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Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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PSEUDOFELTRIA (ACARIFORMES: PIONIDAE) IN EUROPE: THREE PREVIOUSLY DESCRIBED TAXA, A SPECIES NEW TO SCIENCE FROM THE NORTHERN APENNINES, AND A REDEFINITION OF FORELIINAЕ

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(Received 15 August 2013; accepted 30 November 2013; published online 28 March 2014)

ABSTRACT — The morphological variability of Pseudofeltria scourfieldi Soar, 1904, a water mite species known from scattered sites in Central and Northern Europe, is documented on the base of populations from the Bavarian Alps and bibliographic data; its diagnostic characters are discussed in comparison with P. quadriscutata Biesiada, 1971 from Western Beskides (Poland) and P. aemiliana n. sp. from mountain springs in the Region of Emilia Romagna (Italy). Pseudofeltria vanrensburgi Bader, 1974 (Switzerland) is a junior synonym of Forelia variegator (Koch, 1837). A new diagnosis of the subfamily Foreliinae is given and discussed, including species of the genera Pionacercopsis (former subgenus of Pionacercus, here elevated to the genus rank) and Pionacercus.

KEYWORDS — water mites; new species; spring habitat; Northern Italy; systematics; Foreliinae

INTRODUCTION

The genus Pseudofeltria was first described from England, with P. scourfieldi Soar, 1904 as type species. A second species, P. scutigera Walter, 1922, detected in the Swiss Alps and in the following decades recorded from several parts of Central and Northern Europe, was recognized as a junior synonym of P. scourfieldi by Gledhill (1960). In the second half of the past century, six further representatives of the genus were described from Northern America (P. multipora Cook, 1955: Michigan; P. laversi Cook, 1974: Wyoming; P. jonfraseri Habeeb, 1977 and P. julia Habeeb, 1977: California) and Europe (P. quadriscutata Biesiada, 1971: Poland, P. vanrensburgi Bader, 1994: Switzerland). As far as information on habitat preference is available, most Pseudofeltria species are bound to weakly seeping helocrenes which are often exposed to bright sunshine. Descriptions of the larval instar were published for P. multipora by Smith 1976 and P. scourfieldi by Martin (2000). Larvae of both species are abdominal parasites of Chironomid midges (Smith and Oliver 1986, Martin 2000).

During research on the biological diversity in springs of the Northern Apennines, Cantonati et al. (MTSN) detected in 2011 two populations of a species new to science. A definition of its diagnostic features required a revision of the previously described European taxa. In addition, some thought on the diagnostic features of Pseudofeltria induced me to reconsider also the global systematics of Forelia-like genera and to modify the diagnosis of the subfamily Foreliinae such that the genus Pionacercus

http://www1.montpellier.inra.fr/CBGP/acarologia/
ISSN 0044-586-X (print). ISSN 2107-7207 (electronic)
may be accommodated here as proposed as early as 1976 by Smith. The results of these studies are given in the present paper.

MATERIALS AND METHODS

Zoobenthos material was collected in the Berchtesgaden National Park during field work for the long term monitoring of spring habitats (Gerecke and Franz 2006) and in the Northern Apennines in the course of the EBERs project (Exploring the Biodiversity of Emilia Romagna springs, 2011-2013, Cantonati et al.). Sorting of samples and species identification of water mites was done by the author. As far as necessary, specimens were dissected as described by Gerecke et al. (2007).

Material for comparison was given in loan by Museo Civico di Storia Naturale Verona (MC-SNV); Museo Tridentino di Storia Naturale Trento (MTSN); Netherlands Centre of Biodiversity Leiden (NCB); Naturhistorisches Museum Basel (NHMB), Senckenberg Museum Frankfurt (SMF) and Natural History Museum of Denmark Copenhagen (NMDC). The following further abbreviations are used: Ac = acetabulum, Ac-1-3 = first to third acetabula, I-L-6 = Leg I, sixth segment; P-1-5 = palp, first to fifth segment; Cx = coxa; Cx-I-IV = first to fourth coxae. All measurements are given in \( \mu m \).

RESULTS

Family Pionidae, subfamily Foreliinae

Diagnosis — Integument of idiosoma from smooth to completely covered by dorsal and ventral shields, leaving only a narrow membranous dorsal furrow. Posteromedial apodemes of Cx-I varying from short to moderately long. Medial margins of Cx-IV often reduced to median angles. Legs with swimming setae. Male III-L-6 differing in proportions and shape of claws from I-/II-L-6. Genital field with 7 to more than 50 pairs of acetabula.

Discussion — Species of the genus are characterized by the combination of: (1) presence of swimming setae, (2) a reduced medial margin of Cx-IV, (3) modified claws on male IV-L, and (3) the number of acetabula > three pairs.

Genus Forelia Haller, 1882

Pseudofeltria vanrensburgi Bader, 1994, nov. syn.

Discussion — In the original description of *Pseudofeltria vanrensburgi*, Bader (1994) wondered about the presence of swimming setae in an interstitial-dwelling species and considered that type of leg setation as diagnostic in comparison with all other species of the genus. The fact that representatives of the sister taxon *Forelia*, all characterized by this type of leg setation, are generally found in standing waters only, probably was the reason for Bader not to consider the possibility of a *Forelia*-species appearing in an interstitial sample. The two specimens clearly represent *Forelia* variegator, not showing any remarkable morphological deviation from that widely distributed species. As *F. variegator* not rarely appears in pool areas of running waters, an occasional detection of drifting specimens in a stream sediment sample (the indication "COOK" on the label refers probably to the kick sampling method) is not surprising.

**Genus Pionacercopsis** K. Viets, 1926

Diagnosis (after Cook 1974, modified) — Idiosoma soft in female, but with dorsal and ventral shields in male. Coxal plates in four groups in female, but Cx-I+II medially fused and Cx-III+IV closely in touch in male. Cx-I+II with short posterior apodemes, Cx-IV medial margin well developed in male, but more or less reduced in females. In males, Cx-III+IV fused medially and with genital plate, occasionally also with Cx-I+II to a ventral shield; in females, coxal plates in four groups. Male IV-L-4 dorsodistally with a group of strong setae, but not forming a spur. IV-L-6 bowed, with 5-10 peg-like setae on concave margin. Genital field with three pairs of acetaula, in females triangular genital plates flanking membranous gonopore with acetaula covering only restricted parts of the plate, medial and lateral margins between anterior and posterior acetaula straight or bowed. Males without petiole. P-4 mediodistally with small peg-like seta.

Discussion — Material of three species of the genus was taken in study in order to document both, the distinctive character states for separating it from *Pionacercopsis*, and the synapomorphies with *Pseudofeltria*.

**Pionacercus norvegicus** Thor, 1898


**Pionacercus uncinatus** (Koenike, 1885)

Figure 1: *Pionacercopsis vatrax* (Germany, SMF 46850): A-C male. A – venter; B – palp; C – IV-L-4-6; D-F, female. D – I-L-6; E – palp; F – venter partial view. Bars = 100 µm.

*N. Pionacercus leuckarti* Piersig, 1894
(Figure 2)

Material examined — Coll. Gerecke: Female, Brigach-Quellweiher o. Gasthof Engel, 03.08.1984 Gerecke; MTSN: Male I 1293 Italy, Trentino, Tuenno (TN), Brenta, Lago di Tovel, 1178 m, 30.06.-04.07.2003 summer course.

**Genus Pseudofeltria** Soar, 1904

Diagnosis — Secondary sclerotization extended dorsally (with several plates or one large shield, sexual dimorphism frequent) and ventrally (ventral shield including genital sclerites and excretory pore in males, occasionally also in females). Medial margins of Cx-IV reduced to median angles. Legs without swimming setae. III-L claws without sexual dimorphism, in shape similar to I-II-L claws. Male IV-L-5 dorsal and ventral margins distally diverging, with four to six large blade-like distoventral setae; IV-L-6 with large, unmodified claws and a strong dorsal concavity flanked by numerous peg-like setae (long and densely arranged on the proximal margin, short and more distanced from each
other on the distal margin). Genital field with 7-30 pairs of acetabula.

Discussion — Species of *Pseudofeltria* and *Pionacercus* agree, and differ from species of *Forelia*, in the plesiomorphic absence of a sexual dimorphism in III-L. They differ from *Pionacercus* and agree with *Forelia* in the apomorphic polyacetabulate condition of the genital field and differ from both genera in the absence of swimming setae and the presence of unmodified IV-L claws in males. Following a hypothesis of Cook (1974), ancestors of *Pseudofeltria* lost their swimming setae during the immigration into seepage. Further data is needed to decide if *Pseudofeltria* should be considered the sister group of *Forelia*, or the outgroup of [*Forelia* and *Pionacercus*].

**Pseudofeltria scourfieldi** Soar, 1904  
(Syn. *Pseudofeltria scutigera* Walter, 1922:  
Gledhill, 1960)  
(Figure 3)

Material examined — Germany, Upper Bavaria, Berchtesgaden National Park, Sommerbichel, coll. Gerecke: D BGL 696, spring SW Herrenroint, 1300 m, 12°58′20″ E, 47°34′40″ N – 13.06.1994 (0/9/1); D BGL 312 spring complex Herrenroint, rheohelocrene, 1150 m, 12°58′30″ E, 47°34′50″ N – 10.06.1996 (3/2/0); 19.06.1998 (1/1/2); 24.06.2000 (0/1/0). Bulgaria BU flö117, Rila mountains, River Rila catchment, spring seep SW slopes of Popenmutz above Suchoto jezero, 2250 m, 01.08.1966 Flößner leg.

Diagnosis — Both sexes: Genital field with 9-12
pairs of Ac, these often longish, maximum diameter of the largest 22 – 30 µm. Male and female dorsum with one large shield including postocular setae at anterior margin, and posterolaterally two pairs of dorsoglandularia. P-4 with a pair of strong dorsal setae in distal third.

Description:

Both sexes — Colour yellow to brownish. Membranous parts of integument strongly striated, sclerites with a very fine porosity arranged in roundish or longish groups. Palp: P-1 with a stout dorsal seta, P-2 with 5 dorsal setae, ventral margin nearly straight, with a weakly developed projection in distal third; P-3 ventral margin concave, dorsal margin convex, one dorsomedial seta, a pair of stronger developed dorsodistal setae; P-4 robust, dorsally with three setae, one fine in centre, two strong in distal third, ventral margin with a pair of fine setae near a small pointed projection in distal third, distal margin with a strong, pointed peg seta. P-5 stout, with 4 strong claws.

Males — Idiosoma length/width 450 – 515/370 – 395; dorsal shield length/width 390 – 430/260 – 290 (ratio 1.3 – 1.5); coxal shield length/width of Cx-III, 330 – 370/340 – 350 (ratio about 1.0); gonopore length 70 – 90. IV-L-3 and -4 shortened, distally enlarged, both with one small peg-like seta at dorsolateral margin; distal setae: IV-L-3 one pair, rather short, IV-L-4, 6-8, long. IV-L-5 proximally narrow, distally strongly enlarged, ventral margin convex, dorsal margin concave, with three stout dorsal setae and about 8 long, blade-like ventral setae, all inserted in distal half. IV-L-6 ventral margin in proximal part concave, distally rather straight, dorsal margin in centre with a deep inlet bordered by about ten densely arranged stout setae, these in
proximal part longer than in distal part. Claws long, simple sickle-shaped. Length/height IV-L-2, 58 – 98/50 – 75, ratio 1.1 – 1.3; IV-L-3, 73 – 83/48 – 55, ratio 1.4 – 1.7; IV-L-4, 85 – 95/56 – 61, ratio 1.4 – 1.6; IV-L-5, 153 – 175/65 – 71, ratio 2.2 – 2.5; IV-L-6, 175 – 188/basal 43 – 48, central 19 – 30, distal 40 – 45. Length ratio IV-L-4/5, 0.54 – 0.58; IV-L-4/6, 0.45 – 0.53; IV-L-5/6, 0.81 – 0.97. Gnathosoma length 160 – 175, chelicera length 180, basal segment/claw ratio 2.4, length/height 3.4. Palp total length 295 – 305; length/height (ratio, % total length) P-1, 36 – 38/40 – 41 (0.91 – 0.94, 12 – 13 %); P-2, 88 – 93/65 – 66 (1.32 – 1.42, 30 %); P-3, 50 – 51/44 – 48 (1.08 – 1.14, 16 – 17 %); P-4, 84 – 88/43 – 45 (1.94 – 1.97, 28 – 29 %); P-5, 35 – 38/18 – 20 (1.88 – 2.00, 12 %). Length ratio P-2/P-3, 1.71 – 1.85; P-2/P-4, 1.03 – 1.06; P-3/P-4, 0.57 – 0.60.

Females — Idiosoma length/width 570 – 590/460 – 490; dorsal shield length/width 440 – 470/285 – 310 (ratio 1.5 – 1.6); coxal shield length/width of Cx-III, 370 – 390/380 – 405 (ratio about 1.0); gonopore length 175 – 180. IV-L without particular characteristics. Gnathosoma length 150 – 175, chelicera length 168, basal segment/claw ratio 2.2, length/height 3.2. Palp total length 316 – 323, more slender than in males (in particular P-2 and P-4): length/height (ratio, % total length) P-1, 38 – 43/44 (0.91 – 0.97, 12 – 13 %); P-2, 93 – 98/58 – 60 (1.60 – 1.63, 29 – 30 %); P-3, 50 – 55/46 – 49 (1.03 – 1.14, 16 – 17 %); P-4, 94 – 95/38 – 40 (2.38 – 2.50, 29 – 30 %); P-5, 38 – 40/18 – 20 (1.87 – 2.00, 11 – 13 %). Length ratio P-2/P-3, 1.77 – 1.85; P-2/P-4, 0.99 – 1.04; P-3/P-4, 0.53 – 0.59.

Discussion — The idiosoma and palp measurements of the Bavarian populations lie within the size range given by Gledhill (1960) except for the, absolutely and relatively, slightly longer P-3. Furthermore, with an idiosoma length of 618 – 636 µm, females from the English lake district are larger than both the holotype (560) and the Bavarian specimens, but Schwoerbel (1959) published intermediate size ranges (558 – 625 µm) from females collected in Alsace (France). The holotype male of *P. scutigera* is minor in size than the minima calculated for populations from Bavaria (see above) and from the English Lake district (Gledhill 1960), but does not show remarkable differences in proportions. No data were previously published for single leg segments. The specimen from the Bulgarian Rila mountains agrees in number and shape of Ac, but differs in the presence of an additional small sclerite platelet in the posterior dorsal furrow.

**Pseudofeltria quadriscutata** Biesiada, 1971

Diagnosis — Female (male unknown): Genital field with 17-18 pairs of Ac, maximum diameter of the largest > 20 µm. Female dorsum with four plates: A pair of central plates between unpaired anterior and posterior plates – the latter including two pairs of glandularia. Calculating from figures in the original description, measurements of the dorsal plates are (length/width): Anterior plate 194/212 (ratio 0.9); lateral platelets 133 / 80 (ratio 1.7); posterior plate 309/265 (ratio 1.2). P-4 lacking strong dorsal setae in distal third.

Discussion — *Pseudofeltria quadriscutata* differs from the other European species in the high number of acetabula (following our experience a character state that should be similarly expressed also in the still unknown male). Females of the species are furthermore unique in the same giving presence of four dorsal plates and in the absence of strong dorsal setae on P-4.

From the measurements published by Biesiada (1971) results that the species is larger than the maxima measured for females of *P. scourfieldi*: Idiosoma length/width 700/570; coxal field length/width 400/433; length/height P-1, 54/54; P-2, 120/75; P-3, 59/59; P-4, 110/46; P-5, 43/19. In general palp proportions, with rather slender P-2-4, *P. quadriscutata* is similar to *P. scourfieldi* females, but it differs in a relatively longer P-2 (relative length 31 %, P-2/3 length ratio 2.0).

**Pseudofeltria aemiliana** n. sp.

*Pseudofeltria* sp. Gerecke and Benfatti 2013 (Figure 4-5)

Type series — Holotype male, MTSN, in Koenike’s fluid, undissected; Italy, Emilia Romagna, EBERs 15 Emilia Romagna, Corniglio (PA), Sorgente elocrena Lago Scuro; 1534 m, 10°2'56.534” E, 44°22’41.151
FIGURE 4: *Pseudofeltia aemiliana*, paratype female: A – venter; B – dorsum; C – gnathosoma and right palp medially; D – right palp laterally. Bars = 100 µm.
diagnosis — Both sexes: Genital field with 9-13 pairs of Ac, these often round, maximum diameter 15 – 19 µm. Male with one large dorsal shield, female dorsum with five plates - a pair of pentangular frontal plates including postocular setae, posterolaterally flanked by a pair of minor, roundish platelets, in posterior part an unpaired transverse plate bearing a pair of dorsoglandularia. P-4 with a pair of strong dorsal setae.

description:

Both sexes — Integument structure, as well as shape and setation of palps and legs (including male IV-L) as described for *P. scourfieldi*. Colour in preserved specimens brownish-yellow.

Males — Idiosoma length/width 465 – 550/470 – 500 (ratio 1.10 – 1.13); dorsal shield length/width 400 – 510/280 – 330 (ratio 1.4 – 1.5); coxal shield length/width of Cx-III, 350 – 392/365 – 405 (ratio about 0.9); gonopore length 80 – 90. Length/height IV-L-2, 75/58 – 63, ratio 1.2 – 1.3; IV-L-3, 90/58 – 64, ratio 1.4 – 1.6; IV-L-4, 100 – 108/63 – 68, ratio 1.6; IV-L-5, 173 – 178/73 – 78, ratio 2.2 – 2.5; IV-L-6, 185 – 190/basal 45 – 48, central 25, distal 45 – 48. Length ratio IV-L-4/5, 0.58 – 0.61; IV-L-4/6, 0.53 – 0.58; IV-L-5/6, 0.91 – 0.96. Gnathosoma length 170, chelicera length 193, basal segment/claw ratio 2.3, length/height 3.0. Palp total length 315 – 318; length/height (ratio, % total length) P-1, 40/41 – 43 (0.94 – 0.97, 13 %); P-2, 98 – 100/70 (1.39 – 1.43, 31 – 32 %); P-3, 50 – 53/49 – 50 (1.03 – 1.05, 16 – 17 %); P-4, 88 / 43 – 45 (1.84 – 1.94, 28 %); P-5, 38 – 40 / 21 – 25 (1.60 – 1.76, 12 – 13 %). Length ratio P-2/P-3, 1.
Females — Idiosoma length/width 500 – 660/470 – 570 (ratio 1.06 – 1.22); dorsum with paired anterior plates (length/width 140 – 205/100 – 120, ratio 1.4 – 1.7), paired lateral platelets (length/width 85 – 120/65 – 85, ratio 1.3 – 1.6), and unpaired posterior plate (length/width 210 – 280/220 – 290, ratio 0.9 – 1.1); coxal shield length/width of Cx-III, 360 – 420/420 – 510 (ratio 0.82 – 0.90); gonopore length 140 – 200; genital plate length/width 80 – 110/140 – 160. IV-L without particular characteristics. Gnathosoma length 175 – 185, chelicera length 195, basal segment/claw ratio 2.1 – 2.3, length/height (ratio, % total length): P-1, 43 – 45/44 – 48 (0.89 – 1.03, 13 %); P-2, 98 – 100/65 – 68 (1.44 – 1.54, 29 – 30 %); P-3, 55 – 58/50 – 51 (1.07 – 1.15, 16 – 17 %); P-4, 98/45 – 48 (2.05 – 2.17, 29 %); P-5, 40 – 41/20 (2.00 – 2.06, 12 %). Length ratio P-2/P-3, 1.74 – 1.77; P-2/P-4, 1.00 – 1.03; P-3/P-4, 0.56 – 0.59.

Discussion — *Pseudofeltria aemiliana* agrees with *P. scourfieldii*, and differs from the third species known from Europe, *P. quadriscutata*, in a relatively low number of Ac and the presence of a pair of strong dorsal setae on P-4. Also shape and setation of the male IV-L, still unknown for *P. quadriscutata*, are in good agreement in *P. aemiliana* and *P. scourfieldii*. In addition to the presence of a dorsal shield instead of five separate dorsal plates in females, both sexes of *P. scourfieldii* differ from the new species in major-sized Ac (maximum diameter > 20 μm) and the generally more slender shape of idiosoma (length/width ratio 1.20 – 1.28) and coxal field (length/width ratio 0.95 – 1.03).

Acknowledgements

This study was induced by the possibility to cooperate in the interesting EBERs research project conducted by Marco Cantonati (MTSN). It found helpful support by loan of material for comparison from Julia Altmann and Peter Jäger (SMN), Leonardo Latella and Sandro Ruffo (MCSNV), Harry Smit (NCB), Urs Wüst and Ambros Hänggi (NHMB), Nicolaj Scharff (SNMD), and by the gift of specimens from Bulgaria from Dietrich Flössner (Jena). I am particularly indebted to D.R. Cook (Paradise Valley) for his advice on a former draft of this manuscript.

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