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Eukiefferiella coconina sp. n., an afrotropical element occurring in eurythermal lotic habitats of Mayotte Island, France [Diptera, Chironomidae, Orthocladiinae]

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Keywords: *Eukiefferiella coconina* sp. n., Diptera Chironomidae, afrotropical element, Mayotte Island (Overseas Departments and Territories, France), conservation.

The male adult, pupal exuviae and last instar larva of *Eukiefferiella coconina* sp. n., are diagnosed and described based on material collected during the dry season in some warm-eurythermal lotic habitats delimited by the middle basin of the Coconi and Kwale Rivers (altitude 60-80 m), which are respectively located in north western and eastern parts of Mayotte Island (Overseas Departments and Territories, France). The new species closely resembles *E. bedmari* Vilchez-Quero & Laville, 1987 and *E. hessi* Freeman, 1956 based on some common characters found, in particular, in the male adult (for the 3 species) and pupal exuviae (only for *E. bedmari*). In addition, the larva of *E. bedmari* is briefly described and compared to that of *E. coconina* sp. n. The description of *E. coconina* sp. n. increases the total number of worldwide valid species in the genus to 89, and to 22 reported from France including Overseas Departments. Taxonomic remarks, discussions and comments on the ecology of the new spec*i*es are given.

Eukiefferiella coconina sp. n., un élément afrotropical connu d'habitats lotiques eurythermes de l'Île de Mayotte, France [Diptera, Chironomidae, Orthocladiinae]

Mots-Clés : *Eukiefferiella coconina* sp. n., Diptera Chironomidae, élément afrotropical, Île de Mayotte (département et région d'Outre-mer, France), conservation.

L'adulte mâle, l'exuvie nymphale et le dernier stade larvaire d'*Eukiefferiella coconina* sp. n. sont diagnostiqués et décrits à partir d'un matériel collecté au cours de la saison sèche dans certains habitats lotiques eurythermes délimités par le bassin moyen des rivières Coconi et Kwalé (altitude 60-80 m) qui se situent respectivement au nord-ouest et à l'est de l'Île de Mayotte (département et région d'Outre-mer, France). La nouvelle espèce ressemble étroitement à *E. bedmari* Vilchez-Quero & Laville, 1987 et *E. hessi* Freeman, 1956 sur la base de certains caractères communs présents en particulier chez l'adulte mâle (des 3 espèces) et l'exuvie nymphale (seulement d'*E. bedmari*). En outre, la larve d'*E. bedmari* est brièvement décrite et comparée à celle d'*E. coconina* sp. n. La présente description porte à 89 le nombre des espèces valides mondialement connues appartenant au genre *Eukiefferiella* et à 22 celui de la faune de France au sens large comprenant ses départements et régions d'outre-mer. La position systématique et l'écologie de la nouvelle espèce sont discutées.

1. Introduction

The genus *Eukiefferiella* Thienemann, 1926 has been reported from all zoogeographical regions except for the Antarctic. It represents one of the most diversified and widespread Orthocladiinae genera in the world and currently includes cold-stenothermous to warm-eurythermic species encountered in lotic habitats mainly delimited by the rhithral of upper and middle basins of rivers and streams. Data on the taxonomy and geographical distribution of genus *Eukiefferiella* included other afrotropical elements (LEHMANN 1972, 1979, 1981, SÆTHER & HALVORSEN 1981, COFFMAN et al. 1986, SVENSSON 1986, ASHE et al. 1987, VILCHEZ-QUERO & LAVILLE 1987, CRANSTON et al. 1989, SÆTHER & EKREM 2003, ASHE & O'CONNOR 2012, QI et al. 2012a, 2012b, REE 2012, ANDERSEN et al. 2013, SÆTHER & SPIES 2013, MOUBAYED-BREIL & ASHE 2015) and show that there are currently 88 valid species worldwide. In a recent paper (MOUBAYED-BREIL & ASHE 2015) 22 *Eukiefferiella* species were reported from Europe, of which 21 recorded from continental France and Corsica. Consequently, there are 22 known valid species from France, which includes Corsica and Overseas Departments and Territories

In this paper, *E. coconina* sp. n. is diagnosed and described as male adult, pupal exuviae and last instar larval stage, based on associated material collected during the early dry season in some pristine lotic habitats (riffles and small waterfalls) extended along the middle basin of the Coconi and Kwale Rivers (Photos 1 à 3) -altitude 60-80 m-, which are located in Mayotte Island (north western and eastern areas, Overseas Departments and Territories, France). Both of Coconi and Kwale River basins are covered by a dense evergreen riparian rainforest, which is typically characteristic of the Afrotropical Region.

In addition, the larva of *E. bedmari* Vilchez-Quero & Laville, 1987, is briefly described and compared to that of *E. coconina* sp. n. Moreover, on the basis of some common morphological characters found in the male adult, *E. bedmari* (known from the Mediterranean Region) and *E. hessi* Freeman, 1956 (known from Cape Province, S-Africa) appear to key into a same group of *Eukiefferiella* species.

2. Material and methods

Material composed of male pharate adults, pupal exuviae and larvae of *E. coconina* sp. n. was collected using some standard methods: Surber net for the benthos (larvae and pupae); Brundin drift nets for pharates, pupae and drifted pupal exuviae; troubleau net for individuals floating on the surface of the water. Material of male adults were preserved in 80-85% ethanol, then cleared of musculature in 90% lactic acid (head, thorax, abdomen and anal segment) for about 60 to 80 minutes, which can be left overnight at room temperature without any detrimental effect or damage. The specimens were checked under a binocular microscope after 20 minutes in lactic acid to determine how the clearing was progressing. When clearing was complete the specimens were washed in two changes of 70% ethanol to ensure that all traces of lactic acid were removed.

The studied material was mounted in polyvinyl lactophenol. Before the final slide mountings of the type and paratype material in dorsal view, the hypopygium including tergite IX and anal point, the gonocoxite and the gonostylus, were viewed ventrally and laterally to examine and draw from both sides all the necessary details of the species. In particular, the ventral view of hypopygium was illustrated when anal point and tergite IX were removed. For a better examination of the specific features and more accurate description of the various taxonomic details of the pupa, the

pupal abdomen was mounted not only in dorsal and ventral view, but separately in lateral view, which facilitates proper examination and illustration of all the relevant taxonomic characters.

Part of the abdomen and the halters of the male adult are preserved in 85% ethanol for an eventual DNA analysis. 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.

Photo 1. Coconi stream (Mayotte Island), type-locality of *Eukiefferiella coconina* sp. n.: shaded riffle with aquatic and subaquatic plants, middle basin, dry season from June to September, alt. 60-80 m. Photo N. Mary, 17.VII.2017.

Photo 1. Ruisseau de Coconi (Île de Mayotte), localité-type d'*Eukiefferiella coconina* sp. n.: radier ombragé avec des plantes aquatiques et subaquatiques, bassin moyen, alt. 60-80 m, saison sèche de juin à septembre. Photo N. Mary, 17.VII.2017.

3. Description

Eukiefferiella coconina sp. n.

Material examined

Holotype. Mayotte Island. 1 male adult, leg. N. Mary. Middle basin of the River Coconi, warm-eurythermal lotic habitats including shaded riffles and waterfalls extended along a dense riparian forest covering between 50 and 100% of the River's basin, (NW-Mayotte Island), (12° 50' 20.99" S; 45° 08' 10.80" E);

altitude 60-80 m, 17.VII.2017. Environmental data of water are: conductivity 153 µS/cm; pH about 7.75; temperature 22-28°C.

Paratypes. Mayotte Island. (leg. N. Mary). 1 male pharate adult, 13 larvae, same locality and data as holotype. 1 male pharate adult, 11 larvae, middle basin of Kwale River (E-Mayotte), warm-eurythermal lotic habitats with shaded riffles and waterfalls covered by a dense riparian forest, (12° 47' 49.0" S; 45° 11' 08.7" E); altitude 60-80 m, 21.VII.2015. Environmental data of water are: conductivity 273 µS/cm; pH 8.0-8.1; temperature 22-28°C.

Holotype (mounted on 2 slides) is deposited in the collections of the Zoologische Staatssammlung of (ZSM), Munich, Germany. The paratypes are deposited in the collection of the senior author.

Etymology

The new species is named '*coconina*' after the Coconi stream, which is located in Mayotte Island where the type material was collected.

Diagnostic characters

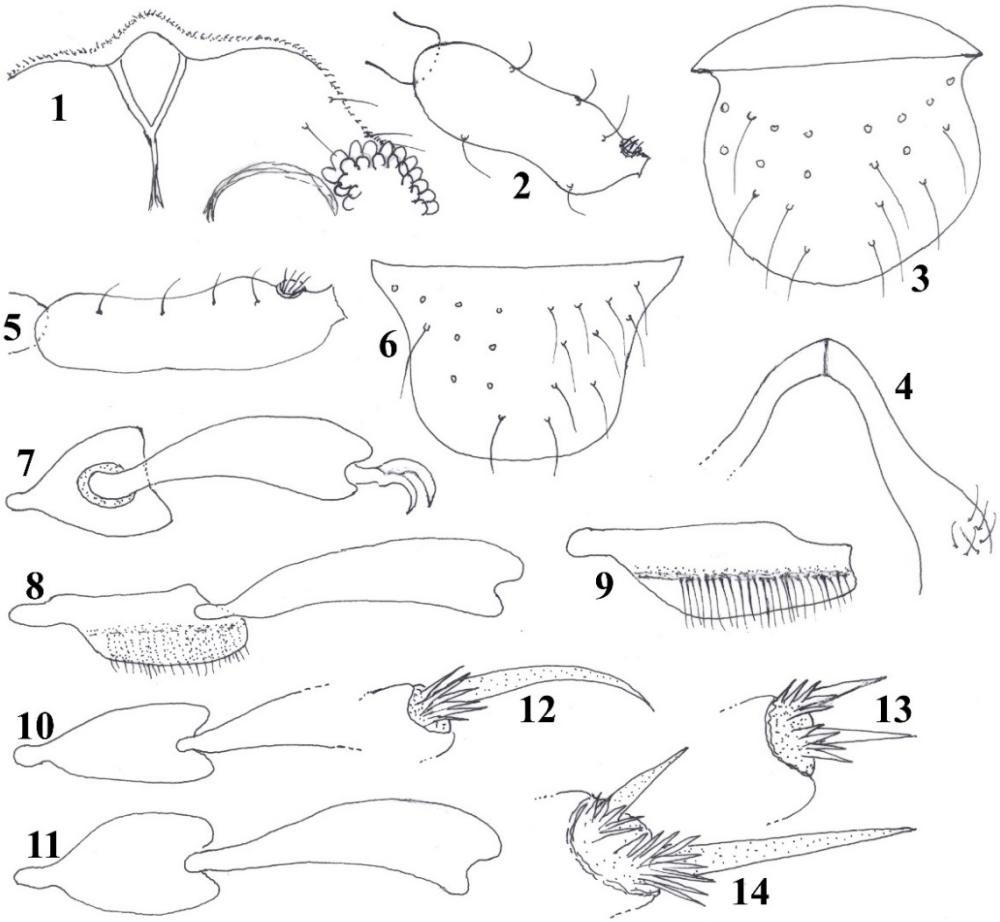
The new species is closely related to *E. bedmari* Vilchez-Quero & Laville, 1987, based, in particular, on some common relevant features of both adults and pupal exuviae. However, the new species is separated from other members of *Eukiefferiella* species by the following combination of characters. Tarsomere ta_4 of PI heart-like shaped and distinctly shorter than tarsomere ta5; tarsomere ta_4 of PIII bearing a characteristic row of posteriorly directed setae located on ventral side. Gonocoxite distinctly truncate apically, ventral margin with a large rectangular and contrasting lobe, bearing 2 rows of stout setae, caudal part hyaline and bare. Inferior volsella markedly contrasting, triangular and narrowing apically to a nose-like apex, which is bare and slightly projecting downwards, posterior margin with a row of 5-6 stout setae bent downwards. Gonostylus arched medially and slightly projecting upwards apically; proximal part of anterior side with a typical rounded expansion, which is bearing 2 short inwardly directed setae; anterior margin bearing 3-4 orally directed setae; crista dorsalis indistinct.

Male imago

(n = 3; Figs 1-4, 7-9, 12-14, 15-22)

Large sized species. Total length 4.40-4.50 mm, abdomen length 3.20-3.30 mm, 0.65-0.75 µm maximum width. Wing length 1.35-1.40 mm. General colouration contrasting brown to blackish especially the thorax; head dark brown; antenna dark brown, last flagellomere darker distally (Fig. 1); thorax dark brown with blackish mesonotal stripes; legs brown to blackish, fifth tarsomeres of all legs darker; abdomen dark brown, anal segment blackish.

Head. Vertex and coronal area (Fig. 1) with Y-shaped suture; Eyes bare, inner eye margin bare; temporals consist of 4-5 setae including 2-3 inner and 2 outer verticals. Palp 5-segmented, first palpomere well developed, segments 1-3 fused; length (in µm) of segments: 15, 20, 45, 55, 75; palpomere 3 (Fig. 2) with 5 sensilla clavata in 2 rows, sensilla coeloconica located near the apical part. Clypeus (Fig. 3) 60 µm long and 65 µm maximum width, nearly circular with convex basal part and bearing 20-21 setae in 4 rows. Antenna 13-segmented, 795-815 µm long and linearly elongated; last flagellomere 465-475 µm long, weakly clubbed apically, with numerous apical sensillae chaetica; antennal groove clearly visible, beginning on segment 3 and reaching ultimate flagellomere; AR 1.37-1.40.



Figures 1-14. Male imago of *Eukiefferiella* spp. *E. coconina* sp. n.: head, vertex with coronal suture (1); palpomere 3 (2); clypeus (3); lobes of antepronotum (4). *E. bedmari*: palpomere 3 (5); clypeus (6). *E. coconina* sp. n.: tarsomeres 4 and 5 in dorsal view of PI (7) and PIII (8); tarsomere 4 of PIII (ventral, 9). *E. bedmari*: tarsomeres 4 and 5 in dorsal view of PI (10) and PIII (11). *E. coconina* sp. n.: tibial spur of PI (12); tibial spurs of PII (13) and PIII (14).

Figures 1-14. Imago mâle d'*Eukiefferiella* spp. *E. coconina* sp. n. : tête, vertex et suture coronale (1) ; palpomère 3 (2) ; clypeus (3) ; lobes de l'antépronotum (4). *E. bedmari* : palpomère 3 (5) ; clypeus (6). *E. coconina* sp. n. : tarsomères 4 et 5 en vue dorsale de PI (7) et PIII (8) ; tarsomère 4 de PIII, vue ventrale (9). *E. bedmari* : tarsomères 4 et 5 en vue dorsale de PI (10) et de PIII (11). *E. coconina* sp. n. : épine tibiale de PI (12) ; épines tibiales de PII (13) et PIII (14).

Thorax. Lobes of antepronotum (Fig. 4) in contact (not gaping), antepronotals 6; acrostichals 24-26 consist of short setae starting close to antepronotum; dorsocentrals 12-13 in one row; humerals 5; prealars 4 in one row; preepisternals absent; humeral pit indistinct; scutellum with 14

setae (7 on each side of the median area). Wing. Brachiolum with 1 seta; number of setae on veins: R, 11-12; R_1, 0; R_{2+3}, 1; remaining veins bare; squama with 27-29 setae. Legs. Sensilla chaetica present on: ta_1- ta_4 Tarsomere ta_4 of PI (Fig. 7) heart-like shaped 75 µm long and 45 µm maximum width; tarsomere ta_4 of PIII (Fig. 8) 80 µm long and about 30 µm maximum width, rectangle-like in its ¾ distal part; tarsomere ta_4 of PI, PII and PIII markedly shorter than ta_5; ventral side of tarsomere ta_4 of PIII (Fig. 9) bearing a characteristic row of 23-25 posteriorly directed setae; tibial spur of PI (Fig. 12) 70-75 µm long, distinctly spiniform and projecting upwards apically; tibial spurs of PII (Fig. 13) 45 µm long, subequal; tibial spurs of PII (Fig. 14) 90 and 40 µm long. Length (in µm) of spurs on tarsomeres ta_1-ta_3 of: PI (ta_1, vestigial, ta_2-ta_3 absent); PII (40 on ta_1-ta_2, 35 on ta_3); PIII (40 on ta_1-ta_2, 30 on ta_3). Length (µm) and proportions of prothoracic (PI), mesothoracic (PII) and metathoracic (PIII) legs as in the following table:

	fe	**ti**	**ta_1**	**ta_2**	**ta_3**	**ta_4**	**ta_5**	**LR**	**BV**	**SV**	**BR**
PI	765	715	485	325	245	75	100	0,70	2,54	3,01	1.00
PII	685	705	300	185	120	80	100	0,43	4,45	4,63	1.45
PIII	785	725	310	175	125	80	110	0,43	4,85	4,88	1.90

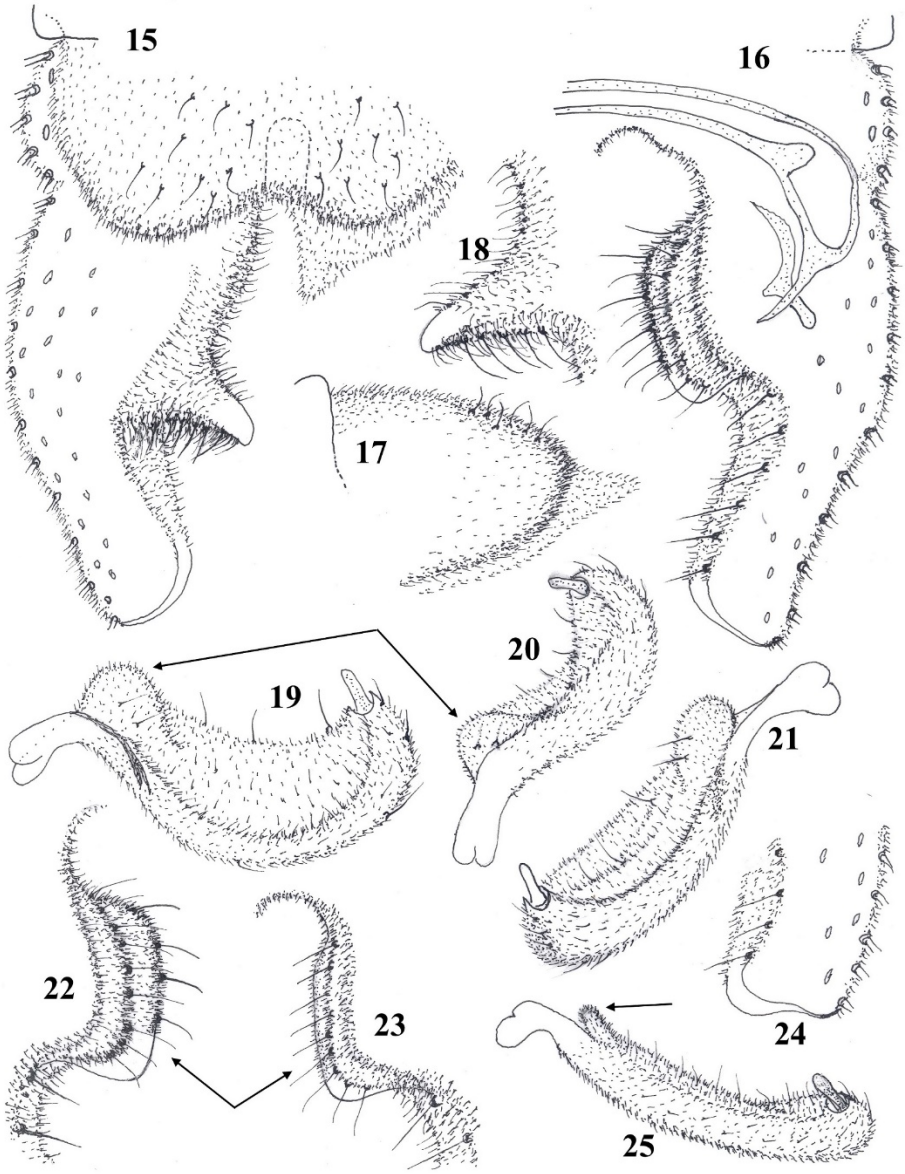
" LR = Length of tarsomere ta_1 divided by length of tibia (ti); BV = Combined length of femur (fe), tibia and ta_1 divided by combined length of tarsomeres ta_2-ta_5; SV = Ratio of femur plus tibia to tarsomere ta_1; BR = Ratio of longest seta of ta_1 divided by minimum width of ta_1, measured one third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

Abdomen. Hypopygium in dorsal and ventral view (Figs 15-16), ventral view with tergite IX removed as in Fig. 16. Tergite IX 125 µm long and 225 µm maximum width, broadly semi-circular, with a bifid posterior margin; dorsal side slightly rounded and lacking hump when is viewed laterally (Fig. 17); 16-18 short setae 15-17 µm long are present on postero-median area (8-9 setae on each side of the median part. Anal point absent. Laterosternite IX with 12-14 setae inserted laterally (6-7 on each side). Sternapodeme and phallapodeme (Fig. 16), transverse sternapodeme linearly elongated; phallapodeme sickle-like shaped distally. Gonocoxite (Figs 15-16) 80 µm long and 55-60 µm maximum width, markedly truncate apically; ventral side with a large and contrasting rectangular basal lobe (Figs 16, 22), which is projecting inwards and bearing 2 rows of stout setae, caudal part hyaline and bare. Inferior volsella (Figs 15, 18) 25-27 µm long and 35-37 µm maximum width, markedly contrasting, triangular and projecting inwards, distinctly narrowing apically to a nose-like apex, which is hyaline and bare; posterior margin with a row of 5-6 stout setae bent downwards and curved backwards. Gonostylus in dorsal (Fig. 19), lateral (Fig. 20) and ventral view (Fig. 21), 60 µm long and 15 µm maximum wide, arched medially and slightly projecting upwards apically, proximal part of anterior side with a typical rounded expansion (15 µm long and 10 µm high), which is bearing 2 short inwardly directed setae; anterior margin bearing 3-4 orally directed setae; crista dorsalis indistinct.

Male pupal exuvia

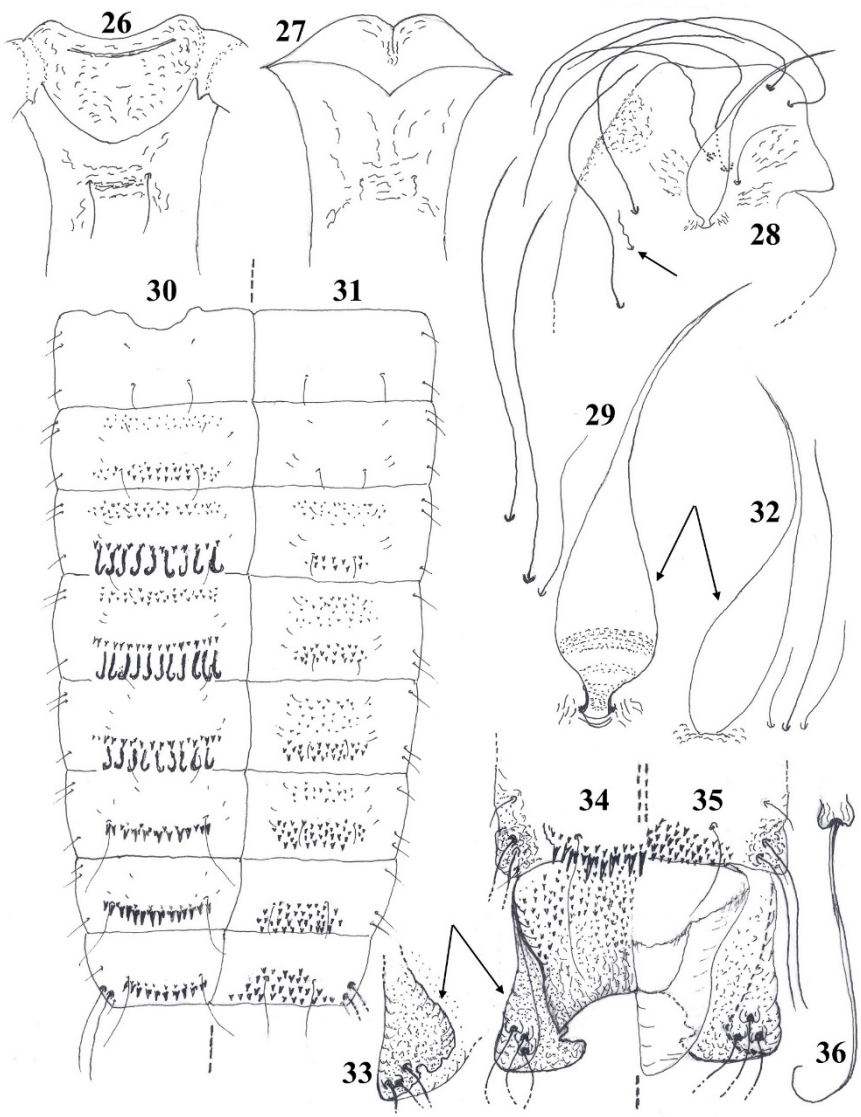
(n = 3; Figs 26, 28-31, 34-36)

Large sized *Eukiefferiella* species. Total length 4.40-4.50 mm; abdomen length 3.30-3.40 mm. Colouration golden to dark brown in general, thorax and abdomen brown yellowish to dark brown, anal lobe brown to dark brown including genital sacs, brownish shading present near the base of wing sheath. Frontal apotome brownish and distinctly rugulose. Cephalothorax with granulation limited to antero-median of thoracic suture, anteromedian area with scattered wrinkles; swollen part of thoracic horn with wrinkles in a circular pattern.



Figures 15-25. Male imago of *Eukiefferiella* spp. *E. coconina* sp. n.: hypopygium in dorsal (15) and ventral view (16); tergite IX (lateral, 17); inferior volsella (dorsal, 18); gonostylus in dorsal (19), lateral (20) and ventral view (21); gonocoxite, basal lobe (ventral, 22). *E. bedmari*: gonocoxite, basal lobe (ventral, 23) and apical part (ventral 24); gonostylus (dorsal, 25).

Figures 15-25. Imago mâle d'*Eukiefferiella* spp. *E. coconina* sp. n. : hypopyge, vue dorsale (15) et ventrale (16) ; tergite IX, vue latérale (17) ; volselle inférieure, vue dorsale (18) ; gonostyle, vue dorsale (19), latérale (20) et ventrale (21) ; lobe basal du gonocoxite, vue ventrale (22). *E. bedmari* : gonocoxite, vue ventrale du lobe basal (23) et de la partie apicale (24) ; gonostylus, vue dorsale (25).



Figures 26-36. Male pupal exuviae of *Eukiefferiella* spp. Frontal apotome of *E. coconina* sp. n. (26) and *E. bedmari* (27). *E. coconina* sp. n.: cephalothorax (28); thoracic horn (29); armament and chaetotaxy of abdominal segments I-VIII, tergites (30) and sternites (31). *E. bedmari*: thoracic horn (32); caudo-lateral part of anal lobe, left side in dorsal view (33). *E. coconina* sp. n.: posterior part of segment VIII with anal segment in dorsal (34) and ventral view (35); megaseta (36).

Figures 26-36. Exuvie nymphale mâle d'*Eukiefferiella* spp. Apotome frontale d'*E. coconina* sp. n. (26) et d'*E. bedmari* (27). *E. coconina* sp. n. : céphalothorax (28) ; corne thoracique (29) ; ornementation et chaetotaxie des segments abdominaux I-VIII, tergites (30) et sternites (31). *E. bedmari* : corne thoracique (32) ; partie caudo-latérale gauche du lobe anal, vue dorsale (33). *E. coconina* sp. n. : partie postérieure du segment VIII et du segment anal, vue dorsale (34) et ventrale (35) ; macrosoie anale (36).

Frontal apotome (Fig. 26) with a concave anterior margin, which is bearing an arched blackish mark, frontal setae about 40 µm long, well developed. Cephalothorax (Fig. 28) with 2 median antepronotals about 450 µm long, lateral antepronotals absent; distance between median antepronotals 50 µm. Precorneals consist of 2 very long setae about 440-450 µm long and one shorter of 250-260 µm long; distance between the 2 longer setae 40 µm; thoracic horn (Fig. 29) about 450 µm long, typically swollen at base and obviously distinct from the apical filament; swollen part 135-145 µm long, bearing circular marks at base. Dorsocentrals (Fig. 28) composed of 3 setae (Dc_1, Dc_2 and Dc_3) including 2 long and subequal of 380-390 µm long; Dc_2 thin and bristle-like, about 65 µm long; Dc_1 and Dc_2 separated by 30-40 µm, Dc_3 is located close to Dc_3.

Abdomen. Dorsal and ventral view of armament and distribution pattern of shagreen, rows of posterior transverse spines and hooks on abdominal segments I-VIII as in Figs 30-31. Tergite and sternite I bare. Anteromedian group of shagreen and small points present on tergites II-IV and sternites III-VI; posterior transverse rows of spines present on tergites III-VIII, composed of one row on III-V and 2 rows on VI-VIII, small sized on III-V, becoming gradually larger on VI-VIII. Posterior transverse row of long hooks (60-70 µm long) present on tergites III-V, number of hooks on tergites III-VI: 8-9 hooks on III, 11 on IV and 9 on V. Posterior transverse rows of spines present on sternites III-VIII, becoming gradually larger and more dense on VI-VIII. Distribution pattern of lateral setae on segments I-VIII as in Figs 30-31, consists of 2-3 setae on segment I-VII and 4 setae on segment VIII, the 3 apical setae on caudo-lateral part of segment VIII include 2 long of 300 µm long and 1 vestigial of 15 µm long. Tergites VI-VIII with 2 postero-median setae of 350-400 µm long. Pedes spurii B and Pedes spurii A absent. Anal lobe in dorsal and ventral view as in Figs 34-35, 325 µm long, 425 µm wide at base, apical part about 350 µm wide, each side of the apical part 115 µm wide; general shape nearly rectangular; caudo-lateral part inwardly folded over; apical part square-like shaped, with nearly straight margin and bearing a characteristic notch located on inner lateral margin; dorso-median part with a characteristic trapezoidal plate-like, distinctly narrowing distally to a pointed apex, posterior margin concave, anteromedian area covered with dense spinulae; macrosetae (Fig. 36) about 350 µm long markedly curved and pointed apically; male genital sac 190-200 µm long, overreaching apical margin of anal lobe by 40-45 µm.

Last instar larva of *E. coconina* sp. n.

(n = 15; Figs 37, 39, 41-43, 46-47)

General colouration brown yellowish to greenish with blackish mandibles, foramen occipitale and mentum. Thoracic segments brown yellowish. Abdominal segment and anal segment entirely pale brown with blackish anal claws.

Total length 5.30-5.40 mm; abdomen 3.70-3.80 mm. Head. Labium, clypeus and frontal apotome with setae 1-5 simple and setae-like, length (µm): S1, 40-45; S2, 55-60, S3, 75, S4, 115-120, S5, 150-160. Clypeus and frontal apotome (Fig. 37); clypeus 30 µm long, 50 µm maximum wide, with trapezoidal lobes which are in contact; frontal apotome about 400 µm long, 150-160 µ maximum width; wider medially and gradually narrowing distally; S3 and S4 separated by 40 µm, S4 and S5 by 70 µm. Antenna (Fig. 39) 110-115 µm long, 5-segmented; segment 1 about 70 µm long, about 15 µm maximum wide, remaining segments 2-5 about 40 µm long, AR 1.75; antennal seta on segment 1 vestigial; ring organ located on 1/3 distance from base; accessory blade about 35 µm long, reaching tip of segment 5; lauterborn organ on segment 2 absent. Mandible (Fig. 41) about 135 µm long, 65 µm maximum wide at base, inner margin bearing 5 pointed teeth, apical tooth as

long as the 2 combined preceding teeth; seta subdentalis and seta interna indistinct. Mentum (Fig. 42) 70 µm long, 90 µm maximum width, bearing 5 pairs of lateral teeth pointed apically; median tooth tong-like and well domed medially; longitudinal bands of dark striated sclerotisation widely present. Foramen occipitale (Fig. 43) bell-like shaped with domed basal part, apical expansion well developed, distinctly pointed and projecting inwards.

Body. Anterior parapods about 250 µm long, longest claw 75 µm long. Numerous setae are present on thorax and abdominal segments. Pro-, meso- and meta-thorax with 8 setae on each part: 4 located dorsally and 4 ventrally. Abdominal segments I-VII with 8 setae (4 on tergites, 4 on sternites); lateral setae on segments I-VIII are short; setae on tergites are longer, especially on tergites VI-VIII. Anal segment in lateral view as in Figs 46-47. Anal tubules (Fig. 46) unequal in size and shape, outer tubule distinctly long lobe-like shaped. Procercus (Fig. 47) sub-circular, 35 µm long, 25 µm maximum wide, bearing 7 anal setae including 1 short (75 µm long) and 6 of 500-520 µm long. Posterior parapods (Fig. 47) about 250 µm long each, bearing retractile crochets differently shaped.

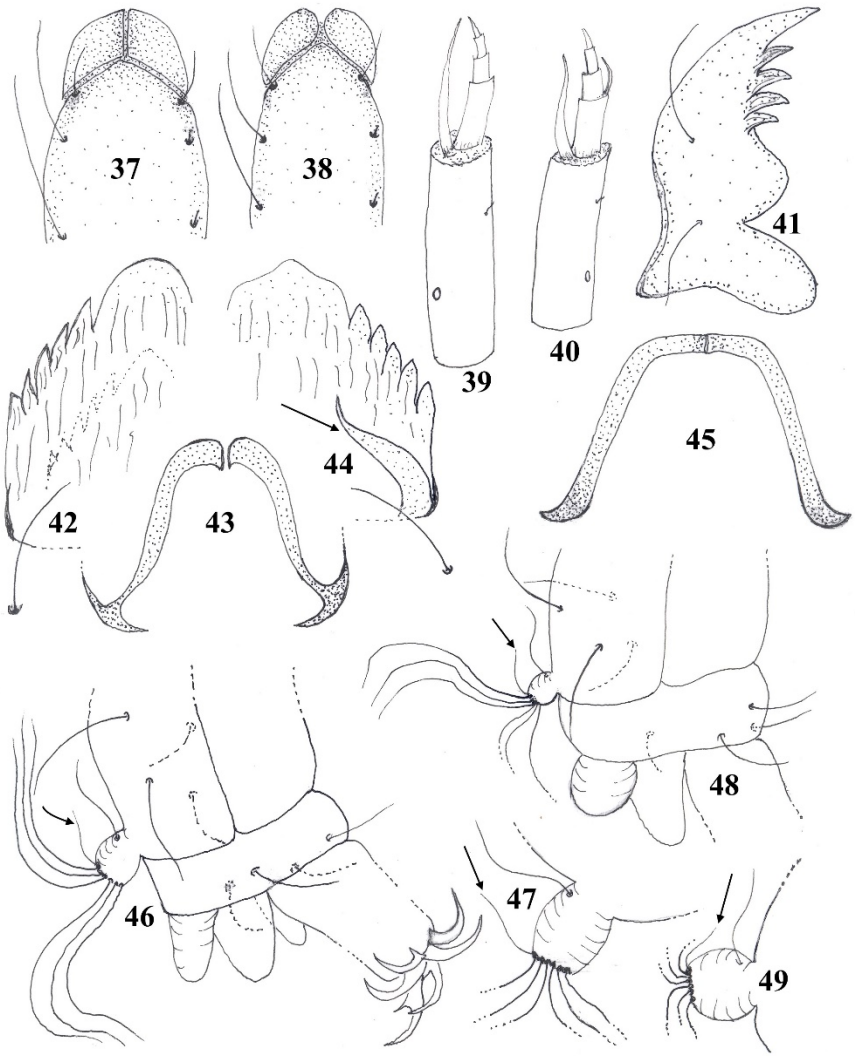
Last instar larva of *E. bedmari* Vilchez-Quero & Laville, 1987

(n = 10; Figs 38, 40, 44-45, 48-49)

Material examined was collected in: Corsica, continental France and Lebanon; middle and down basins of rivers, altitude 20-500 m.

General colouration as in *E. coconina*. Total length 3.70-3.80 mm; abdomen 2.70-2.80 mm. Head. Setae 1-5 simple and setae-like, length (µm): S1, 30; S2, 50; S3, 60; S4, 105; S5, 130. Clypeus and frontal apotome (Fig. 38); clypeus 20 µm long, 35 µm maximum wide, with ellipsoidal lobes which are widely open; frontal apotome about 330 µm long, 120-130 µm maximum width; wider medially and gradually narrowing distally; S3 and S4 separated by 35 µm, S4 and S5 by 55 µm. Antenna (Fig. 40) 80 µm long, 5-segmented; segment 1 about 40 µm long, about 10 µm maximum wide, remaining segments 2-5 40 µm long, AR 1.00; antennal seta on segment 1 vestigial; ring organ located on 1/3 distance from base; accessory blade about 25 µm long, reaching tip of segment 4; lauterborn organ on segment 2 well developed. Mandible with 5 pointed teeth, apical tooth as long as the 2 combined preceding teeth; seta subdentalis and seta interna indistinct. Mentum (Fig. 44) as long as wide (75 µm long, 75 µm maximum width), bearing 5 pairs of lateral teeth nearly rounded apically; median tooth 15 µm long and 20 µm wide, bearing a distinct median hump; longitudinal bands of dark striated sclerotisation present; caudo-lateral part bearing a sclerotized characteristic expansion inwardly projecting. Foramen occipitale (Fig. 45) trapeze-like shaped with straight basal part, apical expansion weakly developed and slightly curved outwards.

Body. Anterior parapods about 200 µm long, longest claw 60 µm long. Chaetotaxy of thorax and abdominal segments I-VIII as in *E. coconina* sp. n., only setae on tergite VIII are longer than those on sternite VIII. Anal segment in lateral view as in Figs 48-49. Anal tubules (Fig. 48) unequal in size and shape, outer tubule distinctly shorter and spherical. Procercus (Fig. 48) nearly circular, 25 µm long, 20 µm maximum wide, bearing 7 anal setae including one short (65 µm long) and 6 about 500 µm long. Posterior parapods (Fig. 49) about 200 µm long each, bearing retractile crochets differently shaped.



Figures 37-49. Last instar larva of *Eukiefferiella* spp. Frontal apotome and clypeus of: *E. coconina* sp. n. (37), *E. bedmari* (38). Antenna of: *E. coconina* sp. n. (39), *E. bedmari* (40). *E. coconina* sp. n.: mandible (41); mentum with submentum seta 'Sm' (42); foramen occipitale with apical expansion (43). *E. bedmari*: mentum with submentum seta 'Sm' (44); foramen occipitale (45). *E. coconina* sp. n.: anal segment in lateral view (46); procercus with basal subapical setae of anal segment (47). *E. bedmari*: anal segment in lateral view (48); procercus with subapical and basal setae of anal segment (49).

Figures 37-49. Dernier stade larvaire d'*Eukiefferiella* spp. Apotome frontal et clypeus d'*E. coconina* sp. n. (37) et d'*E. bedmari* (38). Antenne d'*E. coconina* sp. n. (39) et d'*E. bedmari* (40). *E. coconina* sp. n. : mandibule (41) ; mentum et soie du submentum 'Sm' (42) ; tête, foramen occipitalis et expansion apicale (43). *E. bedmari* : mentum et soie du submentum 'Sm' (44) ; tête, foramen occipitalis (45). *E. coconina* sp. n. : segment anal, vue latérale (46) ; procerque avec les soies subapicales du segment anal (47). *E. bedmari* : segment anal, vue latérale (48) ; procerque avec les soies subapicales et basales du segment anal (49).

4. Taxonomic remarks

E. bedmari and *E. hessi* represent the nearest *Eukiefferiella* species to *E. coconina* sp. n. based on the following common morphological characters present in the:

- male adult: shape of inferior volsella, for both *E. bedmari* and *E. hessi*;

- pupal exuvia: chaetotaxy of the thorax, shape of thoracic horn, distribution pattern of armament on tergites and sternites, for *E. bedmari*;

- larva: shape pattern of antenna, mentum, foramen occipitale and anal segment.

Moreover, due to some phylogenetic affinities, *E. coconina* sp. n. could be considered as an ancestor afrotropical element of only *E. bedmari*. Consequently, *E. coconina* sp. n. and *E. bedmari* appear to key into a same group of *Eukiefferiella* species. However, *E. coconina* sp. n. is easily distinguished from other related members of *Eukiefferiella* genus by a combination of differentiating characters.

Male adult

Sensilla clavata on palpomere 3 in 2 rows (Fig. 2), are located in one row in *E. bedmari* (Fig. 5); clypeus circular (Fig. 3), is trapezoidal in *E. bedmari* (Fig. 6); tarsomere ta_4 of PI heart-like in *E. coconina* sp. n. (Fig. 7), is elongated in *E. bedmari* (Fig. 10); ventral side of tarsomere ta_4 of PIII (Figs 8-9) with a characteristic row of 23-25 posteriorly directed setae, is absent in *E. bedmari* (Fig. 11); apex of gonocoxite truncate (Fig. 16), is straight in *E. bedmari* (Fig. 24); ventral basal lobe of gonocoxite projecting inwards and bearing 2 rows of stout setae (Figs 16, 22), is not projecting and bearing only one row of stout setae in *E. bedmari* (Fig. 23); rounded expansion on proximal part of gonostylus (Figs 19-21), is weakly represented in *E. bedmari* (Fig. 25) and absent in *E. hessi* (cf. LEHMANN 1979, Fig. 58).

Pupal exuviae

Frontal apotome (Fig. 26) concave with a characteristic black arched mark basally, is domed in *E. bedmari* (Fig. 27); thoracic horn, antepronotals and dorsocentrals (Fig. 28), are much shorter in *E. bedmari* (see VILCHEZ-QUERO & LAVILLE 1987, Figs 2A-2B); posterior rows of long hooks on tergites III-V, absent on tergite III in *E. bedmari* (*Ibid*., Fig. 2C); posterior rows of short spines on sternites III-VIII, are present only on sternites IV-VIII in *E. bedmari* (*Ibid*., Fig. 2D); dorsal side and apical part of anal lobe (Figs 34-35), are differently figured in *E. bedmari* (Fig. 33; VILCHEZ-QUERO & LAVILLE 1987, Fig. 2F).

Larvae

Lobes of clypeus in contact, with linear suture (Fig. 37), are widely gaping in *E. bedmari* (Fig. 38); accessory blade reaching tip of segment 5 (Fig. 39), is not reaching segment 5 in *E. bedmari* (Fig. 40); median tooth of mentum tong-like (Fig. 42), is bearing a median hump in *E. bedmari* (Fig. 44); outer tubule of anal segment thumb-like (Fig. 46), is spherical in *E. bedmari* (Fig. 48).

5. Ecology and geographical distribution

The new species is a typically rheobiontic and thermophilic element exclusively encountered in lotic habitats, which consist of moderately shaded rhithral extended along the middle basin of

the Coconi and Kwale Rivers of Mayotte Island. Hygropetric areas covered by a dense riparian rainforest with eurythermal water (20-23°C) on rocky to stony substrata rich in gravely and sandy layers (Photos 1 à 3), probably represent the most common aquatic habitats for larval and pupal populations. Environmental data of water are: conductivity 153-273 µS/cm; pH 7.75-8.1; annual temperature variations are: 22-28°C.

Photo 2. Coconi stream (Mayotte Island), middle basin after the humid and rainy season from December to Marsh. Photo N. Mary, April 2016.

Photo 2. Ruisseau de Coconi (Île de Mayotte), bassin moyen après la saison humide et pluvieuse de décembre à mars. Photo N. Mary, avril 2016.

Both larvae and pupae of *E. coconina* sp. n. are morphologically well adapted to running water (riffles and waterfalls) using their long stout and curved setae or long spines and hooks to anchor on pebbles, stones and rocks. Emergence of adults for *E. coconina* sp. n. is recorded during the early dry season (from June to July).

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. Their biogeographical significance is still underestimated and deserves therefore greater consideration, protection and preservation in the years to come.

Afrotropical associated rheobiontic chironomid species encountered in the same localities as *E. coconina* sp. n., consist in general of vulnerable and sensitive species. Their specific richness, recorded in the middle basin of both Coconi and Kwale Rivers, appears to be much lower than

other communities reported by LEHMANN (1979, 1981) from similar ecological zones located in S-Africa and Cap Province. This is certainly due to various intense human activities and therefore, results from impacts of disturbances on riverine aquatic habitats, which greatly suffers nowadays from both climate change and anthropogenic effects.

Occurrence of this new rheophilic and thermobiontic species in Mayotte Island indicates that it is apparently more widespread in other eurythermal lotic habitats of the Afrotropical Region, and consequently can be expected from southern Africa (Cape Province) and some neighbouring islands of the Indian Ocean like Comoros and Madagascar.

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Photo 3. Kwale stream (Mayotte Island), middle basin, dry season. Photo N. Mary, 21.VII.2017.

Photo 3. Ruisseau de Kwalé (Île de Mayotte), bassin moyen, saison sèche. Photo N. Mary, 21.VII.2017.