Ephemera, 2018 (2019), Vol. **20** (2) : 87-97

Rheocricotopus (*Rheocricotopus*) *rifensis* sp. n., a new rheobiontic species from waterfalls located in the Moroccan Rif [Diptera, Chironomidae, Orthocladiinae]

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Keywords: *Rheocricotopus* (*R.*) *rifensis* sp. n., Diptera Chironomidae, waterfalls, Moroccan Rif, conservation.

Rheocricotopus (*R.*) *rifensis* sp. n. is diagnosed and described as male and female adult and pupal exuviae, based on material collected in two waterfalls (Challal Sghir of Akchour and Chrafate, NW-Morocco, altitude 728 and 860 m) located in the Rifian chain, called the Rif, which includes the most mountainous region of northern Morocco. A combination of some atypical characters found in the male adult and pupal exuviae (tergite IX cup-like shaped, markedly contrasting with narrowed distal part; anal point with 4 setae unusually located at base; superior volsella large with rounded apex and widely projecting downwards; gonocoxite truncate apically; crista dorsalis absent; thoracic horn swollen medially and truncate apically) allowed us to consider this new species as a member of the *reduncus*-group, recently emended by MOUBAYED-BREIL & ASHE (2019). In addition, *R. rifensis* sp. n. is a typical rheobiontic, which can be considered as a Mediterranean local representative of waterfalls delimited by the Moroccan Rif. This description increases the total number of valid species in the *reduncus*-group to 5 for the Palaearctic Region. Comments on the taxonomic position, ecology and geographical distribution of the new species are given.

Rheocricotopus (*Rheocricotopus*) *rifensis* n. sp., nouvelle espèce rhéobionte des cascades du Rif Marocain [Diptera, Chironomidae, Orthocladiinae]

Mots-Clés: *Rheocricotopus* (*R.*) *rifensis* sp. n., Diptera Chironomidae, cascades, Rif, NW-Maroc, conservation.

Les adultes mâle et femelle et l'exuvie nymphale de *Rheocricotopus* (*R.*) *rifensis* sp. n. sont diagnostiqués et décrits à partir d'un matériel collecté dans deux cascades (Challal Sghir d'Akchour et Chrafate, NW-Maroc, altitude 728 et 860 m) situées dans la chaine Rifaine, connue sous le nom de « Rif », qui correspond à la région la plus montagneuse du nord-ouest du Maroc. Une combinaison de certains caractères atypiques de l'adulte mâle et de l'exuvie nymphale (tergite IX en forme de coupe, contrasté et plus étroit dans sa partie distale; pointe anale avec 4 soies placées inhabituellement à sa base; volselle supérieure large avec un apex arrondi et projeté vers le bas; gonocoxite avec apex tronqué; crista dorsalis absente; corne thoracique enflée dans sa partie médiane et tronquée à l'apex) nous a permis d'apparenter cette nouvelle espèce au groupe-*reduncus*, récemment modifié par MOUBAYED-BREIL & ASHE (2019). De plus, *R. rifensis* sp. n. est une espèce typiquement rhéobionte qui peut être considérée comme un élément méditerranéen représentatif des cascades délimitées par le Rif Marocain. Cette description porte à 5 le nombre total des espèces valides appartenant au

groupe-*reduncus* de la Région Paléarctique. La position taxonomique, l'écologie et la distribution géographique de la nouvelle espèce sont discutées.

1. Introduction

Data on the taxonomy and geographical distribution of the known *Rheocricotopus* (*Rheocricotopus*) valid species from Europe and some neighbouring areas (LEHMANN 1972, SASA 1981, CHAUDHURI & SINHARAY 1983, SÆTHER 1986, SÆTHER & SCHNELL 1988, LANGTON 1991, WANG 1995, MAKARCHENKO & MAKARCHENKO 2005, LANGTON & PINDER 2007, ASHE & O'CONNOR 2012, REE 2013, SÆTHER & SPIES 2013, NAMAYANDEH & BERESFORD 2018, MOUBAYED-BREIL & ASHE 2019) show that there are currently 26 valid species worldwide of which only 5 are reported from Europe and North Africa. Male and female adults and pupal exuviae of *Rheocricotopus* (*R.*) *rifensis* sp. n. are diagnosed and described based on material collected in two waterfalls (Challal Sghir of Akchour and Chrafate, altitude 728 and 860 m) located in the Rifian chain, called the Rif, which includes the most mountainous region of northern Morocco. The new species seems currently reported only from waterfalls located in the Moroccan Rif. It keys into the *reduncus*-group, which was recently emended by MOUBAYED-BREIL & ASHE (2019) on the basis of the following characters found in the male adult and pupal exuviae: tergite IX cup-like shaped, narrowing distally, contrasting and bearing a distinct dorsal hump; anal point with 4 setae unusually placed at base; superior volsella rounded apically and widely projecting downwards; gonocoxite truncate apically; crista dorsalis absent; thoracic horn swollen medially and truncate apically. In addition, *R. rifensis* sp. n. is considered as a typical rheophilic element, which appears as a Mediterranean representative of the Moroccan Rif. It belongs to one of the predominant associated rheobiontic taxa/species in both Chrafate and Challal Sghir waterfalls where additional chironomid assemblage are provided by KETTANI & MOUBAYED-BREIL (2018) and MOUBAYED-BREIL & KETTANI (2018).

The genus *Rheocricotopus* Thienemann & Harnisch, 1932 has been revised and divided into two subgenera (*Psilocricotopus* and *Rheocricotopus*) by SÆTHER (1986), who emended three separate groups within each of the previously cited subgenus: *godavarius*-group, *chalybeatus*-group and *atripes*-group for *Psilocricotopus* subgenus; *effusus*-group, *fuscipes*-group and *tuberculatus*-group for *Rheocricotopus* subgenus. The *reduncus*-group currently includes 4 species in the Palaearctic Region: *R. costai* Moubayed-Breil & Ashe, 2019; *R. pyrenaeus* Moubayed-Breil & Ashe, 2019; *R. reduncus* Sæther & Schnell, 1988; *R. tchernovskii* Makarchenko & Makarchenko, 2005. Consequently, the description of *R. rifensis* sp. n. increases the total number of valid species in the genus *Rheocricotopus* (*R.*) to 27 and in the *reduncus*-group to 5 for this region.

2. Material and methods

Standard methods consist of: Malaise trap for adults; 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 and a sweep net for flying adults. Male adults were preserved in 80% ethanol, then cleared of musculature in 90% lactic acid (head, thorax, abdomen and anal segment) for about 60 to 80 minutes, but can be left overnight at room temperature without any detrimental effect or damage. When clearing was complete the specimens were washed in two changes of 50-60% ethanol to ensure that all traces of lactic acid were removed. The studied

material was mounted in polyvinyl lactophenol. Before the final slide mountings (dorsally) of the male holotype and paratype material, the hypopygium including the IXth tergum, the 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. Part of the abdomen and the halteres of the male adults were preserved in 85% ethanol for an eventual DNA analysis. Morphological terminology and measurements follow that of SÆTHER (1980, 1986) and LANGTON & PINDER (2007) for the adults, and SÆTHER (1980) and LANGTON (1991) for the pupal exuviae.

Photo 1. Chrafate waterfall with location of drift nets: type locality of *Rheocricotopus rifensis* sp. n. Photo K. Kettani 02.IV.2018.

Photo 1. Cascade de Chrafate avec emplacement des filets de dérive : localité type de *Rheocricotopus rifensis* sp. n. Photo K. Kettani 02.IV.2018.

3. Description

Rheocricotopus (*R.*) *rifensis* sp. n.

Material examined

Holotype. Morocco. 1 male pharate adult, leg. K. Kettani. Moroccan Rif at Jbel Bouhalla (NW-Morocco), Waterfall of Chrafate, upper basin of Sebou River (Photo 1), Province of Chefchaouen (35.0666134N -5.1075589 W), altitude 860 m, 02.IV.2018. Environmental data: calcareous water; conductivity 659 µS/cm; pH 7.2; dissolved oxygen, 5.9 mg/L; temperature (mean 8.2 °C).

Paratypes (leg. K. Kettani). 1 male pharate adult, 2 pupal exuviae (1 male, 1 female); same locality and data as for holotype. 2 female pupal exuviae, Challal Sghir (Akchour), alt. 728 m; Province of Chefchaouen (35.238986N -5.170411W), alt. 728 m. 05.I.2017.

Holotype (male adult + its pupal exuvia, on 2 slides) is deposited in the collections of the National Museum of Ireland, Kildare Street, Dublin 2, Ireland. Paratypes are deposited in the senior author's collection.

Diagnostic characters

The new species keys to the *reduncus*-group (near both *R. costai* and *R. pyrenaeus*) rather into the *effusus*-group, based on the following common imaginal and pupal characters: lobes of antepronotum gaping and domed; shape of humeral pit; dorsal hump on tergite IX distinct; distal part of superior volsella broadly projecting downwards; general shape of thoracic horn; armament on tergites IV-VI. However, this new species can be separated from other related members of the *Rheocricotopus* (*R.*) by the following combination of characters:

- male adult. Coronal area bearing 2 triangular tubercles projecting towards the median part. Lobes of antepronotum thick and widely gaping medially. Sensilla chaetica on tarsomeres ta_1-ta_5 of PI-PIII, tarsomere ta_5 of PI, PII and PIII entirely blackish. Humeral pit elongate and sinuous, larger in proximal part and narrowing distally, with a distinct small oval-like pit below. Tergite IX cup-like, sinuous medio-dorsally, markedly contrasting alternately and bearing a distinct hump medially which is clearly visible in lateral view. Anal point cup-like shaped at base, with 4 setae unusually located basally. Gonocoxite truncate apically; superior volsella, nose-like apically, distal part distinctly projecting downwards and not turned over inwards; inferior volsella contrasting, dorsal side thumb-like shaped, ventral side lobe-like shaped. Gonostylus thicker in its median part and narrowing distally, crista dorsalis absent.

- pupal exuviae. Frontal apotome *Rheocricotopus* type, anterior half covered with conspicuous wrinkles grouped in 2 circular patches; thorax with granulations located in 3 distinctly separated patches; thoracic horn markedly swollen medially, truncate apically and toothed on one side. Circular median patch of spines present on tergites IV-VI, patch on tergite IV distinctly smaller and armed with shorter spines, patches on tergites V-VI are subequal, more extensive and armed with much longer and larger spines; macroseta sinuous.

Male imago

(n = 3: 1 male adult and 2 male pharate adults; Figs 1-10, 13)

Large sized species. Total length 3.65-3.75 mm. Wing length 1.65-1.75 mm; maximum width 0.80 mm. General colouration markedly contrasting brown to dark brown to blackish, especially on the thorax, legs and tergites. Head and antenna brown to dark brown, clubbed part of antenna blackish; thorax including halteres dark brown; mesonotal stripes nearly blackish; humeral pit brown to dark brown, scutellum contrasting whitish to blackish. Legs brown except for tarsomeres ta_5 which are entirely blackish. Abdominal tergites brownish, anal segment contrasting brown to dark brown.

Head. Eyes pubescent; distal part of lateral inner margin hairy. Coronal area (Fig. 1) with 4 coronals (2 setae on each side), basal margin bearing 2 triangular tubercles projecting towards the median part. Temporal setae 8, including 5 inner and 3 outer verticals, postorbitals absent. Palp 5-segmented, length (µm) of palpomeres 1-5: 25, 40, 75, 90, 125; third palpomere (Fig. 2) with 3 sensilla clavata and 2 sensilla coeloconica. Clypeus (Fig. 3) about 90 µm long, 120 µm maximum width, trapezoidal and bearing 10 setae in 3-4 rows. Antenna 890 µm long; last flagellomere 390 µm long, distinctly clubbed apically, apex with a brush of curved sensilla chaetica; antennal groove reaching segments 2; AR 0.787. Thorax. Lobes of antepronotum (Fig. 4) thick and widely opened medially; lateral antepronotals 6 located apically; acrostichals 24-26 in 1-2 rows, located short

distance from antepronotum; dorsocentrals 10-11 in one row; prealars 3; supraalars absent. Humeral pit (Fig. 5) elongate, wider in its proximal part and narrowing distally, with a distinct small oval-like pit below. Scutellum with 8 uniserial setae. Wing. Brachiolum with one seta. Distribution of setae on veins: R, 17; R_1, 11; R_{2+3}, 0; R_{4+5}, 23; remaining veins bare. Squama with 8-9 setae in one row. Legs. Tarsomere ta_5 of PI, PII, PIII blackish; tibial spur of PI distinctly spiniforme; length (µm) of tibial spurs of: PI, 45; PII, 30 and 25; PIII, 60 and 30; longest seta of tibial comb 50 µm long. Sensilla chaetica present on tarsomeres ta_1-ta_5 of PI, PII and PIII. 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	625	685	515	265	215	190	95	0.75	2.39	2.54	2.40
PII	565	635	345	175	145	90	85	0.54	3.12	3.48	2.25
PIII	635	720	355	225	160	115	90	0.50	2.90	3.82	1.80

" 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."

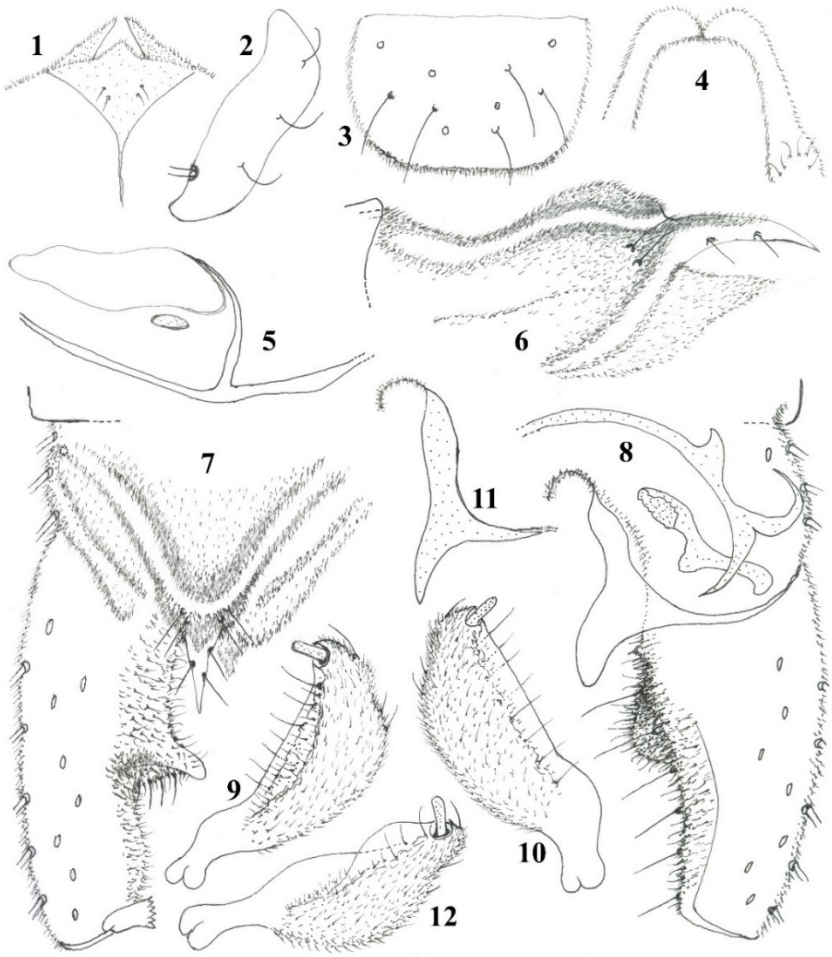
Abdomen. Hypopygium in dorsal and ventral view (Figs 7-8, 9-10). Tergite IX cup-like shaped, about 75 µm width in its distal part, sinuous medio-dorsally, alternately contrasting and bearing a distinct hump distally, which is clearly visible in lateral view (Fig. 6); anal point (dorsal, Figs 7, 13) 40-45 µm long, about 40 µm maximum width at base, cup-like shaped at base, with 7-8 setae including 4 unusually located basally and 3-4 placed laterally. Latero-sternite IX with 8 setae (4 on each side). Sternapodeme and phallapodeme as in Fig. 8; transverse sternapodeme semicircular, lateral expansions claw-like shaped with apical part inwardly turned over; phallapodeme clubbed in its distal half. Virga absent. Gonocoxite 105 µm long, 30 µm maximum width, truncate apically. Superior volsella about 60 µm long, 35 µm wide, nose-like shaped with rounded apex; apical projection 30 µm long, 20 µm maximum width, distal part distinctly projecting downwards and not turned over inwards. Inferior volsella 40 µm long, 30 µm maximum width, triangular and distinctly contrasting; dorsal side thumb-like shaped bearing short setae; ventral side lobe-like shaped, densely covered with medium and short setae. Gonostylus (Figs 9-10) 100 µm long, 30 µm maximum width, thicker in its median part and narrowing distally; crista dorsalis indistinct to absent.

Female imago

(n = 2: 1 female adult and 1 pharate adult; Figs 14-22)

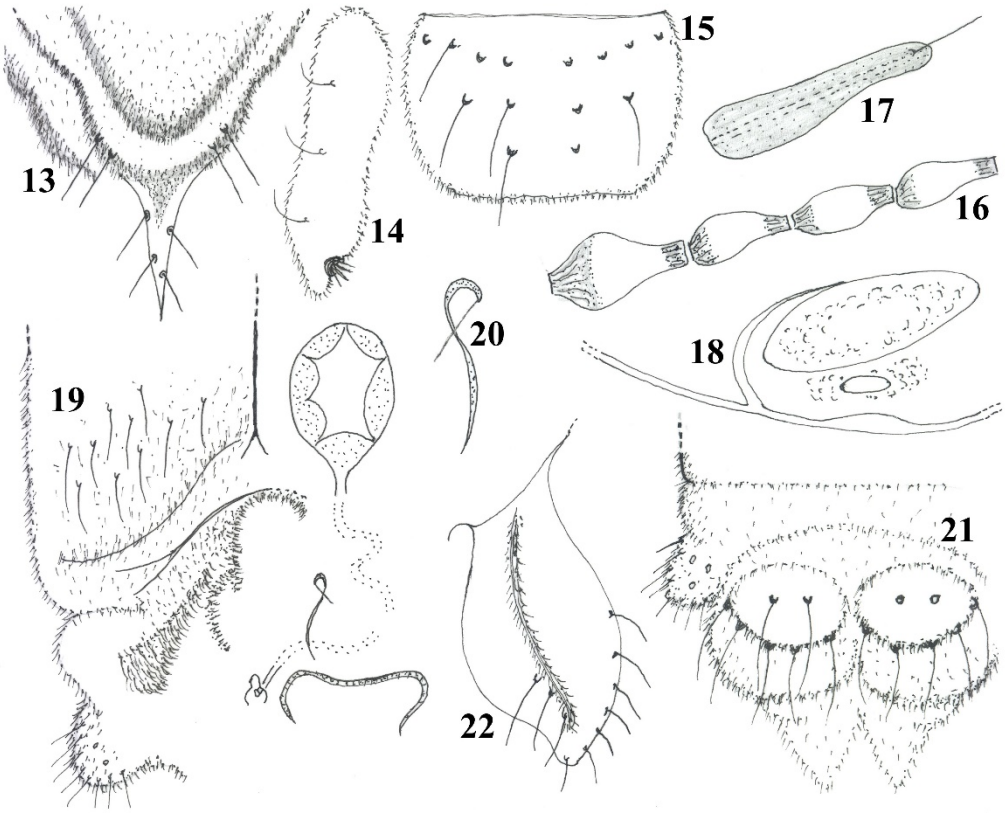
Large sized species. Total length 3.85-3.95 mm. Wing length 1.85-1.95 mm; maximum width 0.85 mm. Colouration as in the male except for the antenna which is contrasting yellowish to blackish, base and apex of segments 1-4 blackish, last flagellomere blackish. Head. Eyes hairy, distal part of lateral inner margin hairy. Coronal area (Fig. 1) as in the male. Temporal setae 9, including 7 inner and 2 outer verticals, postorbitals absent. Palp 5-segmented, length (µm) of palpomeres 1-5: 35, 55, 115, 135, 175; palpomeres 1 and 2 are fused; palpomere 3 (Fig. 14) with 3 sensilla clavata and 4 sensilla coeloconica. Clypeus (Fig. 15) 60 µm long, 75 µm maximum width, trapezoidal, bearing 14 setae in 3 rows. Antenna 5-segmented (Figs 16-17), 395 µm long; last flagellomere 125 µm long, not clubbed and narrowing distally, surface including apex with numerous sensilla chaetica, antennal groove restricted to segment 5 (occasionally reaching segment 4); AR 0.46. Thorax. Lobes of antepronotum gaping and widely opened as in the male; lateral antepronotals 5 located apically; acrostichals 26-28 in 2 rows, starting close to antepronotum;

dorsocentrals 12-13 in 1-2 row; prealars 6-7; supraalars absent; scutellum with 10 setae. Humeral pit (Figs 18) ellipsoidal, with a distinct smaller separate oval pit located below; presence of dense granulation. Wing. Brachiolum with one seta. Distribution of setae on veins: R, 13-14; R_1, 10-11; R_{4+5}, 27-29; remaining veins bare. Squama with 9-10 setae in one row. Legs. Tarsomere ta_5 of PI, PII and PIII blackish. Length (µm) of tibial spurs of: PI, 55; PII, 40 and 30; PIII, 95-100 and 40; longest seta of tibial comb 65 µm long. Sensilla chaetica present on tarsomeres ta_1-ta_5 of PI, PII and PIII.



Figures 1-12. Male imago of *Rheocricotopus* (*R.*) *s*pp. *R. rifensis* sp. n.: head, vertex and coronal area (1); palpomere 3 (2); clypeus (3); lobes of antepronotum (4); humeral pit (5); lateral view of tergite IX and anal point (6); hypopygium in dorsal (7) and ventral view (8); gonostylus in dorsal (9) and ventral view (10). *R. effusus*: superior volsella (11); gonostylus, dorsal (12).

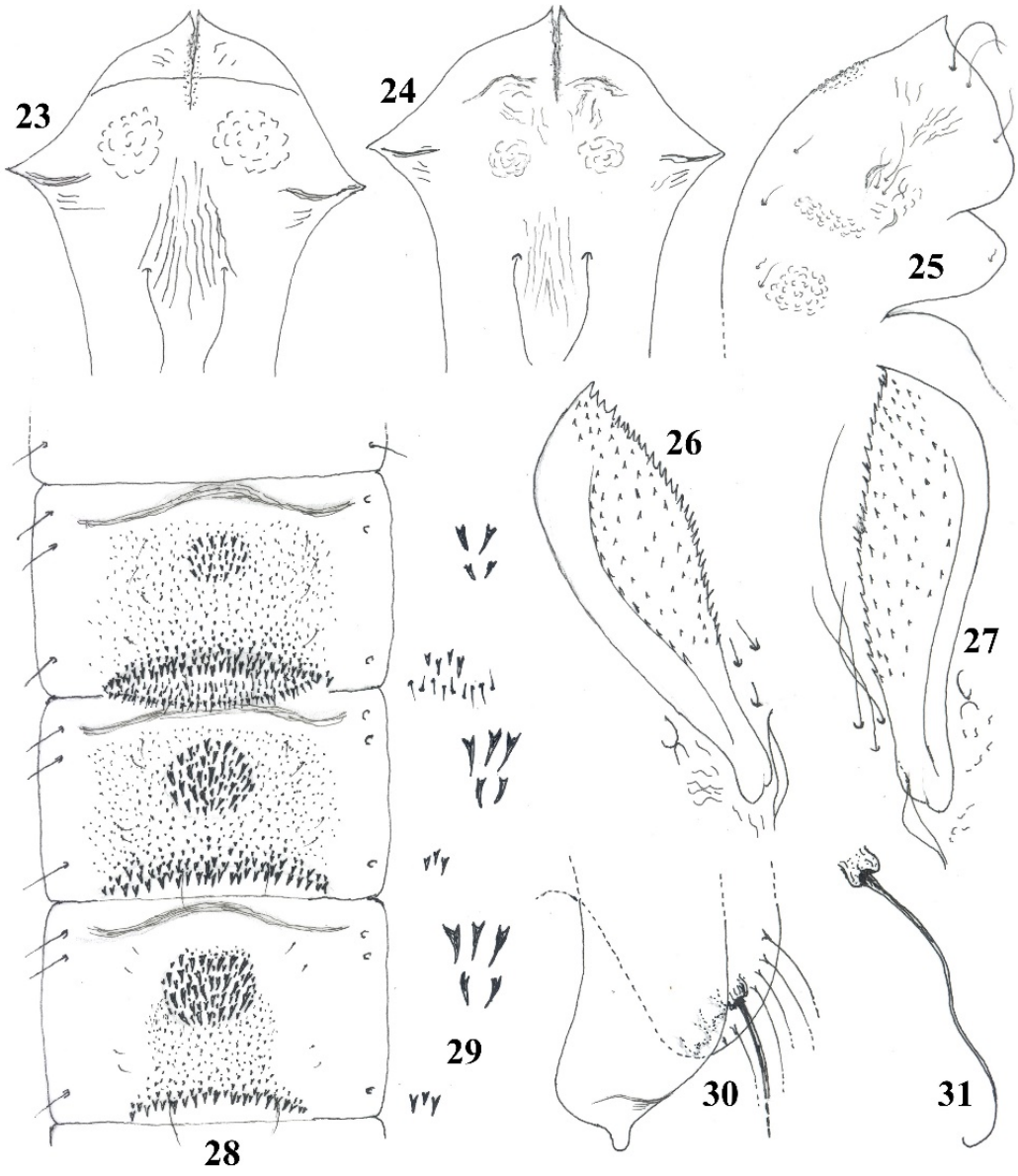
Figures 1-12. Imago mâle de *Rheocricotopus* (*R.*) *s*pp. *R. rifensis* sp. n. : tête, vertex et suture coronale (1) ; palpomère 3 (2) ; clypeus (3) ; lobes de l'antépronotum (4) ; aire humérale (5) ; tergite IX et pointe anale en vue latérale (6) ; hypopyge, vues dorsale (7) et ventrale (8) ; gonostyle, vues dorsale (9) et ventrale (10). *R. effusus* : volselle supérieure (11) ; gonostyle, vue dorsale (12).



Figures 13-22. *Rheocricotopus* (*R.*) *rifensis* sp. n. Male imago: anal point, dorsal (13). Female imago: palpomere 3 (14); clypeus (15); segments 1-4 (16) and last flagellomere (17) of antenna; humeral pit (18); genitalia in dorsal and ventral view (19), including gonapophysis VIII, sternite VIII, seminal capsule and right gonocoxite; apodeme lobe (20); tergite IX with left gonocoxite (21); cercus (22).

Figures 13-22. *Rheocricotopus* (*R.*) *rifensis* sp. n. Imago mâle : pointe anale, vue dorsale (13). Imago femelle : palpomère 3 (14) ; clypeus (15) ; segments 1-4 (16) et dernier segment (17) de l'antenne ; aire humérale (18) ; genitalia, vues dorsale et ventrale (19) y compris la gonapophyse VIII, le sternite VIII, la capsule séminale et le gonocoxite droit ; lobe de l'apodème (20) ; tergite IX et gonocoxite gauche (21) ; cerque (22).

Genitalia in dorsal and ventral view as illustrated in Figs 19-20. Notum 125 µm long, not reaching the base of dorsomesal lobe (distance about 20-25 µm). Gonapophysis VIII: apodeme lobe S-like shaped; dorsomesal lobe conspicuous, consists of 2 similar parts, distal part smaller; ventrolateral lobe narrow proximally and distinctly wider distally weakly projecting inwards apically. Sternite VIII with 20-22 setae (10-11 on each side). Seminal capsules 90 µm long, 65 µm wide, pearl-like shaped, entirely sclerotized; ducts with loops and separate openings. Tergite IX and gonocoxite (Figs 19, 21), gonocoxite lobe-like with 9-10 setae; tergite IX distinctly divided in 2 oval lobes, each bearing 7 setae (5 posterior, 2 median), posterior margin bi-lobed. Cercus (Fig. 22) 90 µm long, 50 µm maximum width.



Figures 23-31. Male pupal exuviae of *Rheocricotopus* (*R.*) *rifensis* sp. n.: frontal apotome, two aspects (23-24); cephalothorax (25); thoracic horn, two aspects (26-27); distribution pattern of armament and chaetotaxy of abdominal segments IV-VI (28); details of armament on tergites IV-VI (29); genital sac with apical part of anal lobe (30); macroseta (31).

Figures 23-31. Exuvie nymphale mâle de *Rheocricotopus* (*R.*) *rifensis* sp. n. Apotome frontale, deux aspects (23-24) céphalothorax (25) ; corne thoracique, deux aspects (26-27) ; ornementation et chaetotaxie des segments abdominaux IV-VI, vue dorsale (28) ; détails de l'ornementation sur les segments IV-VI (29) ; sac génital et partie apicale du lobe anal (30) ; macrosoie (31).

Pupal exuviae

(n = 4: 2 males and 2 females; Figs 23-31)

Total length 3.70-3.75 mm. General colouration brownish. Frontal apotome distinctly wrinkled on antero-median and lateral side; cephalothorax and suture of thorax rugose and wrinkled, posterior part with a characteristic circular granulation; abdomen with dark brown apophyses. Cephalothorax as in Figs 23-25. Frontal apotome (Figs 23-24) semicircular in its proximal half, frontal setae 65 µm long, distance between setae 25 µm. Thorax. Median antepronotals 170 and 115 µm long, lateral antepronotal 85 µm long; prealar vestigial; precorneals 175-185, 120-130, 65-75 µm long. Thoracic horn (Figs 26-27) about 330 µm long, 75-85 µm maximum width, clubbed, toothed on one side, swollen medially and distinctly truncate distally. Dorsocentrals (Fig. 25) consist of: Dc_1, Dc_2 and Dc_4 (setae-like) 10-15 µm long; Dc_3 5 µm long, bristle-like; distance (µm) between: Dc_1 to Dc_2, Dc_2 to Dc_3 80-85, Dc_3 to Dc_4 15-20. Abdomen. Armament, chaetotaxy and distribution pattern of shagreen with details of armament on tergites IV-VI and conjunctives as in Figs 28-29. All pleurae and tergite I bare. Pedes spurii A present on sternites IV-VI, pedes spurii B present only on segment II. Apophyses present on segments II-VIII. Shagreen and points widely present on tergites IV-V, those on tergite VI are restricted to the postero-median part. Caudal transverse rows of posteriorly projecting stout spines present on tergites II-VI, those on tergites IV-V are the widest (270-300 µm in 3 rows), those on tergite VI about 210-220 µm wide; caudal transverse rows of orally and posteriorly directed pins are restricted to conjunctives of tergites II-IV, those on tergite IV are the widest (250 µm); caudal transverse rows of short spines are weakly represented on tergite VII (about 7-10 short spines located on each side of the midline), and are absent on VIII. Distribution pattern, shape and details of circular median patch of stout spines on tergites IV-VI as in Figs 28-29: those on tergites V-VI are subequal in size, more extensive and armed with much larger spines; median patch on tergite IV is smaller and armed with short spines and spinules. Number and distribution pattern of lateral setae and lamelliform setae (taeniae) on segments I-VIII: segments I-VI (lateral setae: 1, 3, 3, 3, 3, 3); segments VII-VIII (taeniae: 4, 5). Anal lobe 240 µm long, 260 µm maximum width; fringe with 16-17 taeniae; genital sac (Fig. 30) 165-175 µm long, inner margin markedly concave, overreaching apical margin of anal lobe by 30-35 µm; macrosetae (Fig. 31) 275-285 µm long, distinctly sinuous and curved apically.

Larva

Known but not described.

4. Taxonomic position

Although the male adult of *R. rifensis* sp. n. resembles that of both *R. costai* and *R. pyrenaeus* (humeral pit elongate; general shape of the superior volsella) the new species keys much more near *R. pyrenaeus* on the basis of the following additional common morphologic characters: lobes of antepronotum distinctly thick and gaping; dorsal hump on tergite IX well domed; thoracic horn clubbed and swollen medially; exuviae with similar shape of thoracic horn and distribution pattern of armament on tergites IV-VI). Nevertheless, due to some phylogenetic relationships, *R. rifensis* sp. n. likely belongs to the *reduncus*-group, which was recently emended by MOUBAYED-BREIL & ASHE (2019) and currently includes: *R. costai, R. pyrenaeus*, *R. reduncus*, *R. tchernovskii* and *R. rifensis* sp. n. However, based on some relevant distinguishing characters the new species can be separated from other related members of both *effusus*-group and *reduncus*-group in having:

- Male adult. Humeral pit (Fig. 5) very long and narrowing apically; tarsomere ta_5 of PI-PIII entirely blackish; tergite IX (Figs 7, 13) cup-like shaped and markedly contrasting; base of anal point bearing 4 unusually located setae; distal part of superior volsella (Fig. 8) broadly projecting downwards, while is triangular in *R. effusus* (Fig. 11; LEHMANN 1969, Fig. 5) and turned over inwards in *R. pyrenaeus* (MOUBAYED-BREIL & ASHE 2019, Figs 41-42); crista dorsalis indistinct/absent (Figs 9-10), while is well represented in: *R. effusus* (Fig. 12; LEHMANN 1969, Fig. 5), *R. costai* (MOUBAYED-BREIL & ASHE 2019, Figs 20-21), *R. pyrenaeus* (*Ibid*. 2019, Figs 44-46).

- Pupal exuviae. Frontal apotome (Figs 23-24) with two circular patches of wrinkles, is bearing only granulation in *R. pyrenaeus* (*Ibid.* 2019, Fig. 60); thoracic horn clubbed and truncate apically (Figs 26-27), while is linearly elongated in *R. costai* and rounded apically in *R. pyrenaeus* (*Ibid*, Figs 24-25 and 62-63); shagreen and points present only on postero-median part of tergite VI (Fig. 28), are occupying almost the entire surface in *R. pyrenaeus* (*Ibid*, Fig. 64).

5. Geographical distribution and ecology

R. rifensis sp. n. is confined to stenothermic waterfalls located in the Moroccan Rif where it represents a local Mediterranean element, which can be expected to occur in other similar mountainous areas situated in Morocco and some neighbouring countries. Pharate adults, pupal exuviae and larvae of *R. rifensis* sp. n. were collected only in Chrafat and Challal Sghir waterfalls. Bryocolous and hygropetric habitats with fast running water represent the most favourite aquatic areas for larval populations. The new species belongs to the crenophilous community of species as documented by LINDEGAARD (1995). Such pristine habitats, which are endangered by pastoralism and other human activities, are considered to be microrefugia and hotspot of diversity and therefore deserve much greater consideration, protection and preservation.

Associated species encountered with *R. rifensis* sp. n. in the same localities include: *Boreoheptagyia legeri* (Goetghebuer, 1933); *Diamesa insignipes* Kieffer, 1908; *D. lateralis* (Goetghebuer, 1921); *Potthastia gaedii* (Meigen, 1838); *Bryophaenocladius aestivus* (Brundin, 1947); *B. illimbatus* (Edwards, 1929); *B. subvernalis* (Edwards, 1929); *B.* sp. 1 and *B.* sp. 2; *Chaetocladius dentiforceps* (Edwards, 1929); *C. dissipatus* (Edwards, 1929); *Eukiefferiella devonica* Lehmann, 1972; *E. fuldensis* Lehmann, 1972; *E. gracei* (Edwards, 1929); *Metriocnemus eurynotus* (Holmgren, 1883); *Orthocladius frigidus* (Zetterstedt, 1838); *Parametriocnemus stylatus* (Spärck, 1923); *Pseudorthocladius berthelemyi* Moubayed, 1989; *Rheotanytarsus langtoni* Moubayed-Breil & Kettani, 2018; *R. pentapoda* (Kieffer, 1909).

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