

Article

Eukiefferiella permiana sp. n., a plesiomorphic species from the middle basin of the River Lergue (Southern France) (Diptera, Chironomidae, Orthocladiinae)

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ABSTRACT

The male and pupal exuviae of *Eukiefferiella permiana* sp. n., are diagnosed and described based on material composed of male pharate adults and pupal exuviae collected during spring and the dry season in lotic habitats along the middle basin of the River Lergue (southern France, altitude 100-160 m), which is characterized by the primary red soil deposit of the Permian Era (Ruffe red rocks, age about 260 million years). Based on some relevant characters found in the male adult (superior volsella semi-circular, inferior volsella long acute triangle shaped, proximal expansion of gonostylus triangular) and pupal exuviae (frontal apotome with long ridges and 2 small triangular tubercles; base of antennal sheath with broad triangular expansion; thoracic horn enlarged medially, precorneal tubercle absent; large crochets present on tergites IV-V), the new species appears to belong to the *coconina*-group (see MOUBAYED-BREIL & MARY 2019), which includes *E. coconina* Moubayed-Breil & Mary, 2019, *E. bedmari* Vilchez-Quero & Laville, 1987, *E. hessi* Freeman, 1958 and 2 morphotypes: *E. sp. A* (Thailand) and *E. sp. B* (New Caledonia). Currently, the genus *Eukiefferiella* is represented worldwide by about 92 species. Consequently, the description of *E. permiana* sp. n. increases the total number in the genus to 22 from continental France and to 23 from Europe. Taxonomic remarks with key to male adult and pupal exuviae of the *coconina*-gr and comments on the ecology and geographical distribution of the new species are given.

Keywords: taxonomy, key to male adult and pupal exuviae, ecology, conservation measures.

***Eukiefferiella permiana* sp. n., une espèce plésiomorphe connue du bassin moyen de la rivière Lergue, S-France (Diptera, Chironomidae, Orthocladiinae)**

RESUMÉ

Ephemera est une revue du groupe Opie-benthos publiée par l'Office pour les insectes et leur environnement en libre accès et en flux continu. Rendez-vous sur <https://ephemera.insectes.org> pour toutes vos propositions d'articles.

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L'adulte mâle et l'exuvie nymphale d'*Eukiefferiella permiana* sp. n. sont diagnostiqués et décrits à partir d'un matériel collecté au cours du printemps et de la saison sèche dans des habitats lotiques du bassin moyen de la rivière Lergue (sud de la France, altitude 100-160 m) qui se caractérise par des sédiments et des roches rouges datant de l'âge Permien (près de 260 millions d'années). D'après certains caractères pertinents présents chez l'adulte (volselle supérieure semi-circulaire, volselle inférieure longue en forme d'un triangle aigu, expansion proximale du gonostyle triangulaire) et l'exuvie nymphale (apotome frontal muni de longues carènes et de 2 petits tubercules triangulaires ; partie basale de l'antenne pourvue d'une expansion triangulaire large; corne thoracique élargie dans sa partie médiane, tubercule précornéal absent; crochets de grande taille présents sur les tergites IV-V), la nouvelle espèce appartient au groupe *coconina* (voir MOUBAYED-BREIL & MARY 2019) comprenant *E. bedmari* Vilchez-Quero & Laville, 1987 ; *E. coconina* Moubayed-Breil & Mary, 2019 ; *E. hessi* Freeman, 1958 et 2 morphotypes : *E. sp. A* (Thaïlande), *E. sp. B* (Nouvelle-Calédonie). Actuellement, près de 92 espèces du genre *Eukiefferiella* sont connues à l'échelle mondiale. La présente description porte à 22 le nombre total d'espèces de ce genre pour la France et 23 pour l'Europe. Un commentaire sur la position systématique et l'écologie ainsi qu'une clé de détermination des adultes mâles et de l'exuvie nymphale du groupe *coconina* sont fournis.

Mots-clés : taxonomie, clés de détermination du mâle adulte et de l'exuvie nymphale, écologie, mesures de conservation.



Photo 1. River Lergue, type-locality of *E. permiana* sp. n. in summer; middle stream, riffle with drift net (arrow).
Photo J. Moubayed, 17.VII.2020.

Photo 1. Rivière Lergue : localité-type d'*E. permiana* sp. n., cours moyen en été, radier avec un filet de dérive (flèche). Cliché J. Moubayed, 17.VII.2020.

1. Introduction

The genus *Eukiefferiella* Thienemann, 1926 has been reported from all zoogeographical regions except for the Antarctic. It currently includes cold-stenothermous and oxybiontic species encountered mainly in lotic habitats of rivers and streams. Members of the *Eukiefferiella* genus represent one of the most widespread Orthoclaadiinae in the world. Data on the taxonomy and geographical distribution worldwide (LEHMANN 1979, ASHE et al. 1987, VILCHEZ-QUERO & LAVILLE 1987, CRANSTON et al. 1989, SÆTHER & EKREM 2003, ASHE & O'CONNOR 2012, QI et al. 2012, SÆTHER & SPIES 2013, MOUBAYED-BREIL & ASHE 2015, MOUBAYED-BREIL & MARY 2019) show that there are currently 91 valid species, of which 22 are reported from Europe and 21 from continental France. In this paper, *E. permiana* sp. n. is diagnosed and described as male adult and pupal exuviae based on associated material collected in some pristine lotic habitats (riffles and waterfalls) covered by the middle basin of the River Lergue (a tributary of the large river Hérault, southern France, altitude 200-150 m) which is characterized by primary red rocks and deposit to date from the Permian period (age about 260 million years). Moreover, on the basis of some common morphological characters found in the male adult and pupal exuviae, the new species appears to key in the *coconina*-group, which include *E. bedmari*, *E. coconina* and *E. hessi* recently emended by Moubayed-Breil & Mary (2019). Taxonomic remarks, discussion with key to male adult of the *coconina*-gr and comments on the ecology and geographical distribution of the new species are given.

2. Material and methods

Material composed of male pharates and pupal exuviae of *E. permiana* sp. n. were collected using some standard methods (Surber net for the benthos, larvae and pupae; Brundin drift nets for drifted pupae and pupal exuviae floating on the

surface of the water). The studied material is collected in lotic habitats extended along the middle basin of the River Lergue (southern France), which is characterized by its primary red deposit to date from the Permian Era. The type-material was preserved in 80-85% ethanol for the taxonomic examination and description. Information on the methodology of mounting and conservation of the type-material is provided in MOUBAYED & LANGTON (2019). Morphological terminology and measurements follow those of SÆTHER (1980) and LANGTON & PINDER (2007) for the imagines, and SÆTHER (1980) and LANGTON (1991) for pupal exuviae.

3. Description

Eukiefferiella permiana sp. n.

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Material examined

Holotype. Southern France. 1 male adult (leg. J. Moubayed). Middle basin of the River Lergue, down to Lodève city, lotic habitats with waterfalls and riffles, (43.7337° N; 3.3140° E); alt. 80-100 m, 17.VII.2020 (Photo 1). Environmental data of water are: conductivity (Cd) 600-1400 µS/cm; pH 7.2-8.4; annual temperature variations, minima, 8-12, maxima, 20-24 °C.

Paratypes (leg. J. Moubayed). 2 male pharates adult, 53 pupal exuviae, same locality and data as for holotype. 1 male pharate adult, 11 pupal exuviae, same locality as for holotype, 23.VIII.2023. 2 male pharate adults, 13 pupal exuviae, waterfalls and riffles (Photo 2) at Lodève city, alt. 150-160 m (43°43'00" N; 3°19'00" E); shaded habitats, T°C 16-18, Cd 400-600 µS/cm; pH 7-7.5; 23.VIII.2023.

Holotype (male adult, mounted on 2 slides) is deposited in the collections of the 'Musée cantonal de Zoologie, Palais de Rumine, 6 place de la Riponne, CH-1014 Lausanne (MZL), Switzerland' (GBIFCH01217133). The remaining paratypes are deposited in the collection of the authors.

Type material was preserved in 80% alcohol, and later mounted in polyvinyl lactophenol. For each adult, the head, thorax and abdomen were cleared in 90% lactic acid then washed in 70% ethanol before mounting on slides.

Etymology: The new species is named 'permi-ana' after the Permian rocks and deposit layers of the Palaeozoic Era (= âge Permien), which covers the middle basin of the River Lergue, where the type material was collected.

Diagnostic characters

The new species is closely related to *E. bedmari*, based on some common relevant features found in the male adult and in particular the pupal exuviae. However, the new species is easily separated from other members of the genus by the following combination of characters.

Male adult

Frontal tubercle absent, temporals 6; clypeus shield shaped. Anal lobe of wing protruding at right angle. Tergite IX semi-circular, with 15-16 setae. Transverse sternapodeme rounded, phallapodeme with sinuous inner aedeagal lobe. Gonocoxite truncate apically, ventral basal margin with a large semi-circular lobe, bearing 1 row of 13-15 inwardly directed setae. Inferior volsella acute-angle shaped, elongate, well projecting downwards, apex almost reaching tip of gonocoxite. Gonostylus slender, linearly elongate; proximal part of anterior side with a characteristic triangular expansion; posterior part rounded; anterior side with 2 characteristic groups of setae arranged in 2 opposite pattern of distribution; crista dorsalis absent, megaseta well developed.

Pupal exuviae

Cephalothorax. Frontal apotome well-domed, weakly wrinkled, with faint warts and 2 small triangular tubercles located medially, frontal setae absent; basal part of antennal sheath with a large triangular expansion; lateral anteprenotals 3 (2 median, 1 lateral); thoracic horn enlarged medially, precorneals consist of 1 very

long seta and 2 smaller, precorneal tubercle absent. Abdomen. Tergite I bare; anterior transverse rows of spines present on tergite II-VIII; tergite II with a large row of small hooks; posterior transverse rows of spines present on tergites III-VIII; larges crochets present only on tergites IV and V (4-5 on IV, 5-6 on V); sternites I-II bare; sternites III-VIII with a posteromedian transverse rows of spines, becoming progressively bigger and dense on V-VIII. Anal lobe with caudolateral part inwardly folded over; megasetae pointed and curved apically; genital sacs over-reaching basal margin of anal lobe.

Male imago

(n = 3; Figs 1A, C, F-L; 2A)

Large to medium sized *Eukiefferiella* species. Total length 3.85 mm, Wing length 1.35 mm. General colouration contrasting brown to dark brown, with blackish antenna and mesonotal stripes; head dark brown; antenna blackish, last flagellomere darker distally; thorax dark brown with blackish mesonotal stripes; legs brownish, fifth tarsomeres of all legs darker; abdomen pale brown, anal segment brownish. Head. Vertex and coronal area (Fig. 1A) with wide V-shaped suture; eyes bare, inner eye margin bare; temporals consist of 6 setae including 3 inner and 3 outer verticals. Palp 5-segmented, segments 1-2 fused; length (in μm) of segments: 25, 30, 50, 90, 130; palpomere 3 with sensilla clavata, sensilla coeloconica consists of 1 pin-like needle. Clypeus (Fig. 1D) 100 μm long, 180 μm maximum width at base, nearly shield shaped, with 16-18 setae in 3 rows. Antenna 13-segmented, 770-810 μm long and linearly elongated; densely covered with long setae of 500-550 μm long, reaching tip of last segment; last flagellomere 400-405 μm long, well-clubbed apically, with numerous apical sensilla chaetica; antennal groove clearly visible, beginning on segments 2/3; AR 1.05-1.10. Thorax. Lobes of anteprenotum well-gaping, anteprenotals 6 including 2 median and 3 lateral anteprenotals; acrostichals 13-14 consist of short setae starting close to anteprenotum;

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV	BR
PI	570	725	425	180	135	65	95	0.59	3.62	3.05	2.10
PII	585	665	320	175	130	60	100	0.48	3.38	3.91	2.0
PIII	615	805	430	255	190	80	110	0.53	2.91	3.30	2.90

Table 1. “LR = Length of tarsomere ta_1 divided by length of tibia (ti); BV = Combined length of femur (fe), tibia and ta_1 divided by combined length of tarsomeres ta_2 - ta_5 ; SV = Ratio of femur plus tibia to tarsomere ta_1 ; BR = Ratio of longest seta of ta_1 divided by minimum width of ta_1 , measured one third from apex.”

dorsocentrals 9-10 in 1 row; prealars 4 in 1 row; preepisternals absent; humeral pit indistinct; scutellum with 12 setae (6 on each side of the median area). Wing. Brachiolium with 1 seta; number of setae on veins: R, 4-5; remaining veins bare; anal lobe right-angled; squama (Fig. 1 C) with 12-13 setae. Legs. Sensilla chaetica present on tibia and ta_1 - ta_5 of PI-PIII. Tarsomere ta_4 of PI-PIII heart-like shaped; tarsomere ta_4 of PI, PII and PIII markedly shorter than ta_5 (in particular that of PII); length of tibial spurs: PI 60 μ m long; PII, 30 and 35; PIII 70 and 35. Length (in μ m) and proportions of prothoracic (PI), mesothoracic (PII) and metathoracic (PIII) legs as in the Table 1. Abdomen. Hypopygium in dorsal and ventral view (Figs 1G-H), ventral view with tergite IX removed as in Fig. 1H. Tergite IX, broadly semi-circular, posterior margin semi-circular; dorsal side with 15-16 short setae (8-9 on each side of the median part), proximal part with a weak hump clearly visible in lateral view (Fig. 1F). Anal point absent. Laterosternite IX with 10 setae (5 on each side). Sternapodeme and phallapodeme (Fig. 1H); transverse sternapodeme rounded, projecting orally; phallapodeme unusually shaped, inner part (aedeagal lobe) distinctly sinuous. Gonocoxite (Figs 1G-H) 175 μ m long, markedly truncate apically; ventral side with a large and contrasting basal semi-circular lobe (Figs 1H, 2A), bearing 1 circular row of 13-15 stout setae. Inferior volsella (Figs 1G, I) 75 μ m long, 50 μ m maximum width at base, markedly elongate, acute-triangle shaped, projecting posteriad, distinctly narrowing apically to a thumb-like apex bearing short setae; posterior margin densely covered with

rows of setae curved down and backwards. Gonostylus in various position (obtuse angle, Fig. 1J; right-angle, Fig. 1K; acute angle, Fig. 1L) 135 μ m long, 20-25 μ m maximum width; linearly elongate, proximal part of anterior side bare, with a typical rounded expansion; anterior side densely covered with 2 groups of fine setae inserted in 2 opposite directions; posterior margin distinctly rounded; crista dorsalis absent, megaseta well developed. HR 1.30; HV 2.85.

Male pupal exuviae

(n = 33; Figs 2A, C-D, F-K)

Large to medium sized *Eukiefferiella* species. Total length 3.95 mm; abdomen length 2.90 mm. Colouration golden to dark brown in general. Frontal apotome brownish and distinctly rugulose; cephalothorax weakly wrinkled, thorax and abdomen brown to dark brown; antero-median area of thoracic suture with dark granulation and wrinkles; wing sheath with dark brown to blackish intense shading; abdomen and anal lobe dark brown including genital sacs. Frontal apotome (Fig. 2C-D) well-domed, slightly wrinkled, bearing faint warts and 2 median small triangular tubercles, frontal setae absent; antennal sheath with basal triangular expansions. Cephalothorax (Fig. 2E) with 3 anteprenotals (2 median 225-245 and 1 lateral anteprenotal 150-160 μ m long). Thoracic horn (Figs 2F-H) 325-350 μ m long, basal part about 150-160 μ m long, apical filament 180-200 μ m long; swollen at base and progressively narrowing toward apex; swollen part about 65-75 μ m maximum width; precorneals consist of 1 very long seta about 275 μ m long and 2 shorter.

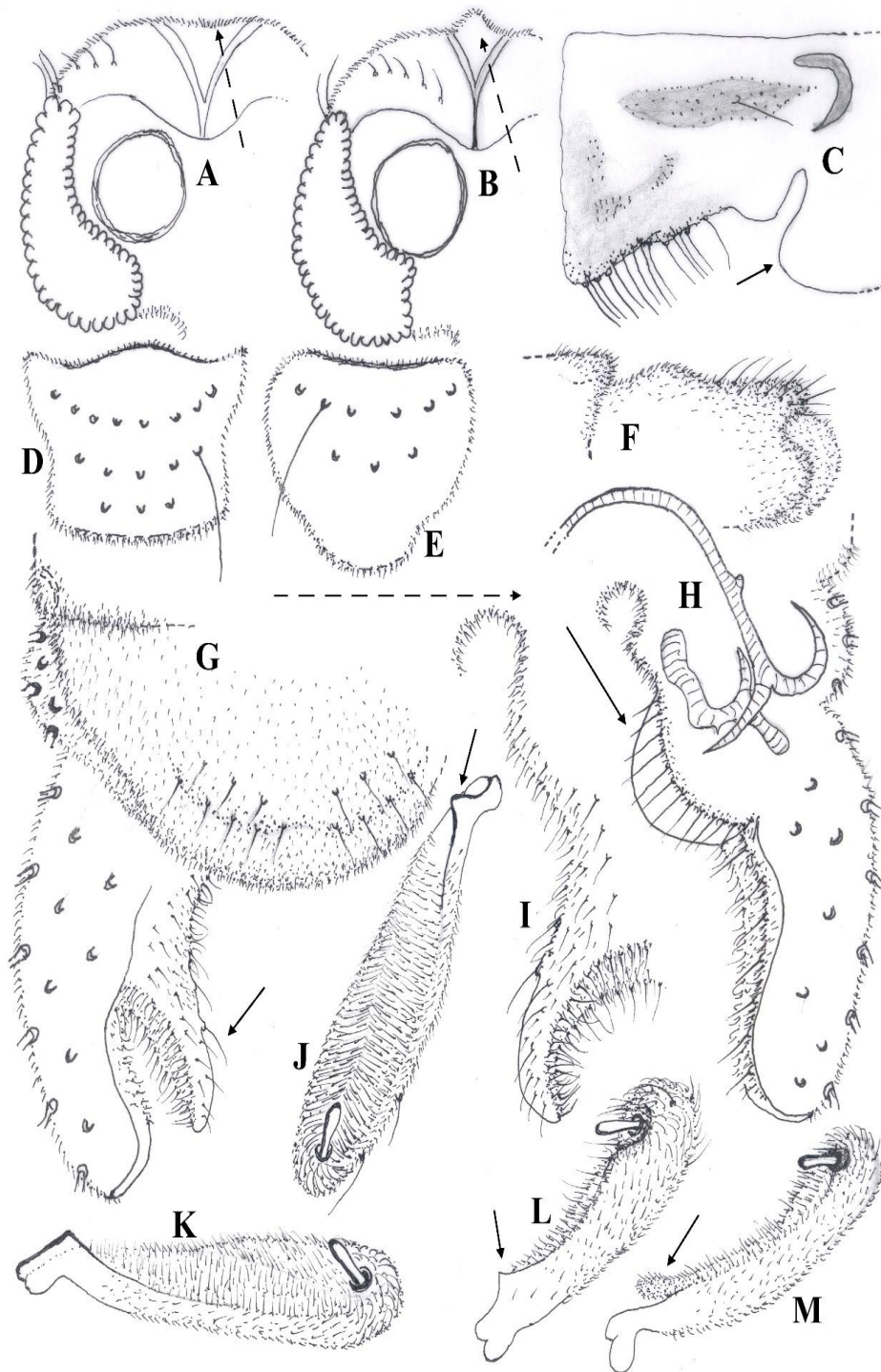


Figure 1. Male imago of *Eukiefferiella* spp. *E. permiana* sp. n. (A, C, D, F-L); *E. bedmari* (L). Head, vertex with coronal suture (A-B); basal part and anal lobe of wing (C); clypeus (D-E); tergite IX, lateral (F); hypopygium in dorsal (G) and ventral view (H); inferior volsella, right side (I); gonostylus at obtuse angle (J), right angle (K, M), acute angle (L). The arrows indicate some distinguishing characters.

Figure 1. Imago mâle d'*Eukiefferiella* spp. *E. permiana* sp. n. (A, C, D, F-L); *E. bedmari* (L). Tête, vertex et suture coronale (A-B); partie basale et lobe anal de l'aile (C); clypéus (D-E); tergite IX en vue latérale (F); hypopyge en vues dorsale (G) et ventrale (H); volselle inférieure, côté droit (I); gonostyle, angle obtus (J), angle droit (K), angle aigu (L). Les flèches indiquent quelques caractères distinctifs.

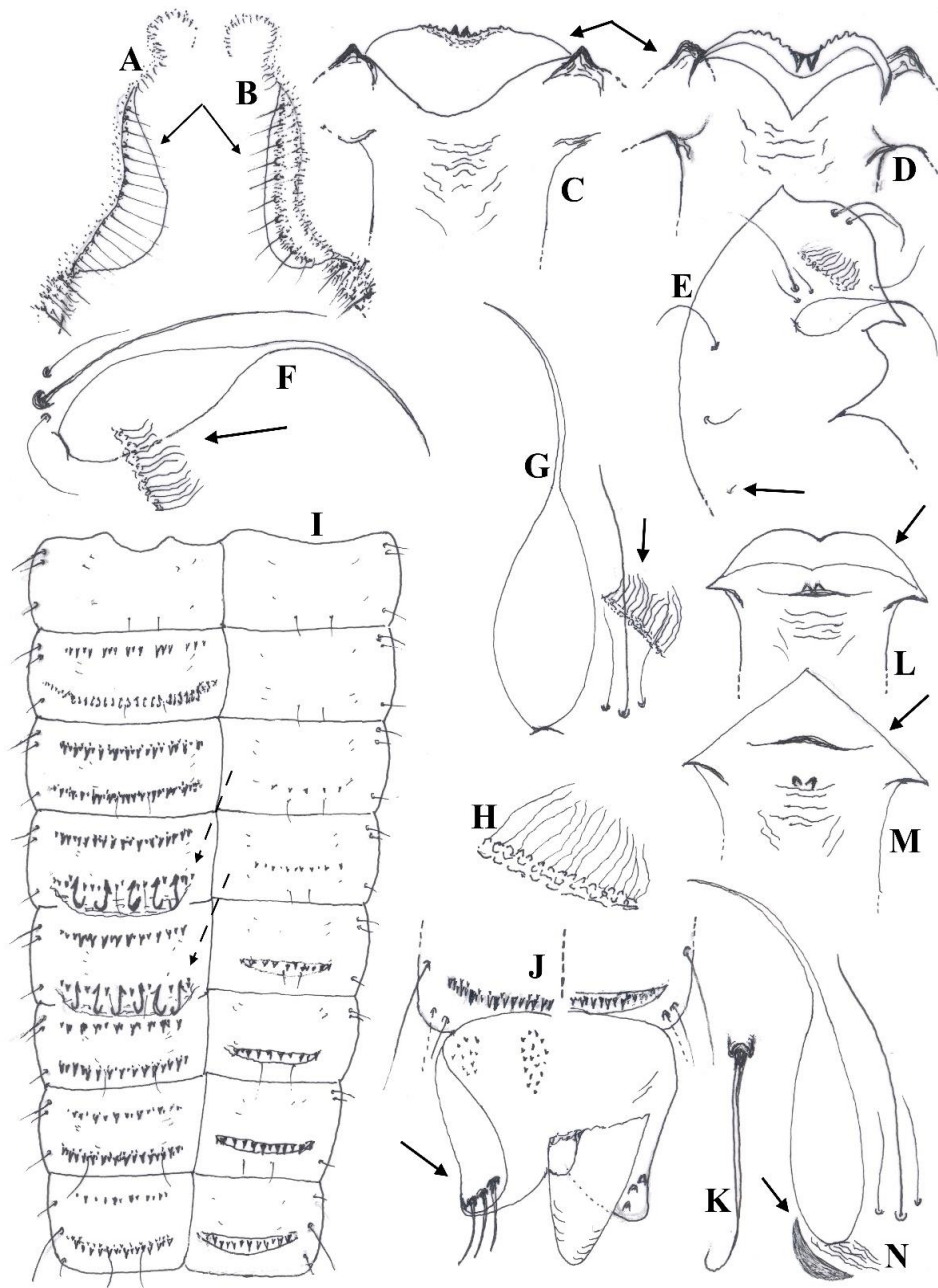


Figure 2. Male adult and pupal exuviae of *Eukiefferiella* spp. *E. permiana* sp. n. (A, C-K); *E. bedmari* (B, L-N). Male adult: ventral basal lobe of gonocoxite (A-B). Pupal exuviae: frontal apotome (C-D, L-M); cephalothorax (E); thoracic horn (F-G, N); ridges on cephalothorax (H); abdominal segments, tergites and sternites I-VIII (I); basal part of segment VIII and anal lobe in dorsal and ventral view (J); megaseta (K); frontal apotome (L-M); thoracic horn (N). The arrows indicate some distinguishing characters.

Figure 2. Adulte et exuvie nymphale mâle d'*Eukiefferiella* spp. *E. permiana* sp. n. (A, C-K); *E. bedmari* (B, L-N) Mâle adulte: lobe basal du gonocoxite en vue ventrale (A-B). Exuvie nymphale : apotome frontal (C-D, L-M); céphalothorax (E); corne thoracique (F-G, N); segments abdominaux, tergites et sternites I-VIII (I); partie basale du segment VIII et lobe anal en vues dorsale et ventrale (J); macrosoie (K); apotome frontal (L-M); corne thoracique (N). Les flèches indiquent quelques caractères distinctifs.



Photo 2. River Lergue at Lodève City. Locality of the paratype of *E. permiana* sp. n., small waterfall, summer season. J. Moubayed, 23.VIII.2023.

Photo 2. Rivière la Lergue à Lodève. Localité du paratype d'*E. permiana* sp. n., petite chute d'eau, au cours de l'été. Cliché J. Moubayed, 23.VIII.2023.

Dorsocentrals (Fig. 2E), Dc_1 and Dc_2 195-205 and 55-60 μm long, Dc_3 vestigial; Dc_1 , Dc_2 and Dc_3 equally separated by about 135 μm . Abdomen with armament and distribution pattern of transverse rows of spines and hooks on tergites and sternites I-VIII, as in figure 2I; tergite and sternite I bare. Anterior transverse rows of spines present on tergites III-VIII; posterior transverse rows of spines present on tergites and sternites III-VIII, composed of 1 row on III-V and 2 rows on VI-VIII, small sized on III-V, becoming gradually larger and denser on VI-VIII. Posterior transverse row of small hook present on tergite II; large crotchets (35-40 μm long) present only on tergites IV-V, 4-5 on IV, 5-6 on V. Distribution pattern of lateral setae on segments I-VIII as in Fig. 2I, consists of 2-3 setae on segments I-VII; the 3 caudo-lateral setae on segment VIII include 1 long 100-105 μm long and 2 smaller 45 μm long. Tergites VII-VIII with 2 postero-median setae 80-90 μm long. Pedes spurii B and Pedes spurii A absent. Anal lobe in dorsal and ventral view as in Fig. 2J, 255-265 μm long, 290-300 μm maximum width at base; general shape broadly rectangular,

caudo-lateral part inwardly folded over; antero-median and antero-lateral parts covered with spinulae; macrosetae about (Fig. 2K) 210-260 μm long, markedly curved and pointed apically; male genital sac 175 μm long, 100-110 μm maximum width at base, overreaching apical margin of anal lobe by 40-45 μm . 4. Taxonomic remarks and differential diagnosis

To date, about 91 species of the genus *Eukiefferiella* are reported worldwide. Among them, 23 are known from Europe and 21 from continental France. Consequently, the description here of *E. permiana* sp. n. increases the total number of known species to 22 from this country. Based on some common characters found in the male adult and pupal exuviae of both *E. permiana* sp. n. and *E. bedmari*, the two previous species appear to key into a same and one group of *Eukiefferiella* species: the *coconina*-group as emended by MOUBAYED-BREIL & MARY (2019). The latter group includes, beside the 2 previous species, *E. hessi* (reported from Cape Province, S-Africa by LEHMAN 1979) and 2 morphotypes: *E. sp. A*, known from Thailand; *E. sp. B*, known from New Caledonia.

However, *E. permiana* sp. n. is easily distinguished from *E. bedmari*, *E. coconina* and other members of the *coconina*-gr by a combination of differentiating characters, which are briefly highlighted in the following differential diagnosis.

Male adult

Head lacking a frontal tubercle (Fig. 1A), is present in *E. bedmari* (Fig. 1B). Clypeus shield-like shaped, is broadly rectangular in *E. bedmari* (Fig. 2E). Ventral basal lobe of gonocoxite large lobe-like (Figs 1H, 2A), is vertically elongate in *E. bedmari* (Fig. 2B), broadly rectangular in *E. coconina* (Figs 16, 22, in MOUBAYED-BREIL & MARY 2019) and apparently absent in *E. hessi* (Fig. 58, in LEHMANN 1979). Proximal expansion of gonostylus rounded (Figs 2J-L), is digitiform in *E. bedmari* (Fig. 2M; Fig. 1A, in VILCHEZ-QUERO & LAVILLE 1987), large lobe shaped in *E. coconina* (Figs 19-21, in MOUBAYED-BREIL & MARY 2019) and absent in *E. hessi* (Fig. 58, in LEHMANN 1979).

Pupal exuviae

Frontal apotome well-domed with warts and 2 small median triangular tubercles (Figs 2C-D), is weakly-domed and bearing a transverse sclerotized band in *E. bedmari* (Figs 2L-M) and concave in *E. coconina* (Fig. 26, in MOUBAYED-BREIL & MARY 2019). Thoracic horn (Figs 2F-G), is differently shaped in both *E. bedmari* (Fig. 2N; Fig. 32, in MOUBAYED-BREIL & MARY 2019), *E. coconina* (Fig. 29, in MOUBAYED-BREIL & MARY 2019) and *E. hessi* (Fig. 60, in LEHMANN 1979) and both of *E. sp. A* and *E. sp. B*. Large crotchets present only on tergite IV-V (Fig. 2J), are similarly observed in *E. bedmari* and both of *E. sp. A* and *E. sp. B*, while are present on tergites IV-VI in *E. coconina* (Figs 30-31, in MOUBAYED-BREIL & MARY 2019) and *E. hessi* (Fig. 61, in LEHMANN 1979). Anal lobe (Fig. 2J) with caudo-lateral part inwardly folded over, is otherwise shaped in *E. bedmari*, *E. coconina* and both of *E. sp. A* and *E. sp. B*.

Nevertheless, the new species can easily be separated from all members of the *coconina*-gr and other related congeners on the basis of a

combination of some differentiating features highlighted in the following key to known male adult and pupal exuviae of the *coconina*-gr species.

Key to known male adult of *Eukiefferiella* species belonging to the *coconina*-gr

1. Gonostylus lacking a proximal expansion.....*E. hessi*
 - Gonostylus bearing a proximal expansion.....2
2. Frontal tubercle triangular; gonostylus linearly elongate; proximal expansion digitiform; ventral basal lobe of gonocoxite vertically elongate.....*E. bedmari*
 - Frontal tubercle absent or present; gonostylus slender and linearly elongate or strongly arched; proximal expansion large lobe-like or triangular; ventral basal lobe of gonocoxite vertically absent or semi-circular3
3. Ventral basal lobe of gonocoxite broadly rectangular; gonostylus strongly arched, anterior side covered with 1 group of fine setae, proximal expansion large lobe-like shaped.....*E. coconina*
 - Ventral basal lobe of gonocoxite broadly semi-circular; gonostylus slender and linearly elongate, anterior side covered with 2 groups of fine setae inserted in 2 opposite directions, proximal expansion triangular*E. permiana*

Key to pupal exuviae of *Eukiefferiella* species belonging to the *coconina*-gr

1. Large crotchets present on tergites IV-VI; ridges absent on cephalothorax.....2
 - Large crotchets present only on tergites IV and V; ridges well-developed on cephalothorax.....3
2. Frontal apotome with transverse sclerotized band; basal part of thoracic horn with circular rows of warts; 9 to 11 large crotchets present on tergites IV and VI.....*E. coconina*
 - Frontal apotome without transverse sclerotized band; basal part of thoracic horn bare; up to

20 larges crotchets present on tergites IV-VI and about 15 on tergite VI*E. hessi*

3. Frontal apotome with or without warts; tergites IV and V with 4-6 larges crotchets.....4

- Frontal apotome without warts; tergites IV and V with 5-7 or 11-18 larges crotchets.....5

4. Frontal apotome without warts, transverse sclerotized band present; ridges small and weakly-developed on cephalothorax; thoracic horn ellipsoidal, not swollen medially.*E. bedmari*

- Frontal apotome with warts, transverse sclerotized band absent; ridges long and well-developed on cephalothorax; thoracic horn swollen medially.....*E. permiana*

5. Tergites IV and V with 11 to 18 larges crotchets; caudal margin of anal lobe straight, not projecting upwards; megaseta strongly curved medially and apically.....*E. sp. A* (Thailand)

- Tergites IV and V with 6 to 7 larges crotchets; caudal margin of anal lobe truncate, projecting upwards; megaseta only curved apically.....*E. sp. B* (New Caledonia)

5. Ecology and geographical distribution

The new species is a typical rheophilic and oxybiontic element exclusively encountered in lotic habitats, which consist of well to poorly shaded rhithral extended along the middle basin of the River Lergue. Typology of the prospected rhithral include riffles and waterfalls partly covered by a riparian and aquatic vegetation on rocky to stony substrata rich in gravely and sandy layers (Photos 1-2), which seem to represent the most favourite habitats for larval populations. Environmental data of water at the type-locality are: conductivity 600-1400 $\mu\text{S}/\text{cm}$; pH 7.2-8.4; annual temperature variations, minima, 8-12, maxima, 18-24°C. Environmental data at Lodève city are: well-shaded habitats, T°C 16-18, Cd 400-600 $\mu\text{S}/\text{cm}$; pH 7-7.5.

Both larvae and pupae of *E. permiana* sp. n. are morphologically well adapted to fast running

water using their long stout and curved setae or long spines and hooks to anchor on pebbles, stones and rocks in fast running water (riffles and waterfalls). Emergence of abundant populations is recorded in particular during the late spring season (April-May). Populations from the early and late summer period (June-August) are less abundant. Such pristine aquatic habitats actually consist of endangered hotspots of diversity and endemism, where intense agricultural activities, eco-tourism, pollution and both natural and accidental flooding. Consequently, the biogeographical significance of the new species is still underestimated and deserves therefore greater consideration, protection and preservation in the years to come. The specific richness recorded in the middle basin of the River Lergue, is apparently lower than that of other communities reported from similar ecological zones located in southern France. This is certainly due to various intense human activities and therefore, results from impacts of disturbances on riverine aquatic habitats (Photo 3), which greatly suffers nowadays from both climate change and anthropogenic effects. Occurrence of this new rheophilic species in the middle basin of the River Lergue indicates that it is currently less widespread in other similar lotic habitats over southern France.

Associated rheobiontic chironomid species encountered in the same localities as *E. permiana* sp. n., consist in a combination of sensitive to tolerant species: *Paramerina cingulata* (Walker, 1826); *Conchapelopia pallidula* (Meigen, 1818); *C. triannulata* (Goetghebuer, 1921); *Nilotanytus dubius* (Meigen, 1804); *Thienemannimyia laeta* (Meigen, 1818); *T. northumbrica* (Edwards, 1929); *Chaetocladius melaleucus* (Meigen, 1818); *Corynoneura lobata* Edwards, 1924; *C. scutellata* Winnertz, 1846; *Eukiefferiella brulini* Moubayed-Breil & Ashe, 2015; *E. fuldensis* Lehmann, 1972; *E. gracei* (Edwards, 1929); *Orthocladius pedestris* Kieffer, 1909; *O. thienemanni* Kieffer, 1906; *O. vaillanti* Langton & Cranston, 1991; *Parakiefferiella bathophila* Kieffer, 1912; *Parametriocnemus*



Photo 3. River Lergue: middle stream, riffle with invasive aquatic plants (*Ludwigia* sp.) showing the impact of pollution on the biological and ecological quality of habitats. J. Moubayed, 23.VIII.2023.

Photo 3. Cours moyen de la Lergue: radier avec herbier de Jussie (*Ludwigia* sp.) montrant l'impact de la pollution sur la qualité biologique et écologique des habitats. Cliché J. Moubayed, 23.VIII.2023.

stylatus (Sparck, 1923); *Paraphaenocladus pseudirritus* Strenzke, 1950; *Paratrachocladus rufigiventris* (Meigen, 1830); *Rheocricotopus chalybeatus* (Edwards, 1929); *R. fuscipes* (Kieffer, 1909); *Thienemanniella clavicornis* (Kieffer, 1911); *Tvetenia calvescens* (Edwards, 1929); *Microsectra apposita* (Walker, 1856); *M. pallidula* (Meigen, 1830); *Rheotanytarsus curt stylus* (Goetghebuer, 1921); *R. muscicola* Thienemann, 1929; *R. photophilus* (GeoGebra, 1921); *Tanytarsus arduennensis* (Goetghebuer, 1922); *T. eminulus* (Walker, 1826); *T. heusdensis* (Goetghebuer, 1923).

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