

***CRICOTOPUS* (S. STR.) *LATELLAI* SP. N., A NEW RHEOPHILIC SPECIES OF THE *TREMULUS*-GROUP FROM THE ITALIAN AND FRENCH MARITIME ALPS (DIPTERA: CHIRONOMIDAE)**

Joel Moubayed-Breil¹ and Patrick Ashe²

¹Consultant in Freshwater & Marine Biology, 10 rue des Fenouils, F-34070 Montpellier, France.

Email: joelmb34@free.fr; corresponding author

²33 Shelton Drive, Terenure, Dublin 12, Ireland. Email: patrick.ashe1983@gmail.com

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Abstract

Cricotopus (*Cricotopus*) *latellai* sp. n. is described and diagnosed based on material comprising male and female pharate adults, pupal exuviae and larvae recently collected in some glacial streams in both the Italian and French Maritime Alps. Taxonomic notes provided in this paper include: description of *C. latellai* sp. n. as male and female adults, pupal exuviae and last instar larvae. The diagnosis of the *Cricotopus tremulus*-group is supplemented with additional characters in the male adult and pupal exuviae. *Cricotopus latellai* sp. n. keys near *C. mantetanus* Moubayed-Breil, 2016 and *C. storozhenkoi* Makarchenko & Makarchenko, 2016. Geographical distribution of *C. latellai* sp. n. is currently restricted to the Italian and French Maritime Alps. It belongs to the Tyrrhenian community of glacial relic species, which are considered to be indicators of climate change in this biogeographical region. Remarks, taxonomic position, and ecology of the new described species are given.

Introduction

Data on the taxonomy, geographical distribution and ecology of the *tremulus*-group of the genus *Cricotopus* v. d. Wulp, 1874 from the Palaearctic (Hirvenoja 1973; Sæther 1977; Coffman et al. 1986; Moubayed & Hirvenoja 1986; Cranston et al. 1989; Casas & Vilchez-Quero 1992; Ashe & O'Connor 2012; Lencioni et al. 2012; Andersen et al. 2013; Sæther & Spies 2013; Makarchenko & Makarchenko 2016; Moubayed-Breil & Ashe 2011, 2016) shows that six valid species are currently known including two from the Russian Far East (*C. leleji* Makarchenko & Makarchenko, 2016 and *C. storozhenkoi* Makarchenko & Makarchenko, 2016) and four from Europe: *C. mantetanus* Moubayed-Breil, 2016; *C. nevadensis* Casas & Vilchez-Quero, 1992; *C. royanus* Moubayed-Breil, 2016 and *C. tremulus* (Linnaeus, 1758). In this paper, a seventh new species (*C. latellai* sp. n.) is described based on associated pharate material

comprising male and female adults, pupal exuviae and larvae collected in glacial streams located in northwest Italy in the dolomitic upstream area of the Po River Basin in the Alpi Marittime at an altitude 1500-1750 m and in southeast France in the karstic upstream area of the Roya River Basin in the Maritime Alps at an altitude of 1500-1750 m.

Methods

Morphological terminology and measurements follow that of Sæther (1980) for the imagines and pupal exuviae. 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. Remarks and discussion on some related species and comments on the ecology and geographical distribution of the new species are given.

Results

Cricotopus latellai sp. n. belongs to the *tremulus*-group based on characters found in the male adult (distribution pattern of median setae on tergites II-V; shape of tergite IX, inferior volsella and gonostylus) and pupal exuviae (chaetotaxy and granulation of thorax; armament of abdominal segments, shape and size of anal macrosetae) and keys near *C. mantetanus* and *C. storozhenkoi*. The new species is only known from high and middle mountain streams located in both the Italian and French Maritime Alps. The 766 valid species known from continental France (Moubayed-Breil & Ashe own observations, Moubayed-Breil 2016) increases to 767 with the description of a new species of *Propilosocerus* Kieffer from eastern France (Moubayed-Breil, in press). Consequently, the description of *C. latellai* sp. n. increases the total number to **768** species known from continental France.

The *tremulus*-group was first emended by Hirvenoja (1973) then modified by Moubayed & Hirvenoja (1986), Casas & Vilchez-Quero (1992) and most recently by Moubayed-Breil (2016). The diagnosis of the *tremulus*-group is refined by including features found in the male adult and pupal exuviae:

Adult male. Palpomere 3 with 2-3 sensilla coelonica placed distally; presence of lateral and occasionally median antepnotals; apex of femur and base of tibia of fore-, mid-, and hind leg blackish; tergites I-II whitish, remaining tergites blackish; chaetotaxy and distribution pattern of setae on median part of tergites II-V; gonocoxite with rounded or truncated apex, bearing or lacking a sub-triangular to rounded setiferous projection placed dorsally close to base of inferior volsella; inferior volsella: (i) pointing downwards at an acute angle, narrow and finger-like (*C. nevadensis*), (ii) a projecting lobe with outer margin gradually bent downwards and lacking strong dorsal setae on outer edge (*C. latellai*, *C. royanus* and *C. tremulus*), (iii) a projecting lobe with outer margin abruptly bent downwards at a right angle and with 2 strong dorsal setae on outer edge (*C. mantetanus*); crista dorsalis medium to large, tooth-like, with pointed or rounded apex, moderately to strongly projecting orally.

Pupal exuviae. Colouration brownish or contrasting whitish to blackish; frontal apotome with wrinkles and granulation, occasionally domed, frontal setae inserted on prefrons, ventral to antennal sheaths; cephalothorax with moderate to dense wrinkles and granulation, bearing or lacking a transverse posteromedian blackish shading placed between the thoracic suture (Dc_3 and Dc_4) and base of wing sheath, dorsocentrals are all setae-like or include 1-2 bristle-like setae; thoracic horn tube-like, foliate to ellipse-shaped with or without narrowing apex, toothed in general, occasionally smooth, teeth are pointed or occasionally smooth; anterior and posterior fields of spines on tergites III-VI clearly separated; median field of spines on tergite VI circular, diamond-like to sub-oval, posterior area of sternites V-VI with or without a faint transverse median patch of spines which, when present, are more concentrated and markedly larger on VI; anal lobe with distal part narrowing or distinctly swollen, apical rows of small spines restricted to apical area or extending well above insertion of anal macrosetae; macrosetae short and pin-like with a slightly curved apices.

Description

Cricotopus latellai Moubayed-Breil & Ashe, sp. n.

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Material examined

Holotype. Italy, Alpi Marittime. Po River Basin, upstream, rapid to moderate rhithral and waterfalls, altitude 1500-1700 m, 44° 42' 05" N, 7° 05' 37" E, 11.VII.2017; 1 male pharate adult, leg. J. Moubayed-Breil and P. Ashe. Environmental data of water: moderately crystalline, conductivity about 20-30 μ S/cm; temperature 8-12 °C.

Paratypes. Italy, Alpi Marittime. Adults (5 males, 2 females); pharate adults (2 males, 2 females); pupal exuviae (10 males, 15 females); 3 larvae; same locality and date as for holotype. Continental France, Maritime Alps, Casterino stream, a tributary of the Roya River, alt. 1500-1700 m, 44° 4' 34" N, 7° 26' 18" E, 22.VI.2016; pupal exuviae (1 male and 2 females); leg. J. Moubayed-Breil. Environmental data of water are: calcareous water, conductivity 95-100 μ S/cm; temperature 8-12 °C during late spring and summer.

Holotype (on 2 slides, including the male adult and its pupal exuviae) with 1 additional paratype are deposited in the collections of the Zoologische Staatssammlung München (ZSM), Munich, Germany. Remaining paratypes are deposited in the senior author's collection. Type material was preserved in 80-85% alcohol, and later mounted in polyvinyl lactophenol. For each adult, the head, thorax and abdomen were cleared in 90% lactic acid then washed in about 60% ethanol before mounting on slides.

Diagnostic characters

Based on similarity of characters found in the male adult and pupal exuviae of the *tremulus*-group, three species (*C. latellai* sp. n., *C. mantetanus* and *C. storozhenkoi*) are considered to be sister species. However *C. latellai* sp. n. can be easily separated with the following characters:

Male adult: palpomere 3 with 2 sensilla coelonica (tubule-like) placed distally; tergites III-IV with 3 median setae placed distally; laterosternite VIII not lobe-like; inferior volsella consists of a projecting lobe-like, with rounded outer margin gradually bent downwards, posterior area bearing two minute lobes, with a distinct rounded setiferous lobe placed close to its base; crista dorsalis large, tooth-like and orally projecting, apex rounded in dorsal view and pointed in lateral view;

Pupal exuviae: thoracic horn foliate to ellipse-like, narrowing distally with pointed to smooth ending apically, toothed, teeth are smooth in general or occasionally weakly pointed; tergite VI with median dorsal field of spines semi-circular to diamond-like; posterior area of sternite VI with a distinct median patch of spines; distal part of anal lobe narrowing, apical rows of small spines extending well above insertion of anal macrosetae; macrosetae short with markedly curved apices.

Etymology: The new species is named '*latellai*' after our colleague Dr. Leonardo Latella, curator of zoology at the Museum of Natural History of Verona (Italy), who is contributing to preserve the biological and ecological quality of water and environment in Verona and surrounding areas.

Male adult

(n = 7: 2 pharate adults + 5 adults; Figs 1-4, 7-11, 13-15)

Medium to large sized *Cricotopus* species. Total length 3.50-4.00 mm. Wing length 2.20-2.40 mm; TL/WL = 1.60-1.70. General colouration contrasting blackish to brownish to yellowish with black mesonotal stripes. Head dark brown, antennae pale brown, thorax brown to dark brown, mesonotal stripes distinctly blackish; wing pale to pale brown. Legs mostly yellowish brown to dark brown, only base of femur and base and apex of tibia of PI-PIII blackish. Tergites I-II whitish, tergites III-VIII entirely brownish to blackish, anal segment contrasting brown to dark brown.

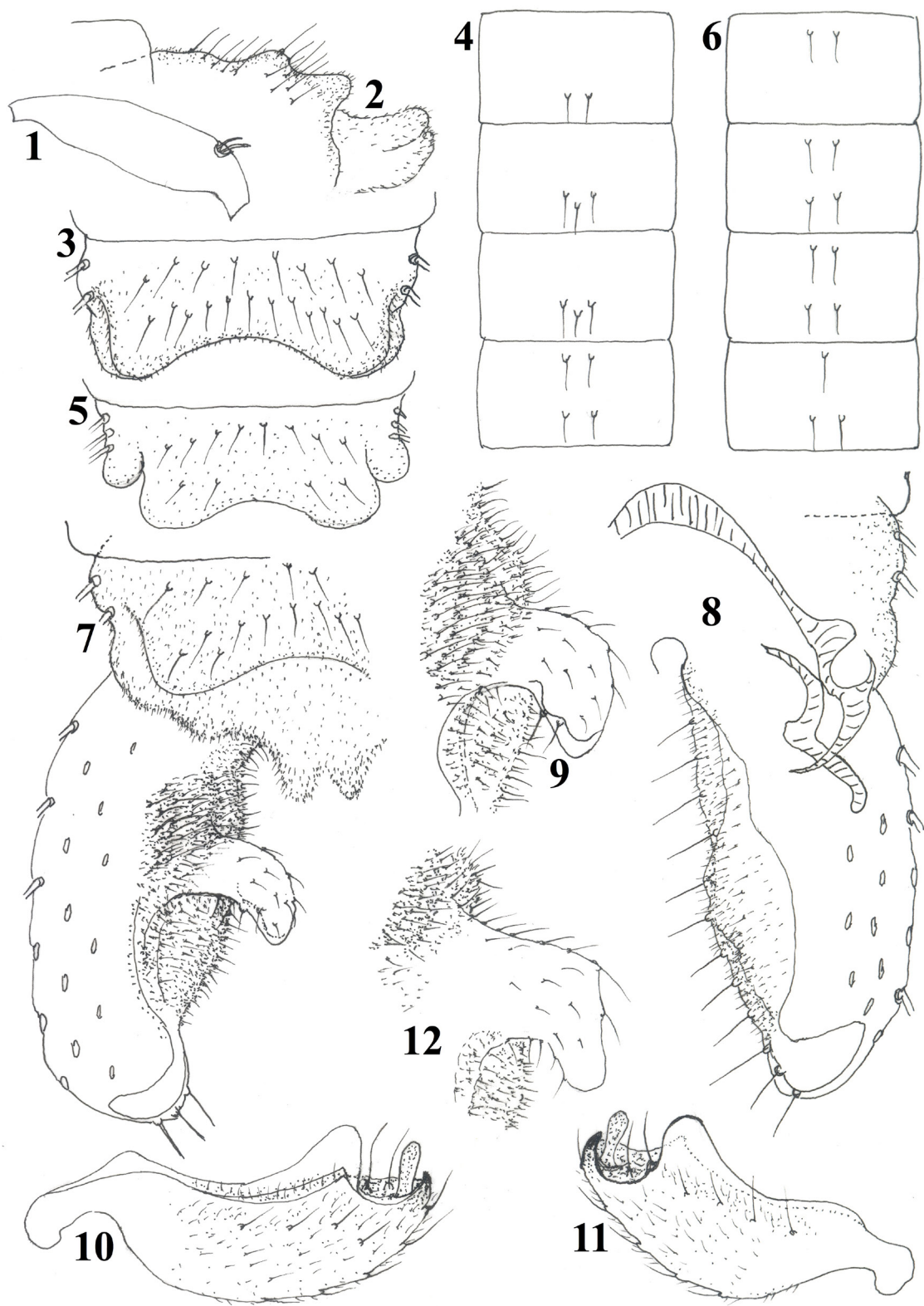
Head. Eyes hairy, inner eye margin bare. Temporals consist of 8 uniserial setae including 5 inner and 3 verticals. Clypeus trapezoidal to sub-square shaped with 14-16 setae placed in 4 rows. Palp 5-segmented; first and second palpomeres fused; length (µm) of segments 40, 70, 120, 135, 195; palpomere 3 with 2 sensilla coeloconica (tubule-like) inserted in a circular depression placed on distal part (Fig. 1). Antenna 900-930 µm long, 13-segmented; antennal groove beginning on segments 3-4 and reaching ultimate flagellomere; ultimate flagellomere 400-430 µm long, distinctly clubbed and bearing a brush of curved sensilla chaetica apically. AR 0.80-0.85.

Thorax. Lobes of antepnotum gaping, with 3 median and 3-4 antepnotals which are slightly indistinct; acrostichals 29-31 uni-biserial, dorso-centrals, 16-18 multiserial and converging medially, prealars 3-4. Scutellum with 10 setae in a single row. Wing. Brachiolum with 1 seta. Number of setae on veins: R, 3-5; remaining veins bare. Squama with 14-16 setae in a single row. Legs. Tarsomere ta_5 of PI, PII and PIII distinctly shorter than ta_4 . Sensilla chaetica densely present on tarsomeres ta_1 to ta_5 of PI, PII and PIII. Length (µm) and proportions of legs (Table 1).

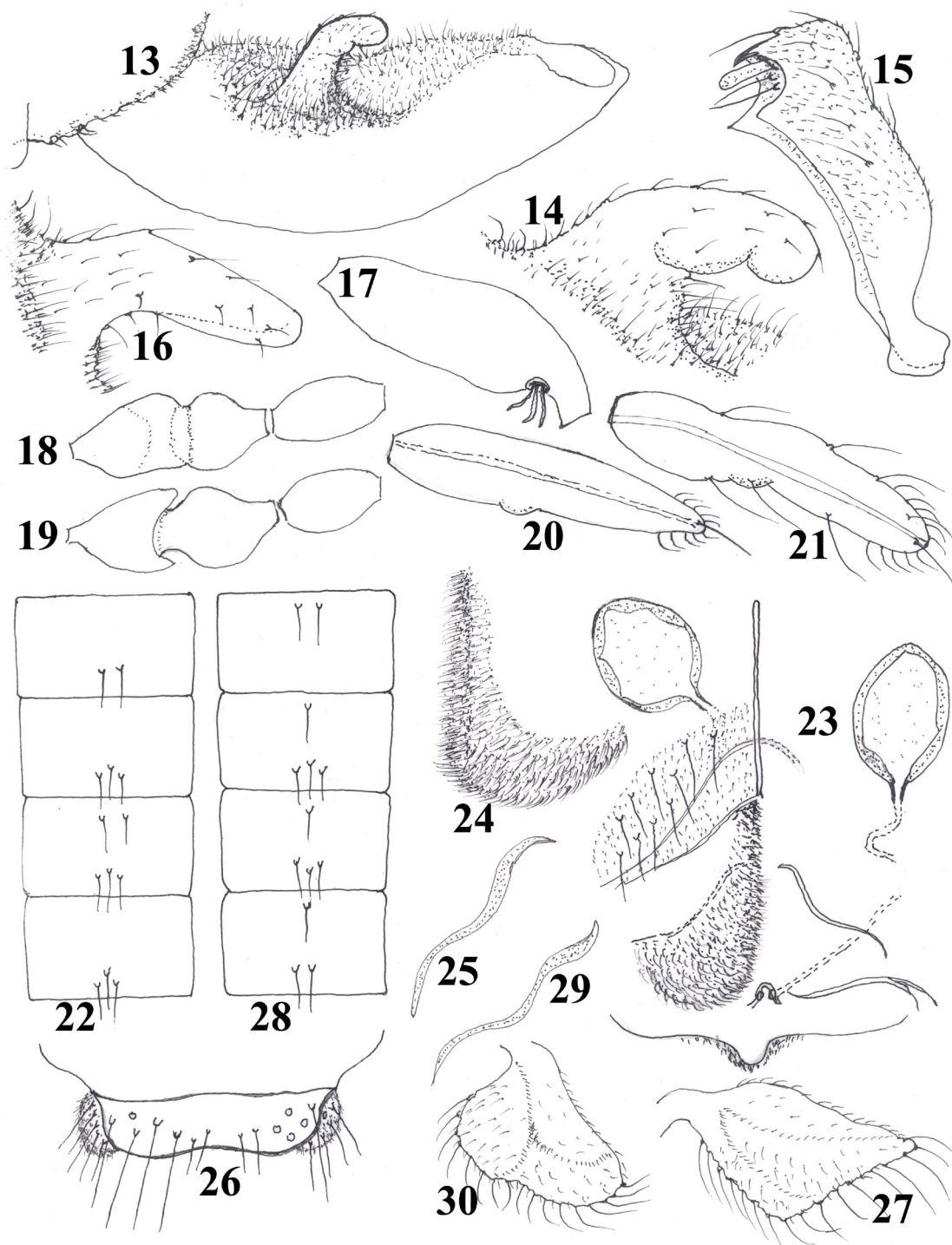
Abdomen. Dorsal margin of tergite IX sinuous with a distinct median lobe (Fig. 2); posterior margin broadly bilobed (Figs 3, 7); presence of 17-20 dorsal setae placed in 2 rows (7-8 anteriorly, 10-12 posteriorly). Laterosternite IX with 4 setae (2 on each side), extended vertically and lacking lateral lobe-like expansions on each side. Anal point absent. Sternapodeme and phallapodeme as in Fig. 8, transverse sternapodeme orally produced and arc-like; phallapodeme markedly sickle shaped. Distribution pattern of setae on median area of tergites II-V as illustrated (Fig. 4): tergite II (2 setae distally); III-IV (3 setae distally); V (4 setae, 2 anteriorly and 2 distally). Hypopygium in dorsal, ventral and lateral view as in Figs 7-11, 13-15, ventral view (Fig. 8) with tergite IX removed. Gonocoxite 250-260 µm long, apex rounded in dorsal view (Fig. 7) and distinctly truncate in lateral view (Fig. 13); inferior volsella hyaline, long lobe-like, projecting with rounded outer margin gradually bent downwards, wider at base and broadly narrowing distally to a rounded apex, presence of two minute lobes on posterior part which are clearly visible in lateral view (Fig. 13), presence of 5-6 small setae on dorsal area. Gonostylus (Figs 10-11, 15) 120-130 µm long, narrowing distally to a pointed apex; posterior margin rounded medially in dorsal view (Figs 10-11), distinctly sinuous in lateral view (Fig. 15), anterior margin concave medially with an orally directed triangular projection clearly visible in lateral view (Fig. 15); 2 orally directed strong setae are placed close to the megaseta. Crista dorsalis (Figs 10-11, 15) large, tooth-like and orally projecting, apex rounded in dorsal view (Figs 11-12) and sharply pointed in lateral view (Fig. 15). Megaseta 18-21 µm long and slender.

Table 1. *Cricotopus latellai* sp. n. Length (µm) and proportions of legs.

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	BV	SV	BR
PI	860	1045	540	350	245	175	120	0.52	2.75	3.53	2.00
PII	970	900	390	235	170	120	105	0.43	3.59	4.80	2.00
PIII	875	990	480	290	220	140	120	0.48	3.05	3.90	1.70



Figures 1-12. Male adult of *Cricotopus* spp. *C. latellai* sp. n.: 1, tarsomere 3 with sensilla coeloconica; 2, tergite IX, lateral; 3, tergite IX, dorsal; 4, distribution pattern of setae on median area of tergites II-V. *C. mantetanus*: 5, tergite IX, dorsal; 6, distribution pattern of setae on median area of tergites II-V. *C. latellai* sp. n.: 7-8, hypopygium in dorsal and ventral view; 9, inferior volsella, dorsal; 10, left gonostylus, dorsal, at right angle; 11, right gonostylus, dorsal, at acute angle. *C. mantetanus*: 12, inferior volsella, dorsal.



Figures 13-30. Male and female adults of *Cricotopus* spp. *C. latellai* sp. n., male adult: 13, gonocoxite and inferior volsella, lateral; 14, inferior volsella, lateral; 15, gonostylus, lateral. 16, *C. mantetanus*: inferior volsella, lateral. *C. latellai* sp. n., female adult: 17, palpomere 3 with sensilla coeloconica; 18-19, antenna, segments 1-3, two aspects; 20-21, last flagellomere, two aspects; 22, distribution pattern of setae on median area of tergites II-V; 23, genitalia, ventral and dorsal view with gonapophysis VIII, sternite VIII and seminal capsules; 24, dorsomesal and ventrolateral lobes; 25, apodeme lobe; 26, tergite IX, dorsal; 27, cercus. *C. mantetanus*: 29, apodeme lobe; 30, seminal capsule.

Female adult

(n = 3: 2 paratype adults + 1 adult; Figs 17-27)

Colouration as in the male adult except for the antennae, which are dark brown to blackish. Segments 1-5 of antenna brown with blackish apex, last flagellomere entirely blackish. Total length (TL) 4.20-4.50 mm. Wing length (WL) 2.20-2.30 µm. TL/WL = 1.85-1.90. Head: eyes hairy; temporal setae 8-9 including 5-6 inner and 3 outer verticals. Clypeus rectangular with 26-28 setae in 4-5 rows. Palp 5-segmented, length (µm) of segments: 40, 55, 50, 55, 125-130; palpomere 3 (Fig. 17) truncate apically and bearing 3 sensilla coeloconica placed distally. Antenna (Figs 18-21) 6-segmented, 365-385 µm long, segments 1 and 2 (Figs 18-19) fused; segments 3-5 together 150 µm long and sub-equal (about 50 µm each), ultimate flagellomere (Figs 20-21) about 120 µm long, moderately clubbed and bearing a distinct small projection placed medially, distal part with 1 preapical seta and a tuft of curved setae including several sensilla chaetica; antennal groove restricted to last flagellomere. AR 0.46. Thorax: chaetotaxy as in the male; wing: distribution of setae on veins as in the male, squama with 11-13 setae in 1 row. Abdomen. Distribution pattern of setae on median area of tergites II-V as illustrated in Fig. 22: tergite II (2 setae distally), III (3 setae distally), IV (5 setae, 2 anteriorly and 3 distally), V (3 setae distally). Genitalia in dorsal and ventral view as illustrated in Figs 23-26. Notum about 100-110 µm long, rami indistinct. Sternite VIII with 22-24 setae (11-12 on each side of the notum). Gonapophysis VIII (Figs 23-25). Dorsomesal lobe uniformly linear; ventrolateral lobe broad and slightly projecting posteriorly; apodeme lobe undulating three times from base to apex. Seminal capsules 100-105 µm maximum length, 70 µm maximum width, sub-oval with narrowed tip and well sclerotized laterally. Spermathecal ducts with loops and separate openings. Tergite IX (Fig. 26) nearly semi-circular and distinctly divided on its posterior part into two large rounded lobes, with 14 setae including 10 placed laterally (5 on each side) and 4 markedly shorter placed medially. Gonocoxite (Fig. 26) broadly globular, bearing 6-7 short setae. Cercus (Fig. 27) normally developed and narrowed distally.

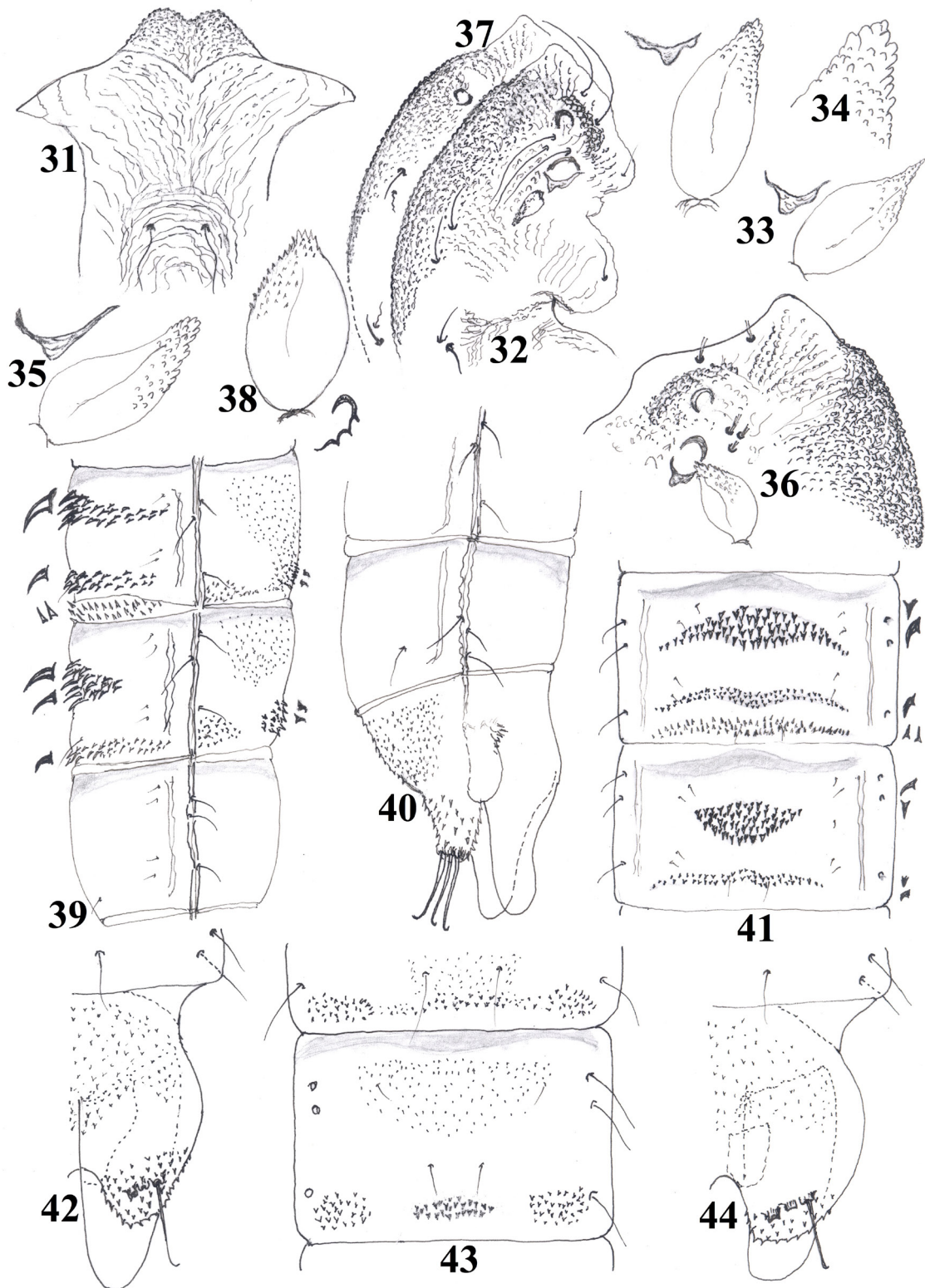
Male pupal exuviae

(n = 15: 7 males, 8 females; Figs 31-36, 39-43)

Colouration contrasting brownish to dark brown with blackish cephalothorax. Frontal apotome with dense wrinkles and granulation; cephalothorax brown to dark brown with blackish anteromedian area, densely wrinkled and granulose,

granulation and wrinkles strongly covering the anteromedian area including the thoracic suture and Dc₁-Dc₂ zone, granulose area along the thoracic suture reaching Dc₃-Dc₄ zone, posteromedian area less granulose, presence of a characteristic transversal posteromedian blackish shading extending between Dc₃-Dc₄ and base of wing sheath. Base of wing sheath covered with blackish bow-like shading. Abdomen including anal segment brown to dark brown; dark brown apophyses distinctly present on segments I/II-VII; muscles marks distinct on segments I-VIII.

Total length 3.60-4.10 mm. Frontal apotome (Fig. 31) distinctly domed with dense granulation, frontal setae bristle-like, inserted on prefrons ventral to antennal sheaths, 45 µm long and separated by only 30 µm. Thorax (Figs 32-36). Anteprenotals 3 including 2 median anteprenotals (130 and 150 µm long) and 1 lateral anteprenotal 60 µm long; 1 prealar 100-110 µm long; precorneals sub-equal (180-190 µm long); dorsocentrals all seta-like, Dc₁ and Dc₂ sub-equal (110-120 µm long), Dc₃ and Dc₄ 40 µm long; distance between Dc₂ to Dc₃ 150 µm, Dc₁ is placed close to Dc₂, Dc₃ and Dc₄ close to one another. Thoracic horn (Figs 33-36) foliate to ellipse shaped with narrowing distal part, toothed apically and distally (mainly on one side), teeth are often distinctly blunt apically. Abdomen. Armament and distribution pattern of patches of spines and points, chaetotaxy and lateral setation of abdominal segments as illustrated in Figs 39-43. Distribution of lateral setae on segments I-VIII: I (2), II-VIII (3). Tergite I bare. Transverse posterior margin of tergite II armed with 1-2 rows of orally projecting hooks, which occupy about 80% of segment width. Anteromedian patches of spines present on tergites III-V (Figs 39, 41), laterally extensive and becoming diamond-like to nearly semi-circular on tergite VI (Figs. 39, 41). Posteromedian transverse patches of spines present on tergites III-VI (Figs 39, 41) not interrupted medially, gradually more extensive laterally and almost reaching muscles marks, size of spines mostly similar. Posteromedian transverse rows of orally projecting spines (Figs 39, 41) restricted to tergites III-V, occupying 75 to 80% of segments width. Pedes spurii B absent. Pedes spurii A present on sternites IV-VI. Armament absent on sternites I-VIII; field of shagreen and points present on anteromedian area of sternites III-VI; posterior transverse rows of spinules present on sternites V-VI, occasionally with a distinct median patch of small spines on sternite VI (Figs 39, 43). Apophyses markedly distinct on tergites I/II-VIII (Figs 28, 80). Anal segment (Figs 40, 42) 200-220 µm long and 300 µm maximum



Figures 31-44. *Cricotopus* spp., male pupal exuviae. *C. latellai* sp. n.: 31, frontal apotome; 32, cephalothorax, chaetotaxy and granulation; 33-35, thoracic horn, three aspects; 34, thoracic horn, details of apical part; 36, cephalothorax, details of anteromedian area. *C. mantetanus*: 37, cephalothorax with dorsocentrals; 38, thoracic horn. *C. latellai* sp. n.: 39, armament and chaetotaxy of abdominal segments V-VII with details of the hook rows on tergites (left) and sternites (right); 40, lateral view of segments VII-VIII and anal segment; 41, armament of tergites V-VI (dorsal view) with median patch of spines and details of the hook rows; 42, anal lobe, right half, dorsal; 43, ventral view of sternites V (distal part) and VI (posteromedian patch of spines); *C. mantetanus*: 44, anal lobe, right half, dorsal.

width, slightly narrowing distally, apical area with small spines extending well above insertion of anal macrosetae. Macrosetae about 100 μm long, stout, pin-shaped and slightly curved apically. Genital sac (Fig. 42) 180-190 μm long, narrowed apically and overreaching apical margin of anal lobe by 65-70 μm .

Final instar larvae

(n = 3, Figs 45-49); 2 of the 3 examined larvae were attached to a pharate pupa.

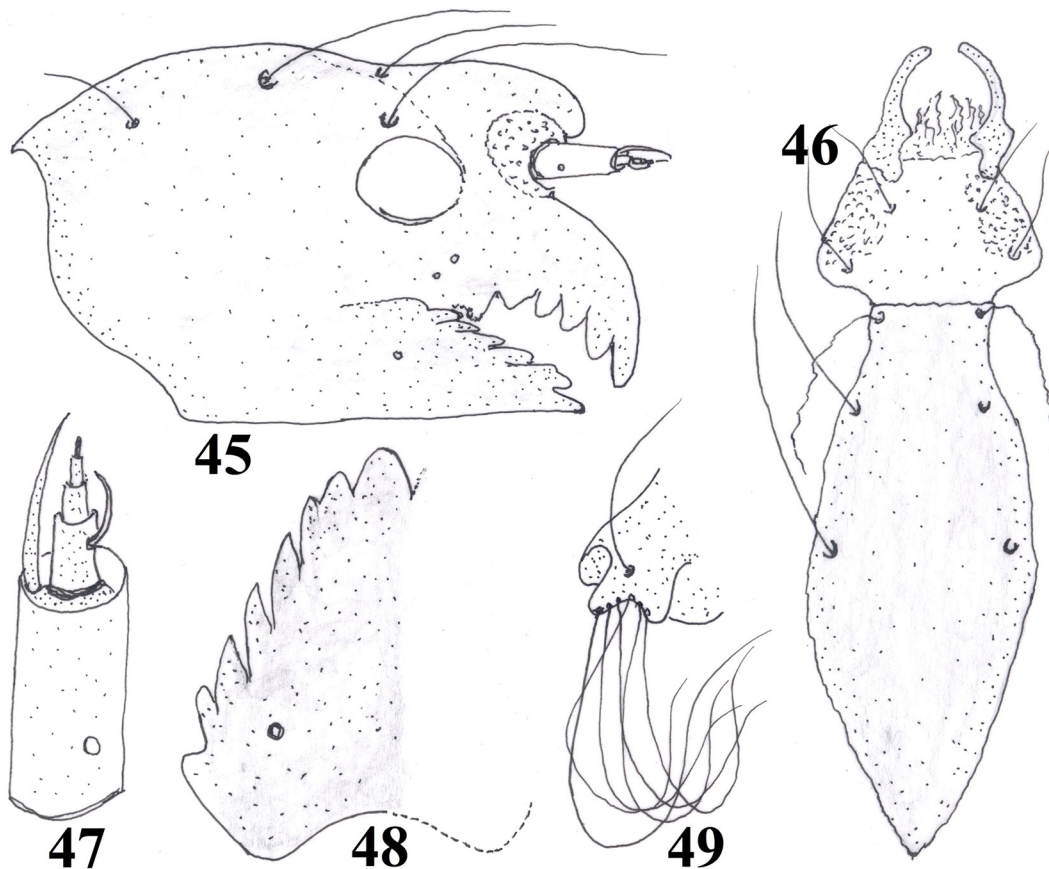
Total length 3.90-4.00 mm, maximum width 0.5-0.6 mm. Colouration contrasting pale greenish to blackish. Head (Fig. 45) blackish with a markedly transparent circular area (clearly visible in lateral view) placed on each side below base of antenna; proximal part of head capsule contrasting brown to dark brown including antennae and epipharyngeal region; mentum totally blackish; anteromedian area of clypeus densely covered with granulation. Thorax, abdomen and anal segment greenish.

Head illustrated in lateral view (Fig. 45). Eye spots broadly circular; clypeus (Fig. 46) nearly trap-

ezoidal, densely granulate on lateral parts; frontal apotome (Fig. 46) 370 μm long, with 3 pairs of lateral setae, median and distal setae are setae-like and about 200 μm long, proximal setae are bristle-like and shorter (about 90 μm long). Antenna (Fig. 47) 5-segmented, 95 μm long; basal segment about 55 μm long and 20 μm maximum width, AR 1.35-1.45; ring organ placed about $\frac{1}{4}$ distance from base of antenna, accessory blade markedly overreaching fifth segment as in *C. storozhenkoi* (Makarchenko & Makarchenko 2016, Fig. 27). Mandible (Fig. 45) with 6-7 teeth, apical tooth nearly as long as combined length of two first lateral teeth. Mentum (Figs 45, 48) composed of 1 median large tooth and 5-6 pairs of lateral teeth, apical pair of teeth smooth and domed, first and second lateral teeth distinctly fused at base. Procercus (Fig. 49) bilobed distally with 6 long setae, dorsal seta about 100 μm long.

Taxonomic position

C. latellai sp. n. can be separated from its morphologically most similar European species *C. mantetanus* by a combination of characters.



Figures 45-49. Larva of *Cricotopus latellai* sp. n. 45, head, right side, lateral view; 46, head capsule, dorsal; 47, antenna; 48, mentum, half part; 49, procercus with dorsal and anal setae, lateral view.

In the male adult: median area of tergites III-IV each with 3 distal setae (Fig. 4), while there is 4 setae (2 anterior and 2 posterior) in *C. mantetanus* (Fig. 6); tergite IX differently shaped in lateral and dorsal view (Figs 2-3) than in *C. mantetanus* (Fig. 5).

In the pupal exuviae: granulation on cephalothorax covering the entire anteromedian area and thoracic suture (Fig. 32), is differently figured in *C. mantetanus* (Fig. 37); dorsocentrals are all setae-like; thoracic horn foliate to ellipsoidal and narrowed distally (Figs 33-34); posteromedian area of sternites VI with a patch of small spines (Fig. 43).

Additional remarks

According to the previously provided key for known male adults and pupal exuviae from the Tyrrhenian Region (Moubayed-Breil 2016), *C. latellai* sp. n. keys near *C. mantetanus* and *C. storozhenkoi* based on the following combination of characters:

outer margin of inferior volsella is rounded for *C. latellai* sp. n. and *C. storozhenkoi*,

shape of the thoracic horn for *C. latellai* sp. n. and *C. mantetanus*, while a nearly similar shape of anal lobe is observed in both *C. latellai* sp. n. and *C. mantetanus*.

Consequently, the main differentiating morphological features found in the male adults and pupal exuviae of the *tremulus*-group can be supplemented based on the combination of characters summarized in the following key of known species from the Tyrrhenian Region.

Male adults

1. Inferior volsella pointing downwards at an acute angle, narrow and finger-like (Moubayed-Breil 2016, Fig. 47; Casas & Vilchez-Quero 1992, Figs 1A-B), outer margin not gradually or abruptly bent downwards *C. nevadensis* (Spain, Portugal)

- Inferior volsella not pointing downwards at an acute angle, not narrow and finger-like, outer margin gradually (Figs 7, 9) or abruptly (Fig. 12) bent downwards 2

2. Outer margin of inferior volsella abruptly bent downwards medially at a right angle and with 2 strong dorsal setae on outer edge (Fig. 12; Moubayed-Breil 2016, Figs 6, 8-9) *C. mantetanus* (France)

- Outer margin of inferior volsella rounded and bent gradually downwards, lacking strong dorsal setae on outer edge (Figs 7, 9; Moubayed-Breil 2016, Figs 43, 45) 3

3. Gonostylus with large, broad, apically rounded, strongly projecting crista dorsalis (Figs 10-11); median area of tergites III-IV each with 3 setae placed distally (Fig. 4) *C. latellai* (France, Italy)

- Gonostylus not as described above, with small crista dorsalis (Moubayed-Breil 2016, Figs 11, 43); median area of tergites III-IV each with 5 setae (2 proximal, 3 distal) (Moubayed-Breil 2016, Fig. 5) or tergites III and IV respectively with 4 setae (1 proximal, 3 distal) and 5 setae (2 proximal, 3 distal) (Moubayed-Breil 2016, Fig. 41) 4

4. Gonostylus with rounded posterior margin, crista dorsalis short, tooth-like with rounded apex (Moubayed-Breil 2016, Fig. 11); median area of tergites III-IV with 5 dorsal setae (2 proximal, 3 distal) (Moubayed-Breil 2016, Fig. 5) *C. tremulus* (widespread Holarctic species)

- Gonostylus with sinuous posterior margin, crista dorsalis tooth-like with pointed apex (Moubayed-Breil 2016, Fig. 43); median area of tergite III with 4 setae (1 proximal, 3 distal) and tergite IV with 5 setae (2 proximal, 3 distal) (Moubayed-Breil 2016, Fig. 41)..... *C. royanus* (France, Italy)

Pupal exuviae

1. Thoracic horn over three times as long as broad, elongated to lobe-like, densely to weakly toothed distally on one side or entirely smooth; median patch of spines on tergite VI diamond-like or spinning-top-like; anal lobe broadly rounded apically, densely covered with rows of small spines placed near the posterior margin 2

- Thoracic horn about twice as long as broad, lobe-like or foliate to ellipse-like, entirely smooth or distinctly toothed distally and apically; median patch of spines on tergite VI rounded or nearly semi-circular; anal lobe narrowing distally (Fig. 42), weakly to moderately covered with small spines (Figs 42, 44) 3

2. Granulation on cephalothorax only covering the anterior part of thoracic suture, sparsely covering the anteromedian area; thoracic horn moderately toothed medially, distally and apically on one side; median patch of spines on tergite VI spinning top-like (Moubayed-Breil 2016, Fig. 77) *C. royanus*

- Granulation on cephalothorax sparse and restricted to the anteromedian area close to the thoracic suture; thoracic horn smooth or only toothed apically, occasionally toothed pre-apically on one side; median patch of spines on tergite VI sub-oval to nearly diamond-like *C. nevadensis*

3. Granulation on cephalothorax restricted to the anteromedian area located close to the thoracic suture; thoracic horn balloon-like and entirely smooth (Hirvenoja, 1973, Fig. 113.3); *C. tremulus*

- Granulation on cephalothorax covering at least the anteromedian area and the thoracic suture (Figs 32, 37); thoracic horn foliate to ellipsoidal in shaped and bearing teeth at least apically (Figs 33-35, 38)..... 4

4. Granulation on cephalothorax covering the anteromedian area and thoracic suture but not reaching the Dc_3 - Dc_4 zone (Fig. 37); thoracic horn ellipse shaped (Fig. 38), toothed apically and medially on one side; median patch of spines on tergite VI diamond-like; anal lobe weakly covered with small spines (Fig. 44) *C. mantetanus*

- Granulation on cephalothorax densely covering the antero- and posteromedian area and the thoracic suture, reaching the Dc_3 - Dc_4 zone (Fig. 32); thoracic horn foliate to ellipsoidal (Figs 33-35) with narrowing distal part, apex of teeth are often smooth (Fig. 34); median patch of spines on tergite

VI diamond-like to semi-circular (Fig. 41); anal lobe moderately covered with small spines (Fig. 42)..... *C. latellai*

Ecology and geographical distribution

Localities where the larval, imaginal and pupal material of *C. latellai* sp. n. were collected consist of pristine epirhithral sections located in middle and high sectors of glacial streams (upper basin of the River Po, northwestern Italy, Fig. 50). Environmental data of water are: crystalline to moderately calcareous water, conductivity (about 20-30 μ S/cm for dolomitic areas of the upstream of the Po River; 95-100 μ S/cm for the calcareous upstream of the Casterino stream); temperature 8-12 °C during late spring and summer. Emergence is observed in June and July but apparently extends to late summer. Geographical distribution (Fig. 51) is delimited by the eastern limit of the Tyrrhenian Region, which covers both the Italian and French Maritime Alps. Moreover, *C. latellai* sp. n. belongs to a relict glacial element, which is believed to characterize the Tyrrhenian continental Province where other Tyrrhenian elements have previously been documented by Moubayed-Breil & Ashe (2016) and



Figure 50. Riffles and waterfalls (altitude 1700-1800 m) delimited by the upper basin of the River Po at ‘Pian del Re’, Alpi Marittime, north-western Italy. Photo J. Moubayed-Breil, 09.07.2017.

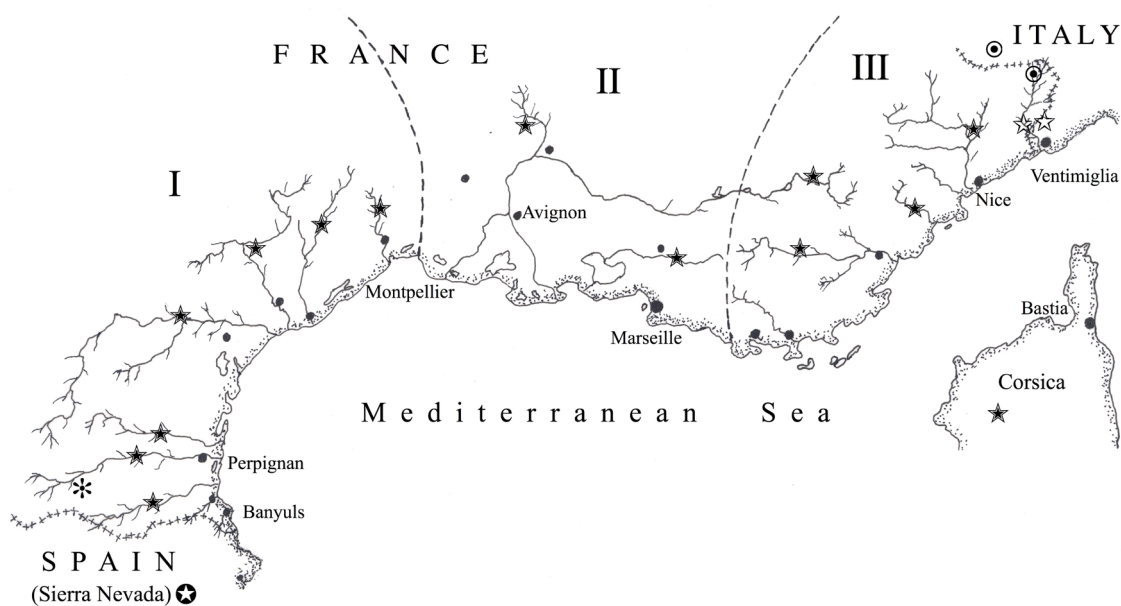


Figure 51. Geographical distribution of the five currently known *Cricotopus* species (*tremulus*-group) in the Tyrrhenian Region delimited by continental France, Italy, Spain and Corsica: *C. latellai* sp. n. ●, *C. mantetanus* *, *C. nevadensis* ●, *C. royanus* ☆, *C. tremulus* ★.

Moubayed-Breil & Orsini (2016). This highlights the importance of some high local glacial mountain ranges in the Mediterranean Region where constructive plans for conservation and preservation of autochthonous glacial relic species must be implemented. Such relic species are considered as biogeographically representative and biological indicators of global warming and climate change.

Associated species in the same habitat to *C. latellai* sp. n. include: *Boreoheptagya legeri* (Goetghebuer, 1933); *Diamesa cinerella* (Meigen, 1835); *D. hamaticornis* Kieffer, 1924; *D. latitarsis* (Goetghebuer, 1921); *D. thomasi* Serra-Tosio, 1970; *D. tonsa* (Haliday, 1856); *D. zernyi* Edwards, 1933; *Pseudodiamesa branickii* (Nowicki, 1873); *P. nivosa* (Goetghebuer, 1928); *Cricotopus* (*Paratrichocladiua*) *spiesi* (Ashe & O'Connor, 2013); *Eukiefferiella ilkleyensis* (Edwards, 1929); *E. fittkau* Lehmann, 1970; *E. minor* (Edwards, 1929); *Krenosmittia camptophleps* (Edwards, 1929); *Limnophyes gelasinus* Sæther, 1970; *Orthocladus ruffoi* Rossaro & Prato, 1991; *Pseudorthocladus curtistylus* (Goetghebuer, 1921); *Thienemannia corsicana* Moubayed-Breil, 2013; *T. gracilis* Kieffer, 1909; *T. spiesi* Moubayed-Breil & Ashe, 2016 and *Tvetenia bavarica* (Goetghebuer, 1934).

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