. In 2003 I collected only a single female in Funchal-Monte, under a stone in a brook valley (see type material) but this locality, although now secondarily forested, also lies within the original distribution of the Laurisilva ecosystem in Madeira (Fig. 69). *Pullimosina dorae* seems to have survived there after the extirpation of the original forest. These facts indicate that this species could be more habitat-tolerant than is *P. kesoni* and can live also in more or less affected laurel forests. In the valley of Ribeira do Seixal it proved to be most common of the three species discussed here, probably occurring throughout the whole year (recorded in January–November). **Distribution.** Madeira (all known localities mapped in Fig. 69).

## General discussion

**Spelobia.** The current concept of this genus follows PAPP (2008), who elevated all 3 subgenera of *Spelobia* Spuler, 1925 (s. lat.), i.e. *Eulimosina* Roháček, 1983, *Bifronsina* Roháček, 1983, and *Spelobia* (s. str.), to genera. The latter remains a species-rich genus that currently comprises a total of 82 species: 78 species as catalogued by ROHÁČEK et al. (2001) and MARSHALL et al. (2011), plus *S. concava* and *S. pseudochunipes* described recently by SU (2011) from China, *S. foldvarii* by PAPP (2017) from Tanzania, and *S. polymorpha* sp. nov. treated above. The overwhelming majority of *Spelobia* species occur in the Holarctic Region; only a few species are known from the tropics although several Neotropical species await description (cf. MARSHALL & BUCK 2010). The presence of an endemic *Spelobia* in Madeira is important inasmuch as this is the first case of endemism in this genus in the whole of Macaronesia; hitherto only some widespread and generally ubiquitous species of *Spelobia* have been recorded from the Canary Islands (ROHÁČEK et al. 2003), Madeira (ROHÁČEK 2007), and the Azores (ROHÁČEK 2010).

**Pullimosina.** The genus is divided into two subgenera, *Dahlimosina* Roháček, 1983 and *Pullimosina* (s. str.), following the concept of the genus by ROHÁČEK (1983a). *Dahlimosina* is a distinctive group clearly delimited from *Pullimosina*



(s. str.) and includes only 8 described species (7 species catalogued by ROHÁČEK et al. 2001 and *P. quadripulata* Su, 2013 from China) of which some Neotropical species are in need of revision (see MARSHALL & BUCK 2010). The nominotypical subgenus is much more speciose, at present comprising 24 species: 21 catalogued by ROHÁČEK et al. (2001) and MARSHALL et al. (2011), *P. meta* Su, 2011 added from China (SU 2011), and 2 species described here from Madeira. Again, most of these species originate from the Holarctic Region but the tropical fauna of *Pullimosina* (s. str.) could also be rich; PAPP (2008: 198), for example, reported numerous unnamed species in the Afrotropical Region. Hitherto, no endemic species of the genus has been known from any of the Atlantic islands in the Macaronesian subregion; only a few widespread and/or subcosmopolitan *Pullimosina* species have been recorded from them (see ROHÁČEK et al. 2003; ROHÁČEK 2007, 2010).

**Origin of Madeiran endemic species.** The relationships of *Spelobia polymorpha* are discussed above. Synapomorphies in the structures of both the male and female postabdomen indicate its close affinity to members of the *Spelobia pseudosetaria* group, particularly to *S. pseudosetaria* itself. The latter species was recorded from Madeira in the past (FREY 1949) but its occurrence has not been confirmed recently, and the only other species of the group, *S. luteilabris* (Rondani, 1880), is currently known to live in the island (ROHÁČEK 2007). Both these species surely occur in Madeira due to relatively recent introductions from Europe. However, *S. polymorpha* most probably evolved from a fully winged ancestor (possibly shared with *S. pseudosetaria*) that reached Madeira from Europe or Northwest Africa long ago and became adapted to the terricolous way of life in leaf detritus

of laurel forests. This scenario is in agreement with the most frequent colonization route of sphaerocerid flies to western Macaronesian islands (as outlined by ROHÁČEK et al. 2003 and ROHÁČEK 2007).

In contrast, the relationships and origin of both new *Pullimosina* species, which share terricolous life habits in laurel forests of Madeira with *S. polymorpha*, remain unclear. These species proved to be mutually most closely related but the affinity of this pair to some of the W. Palearctic and Nearctic species of *Pullimosina* has not been definitely demonstrated (see comments under *P. kesoni* above). However, the ancestor of *P. kesoni* and *P. dorae* could have come from tropical Africa (where *Pullimosina* species are largely unknown, cf. PAPP 2008) and/or from a W. Palearctic lineage which later became extinct in this area and survived on Madeira only. Anyway, the presence of two endemic *Pullimosina* species in Madeira indicates a subsequent speciation within the island or two independent colonizations of the island by the same parent species. To demonstrate either of these hypotheses, a detailed morphological and molecular comparative study of the Madeiran species and their congeners (including the African species) needs to be performed in the future.

**Habitat association of Madeiran endemic species.** As noted above, all three newly described species are inhabitants of Madeiran laurel forest (Laurisilva), or more precisely its montane variant called *Clethro arboreae-Ocotea foetentis sigmetum* [stink-laurel temperate forest series]. This plant community is dominated by laurel trees (Lauraceae), particularly *Laurus novocanariensis*, *Ocotea foetens* and *Persea indica*, and also *Clethra arborea* (Clethraceae) in the tree stratum; for structure of the rich herbaceous undergrowth see CAPELO et al. (2005). The best preserved original forests

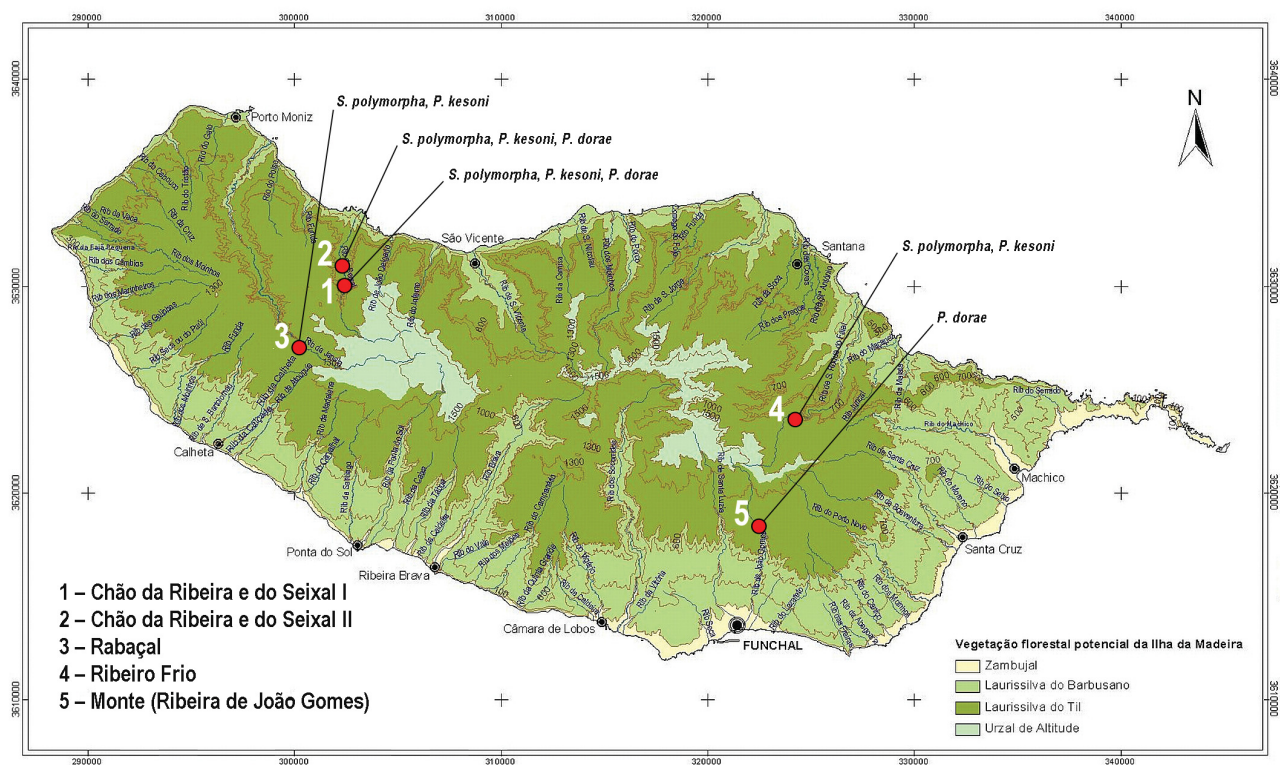


Fig. 69. Map of Madeira Island with all known localities of *Spelobia polymorpha*, *Pullimosina kesoni* and *P. dorae* spp. nov. The extent of original distribution of montane laurel forests (named Laurissilva do Til in the legend) is in dark green colour.

of this type occur particularly in the northwestern part of Madeira, covering the montane slopes of northerly flowing rivers, such as Ribeira de Janela (Fig. 31) and/or Ribeira do Seixal (Fig. 50). All the above new species were recorded from the latter valley (two localities at Chão da Ribeira e do Seixal) and two species, *S. polymorpha* and *P. kesoni*, in the upper part of the former (locality at Rabaçal). Another area with nice laurel forests of the same type is located in the central part of eastern Madeira, northeasterly from Pico Ruivo Mt. and Pico do Arieiro Mt., in the vicinity of Ribeiro Frio village (see Figs 6, 51). In this locality also the latter two species were found. Except for a single record of *P. dorae* from the vicinity of Funchal-Monte (in the valley of Ribeira de João Gómez) none of the above species was found in other parts of Madeira, although the same sifting method was used in a number of forested localities during our collecting trip to Madeira in 2003 (see ROHÁČEK 2007). However, it is to be noted that the finding of *P. dorae* in Funchal-Monte, although a single individual from the southern slopes of Madeira, also originated from a valley formerly occupied by laurel forests and the species seems to have survived here (albeit only temporarily) where the original forests have been replaced by secondary woodland comprising non-native trees.

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