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On the genus *Cricotopus* v. d. Wulp, 1874 (*tremulus*-group) from continental France and Corsica with description of *C. mantetanus* sp. n. and *C. royanus* sp. n. [Diptera, Chironomidae, Orthocladiinae]

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Two new species and one new morphotype of the genus *Cricotopus* v. d. Wulp, 1874 (*Cricotopus* subgenus, *tremulus*-group) are described based on associated pharate adults material and pupal exuviae collected in helocrenes and pristine cold stenothermic streams located in the Tyrrhenian sub-region including South Eastern, South Western France and Corsica. The first new species, *C. mantetanus* sp. n. is exclusively confined to the upper basin of the siliceous high mountain Soques and Alemany stream (Mantet Nature Reserve, Eastern Pyrenees, alt. 1600-2000 m). The second, *C. royanus* sp. n., occurs in the upper and middle basins of the karstic Roya River including its tributaries (Mercantour National Park, Maritime Alps, alt. 350-1600 m). The new morphotype, *C.* sp. 1, is collected in the upper basin of the Canaglia stream (central Corsica, alt. 1350 m), a siliceous cold pristine and stenothermic tributary of the Gravona River. An additional second new morphotype (*C.* sp. 2) is occurring in the rhithral of some streams located in the northern part of the Roya River basin: Casterino stream (upper and middle basin, alt. 1300-1600 m). The latter new morphotype *C.* sp. 2 keys near *C. mantetanus* sp. n. and *C. tremulus* (Linnaeus, 1758). It is not described in this paper.
The immature stages of *Cricotopus* (*Cricotopus* subgenus) are phytophagous to algae feeder occurring in all types of freshwater habitats but mainly and more commonly in flowing water. Those of the two new species and the new morphotype are exclusively rheobiontic and crenophilous being encountered in lotic habitats located in high to middle mountain streams. Habitats where the larvae were obtained are enriched with rocks and stones which are densely covered by microalgae (Chlorophyceae, Xanthophyceae, Cyanophyceae) and occasionally by the red algae *Hildenbrundia rivularis*) when water is calcareous.
The *tremulus*-group comprises hitherto six valid species including: *C. nevadensis* Casas & Vilchez-Quero, 1992 (only known from Spain and Portugal); *C. leleji* Makarchenko & Makarchenko, 2016 and *C. storozhenkoi* Makarchenko & Makarchenko, 2016 (recently described from the Russian Far East); *C. tremulus*; *C. mantetanus* sp. n. and *C. royanus* sp. n. Geographical distribution of the two new species is restricted to the continental Province of the Tyrrhenian Region: *C. mantetanus* sp. n., is confined to the siliceous Soques and Alemany streams located in the Eastern Pyrenees (crystalline water, Nature Reserve of Mantet, S-France); *C. royanus* sp. n., is only known from the upper and middle basins of the Roya River and its tributaries which are located in the Maritime Alps (calcareous water, Mercantour National Park, S-E France). This highlights the importance of some high mountain range, considered as cold enclaves in the preservation and persistence of autochthonous glacial relic species, which are considered as biogeographic representative and biological indicators of the global warming and climate change. Taxonomic remarks on some related species, discussion and comments on the ecology, conservation and geographical distribution of the new species are given.

Sur le genre *Cricotopus* v. d. Wulp, 1874 (groupe *tremulus*) en France continentale et Corse avec les descriptions de *C. mantetanus* sp. n. et de *C. royanus* sp. n. [Diptera, Chironomidae, Orthocladiinae]

Mots-Clés : *Cricotopus* spp. n., groupe *tremulus*, ruisseaux de montagne, éléments tyrrhéniens, Alpes-Maritimes, Pyrénées-Orientales, Corse, France, Diptera Chironomidae, conservation.

Deux nouvelles espèces pour la science et un nouveau morphotype appartenant au genre *Cricotopus* v. d. Wulp, 1874 (sous-genre *Cricotopus*, groupe *tremulus*) sont décrits à partir d'un matériel composé de pharates adultes et d'exuvies nymphales récemment collectés dans les bassins supérieur et moyen de ruisseaux froids situés en haute et moyenne montagne que délimite l'écosystème tyrrhénien côtier méditerranéen: provinces continentale et insulaire. La première nouvelle espèce, *C. mantetanus* sp. n. est exclusivement confinée au bassin supérieur du ruisseau des Soques et de l'Alemany, deux affluents de la rivière Mantet (Réserve Naturelle de Mantet, Pyrénées-Orientales, alt. 1600-2000 m, Photos 1, 2). La seconde, *C. royanus* sp. n., n'est actuellement connue que des bassins supérieur et moyen de la Rivière karstique Roya et de ses affluents (Parc National du Mercantour, Alpes-Maritimes, S-E France, alt. 350-1600 m, Photos 3, 4). Le nouveau morphotype, *C.* sp. 1, n'est connu que du bassin supérieur de la Gravona (ruisseau de Canaglia, alt. 1350 m, eaux cristallines, Corse centrale) ; seulement l'exuvie nymphale est décrite. Un second morphotype du groupe *tremulus* (*C.* sp. 2) a été collecté dans certains affluents situés dans la partie Nord du bassin supérieur de la Roya : ruisseau du Castérino (bassin moyen, alt. 1300-1700 m). Ce dernier morphotype se rapproche tout particulièrement de *C. mantetanus* sp. n. et *C. tremulus* (Linnaeus, 1758) sur la base de certains caractères morphologiques : forme de la corne thoracique, granulations du thorax, ornementation du tergite VI et du lobe anal, etc. Sa description n'est pas incluse dans ce travail.

L'adulte mâle et l'exuvie nymphale des deux nouvelles espèces et les nouveaux morphotypes appartiennent au groupe *tremulus* sur la base des principaux caractères distinctifs suivants : - adulte mâle (tarsomère 5 plus sombre que les précédents tarsomères, occasionnellement noirâtre ; apex du fémur et du tibia des pattes PI, PII et PIII noirâtre ; tergites I-II blanchâtres, tergites III-VIII brun noirâtres ; chaetotaxie et mode de distribution des soies sur l'aire médiane des tergites II-V ; pointe anale absente ; gonocoxite avec ou sans expansion dorsale placée au-dessus de la volsella inférieure ; volsella inférieure en forme de pied ou de lobe allongé, dépourvue d'échancrure et recourbée vers le bas) ; - exuvie nymphale (coloration contrastée brunâtre à noirâtre ; soies frontales insérées sur le préfrons, ventralement par rapport au fourreau antennaire; céphalothorax avec une tâche noirâtre transversale distincte ou indistincte qui s'étend entre la suture thoracique posteromédiane (Dc_3 et Dc_4) et la base du fourreau alaire ; corne thoracique en forme d'ellipse, de lobe allongé ou de ballon, émoussée ou faiblement dentelée ; groupe d'épines sur les aires antérieures et postérieures des tergites III-VI distinctement séparés ; forme du groupe d'épines présent sur l'aire médiane du tergite VI ; lobe anal avec ou sans rangées denses ou éparses de petites épines dans la partie apicale ; macrosoies rigides avec apex légèrement recourbé, en forme d'épingle et très courtes (< la moitié du lobe anal).

Les stades immatures du genre *Cricotopus* (sous-genre *Cricotopus*), qui se rencontrent dans tous les types d'habitats dulcicoles et plus particulièrement ceux appartenant aux eaux courantes, sont phytophages et algivores. Ceux de *C. mantetanus* sp. n., *C. royanus* sp. n. et des deux morphotypes, qui colonisent de préférence le rhithral de haute et de moyenne montagne où l'on note une abondance de microflore algale à base de Chlorophyceae, Xanthophyceae, Cyanophyceae ou en présence de l'algue rouge *Hildenbrundia rivularis* (eaux calcaires), sont exclusivement rhéobiontes et crénophiles. L'émergence des adultes a lieu de juillet à septembre pour *C. mantetanus* sp. n. et de mai à septembre-octobre pour *C. royanus* sp. n. Le morphotype *C.* sp. 1 n'a été collecté qu'en juin. Les adultes de *C. mantetanus* sp. n. et *C. royanus* sp. n. sont souvent parasités par des hydracariens. La couleur des imagos et des exuvies nymphales de *C. royanus* sp. n. est variable: nettement contrastée (blanchâtre à noirâtre) en basse montagne, devenant plus sombre à des altitudes supérieures à 1300 m.

C. mantetanus sp. n. et *C. royanus* sp. n. ainsi que d'autres espèces récemment décrites ou citées de la sous-région tyrrhénienne, sont connues pour leur grande fragilité et leur très faible représentativité numérique

(capturés avec moins de 3 individus). Celles-ci n'ont été répertoriées jusqu'à présent que dans des zones humides préservées appartenant à des territoires ou espaces naturels protégés (parcs régionaux ou nationaux, réserve naturelles) qui couvrent des habitats refuges de grande valeur biogéographique.
Toutefois, les localités que couvre l'ensemble du territoire de la Réserve Naturelle de Mantet (Pyrénées-Orientales) dont la localité-type de *C. mantetanus* sp. n., correspondent à d'anciennes enclaves glaciaires relictuelles où prédominent des sous-écoulements d'eaux phréatiques et de surface qui assurent une pérennité hydrologique très favorable aux populations d'insectes hygrophiles. C'est le cas par exemple du bassin supérieur des ruisseaux des Soques et de l'Alemany où s'écoulent des eaux siliceuses et faiblement minéralisées (conductivité 15-25 µS/cm, température 6.5-8.5 °C, pH 5.1-5.5). Les versants que couvrent le haut-Soques et le haut-Alemany se caractérisent en particulier par la présence de moraines glaciaires qui délimitent des habitats refuges de type interstitiel ou cavernicole assimilés à de véritables hot-spots de diversité et d'endémisme. Leur communauté se caractérise non seulement par la présence d'éléments faunistiques de grande valeur patrimoniale (formes crénobiontes et sténothermes d'eau froide), mais surtout par l'originalité de certaines espèces hygrophiles dont l'appartenance à des lignées génétiques autochtones et relictuelles mérite d'être soulignée. *C. royanus* sp. n., en revanche, n'a été répertoriée que dans les Alpes-Maritimes, dans des rivières et ruisseaux à régime de soutien karstique aux eaux bien minéralisées (présence de tufs calcaires, conductivité 95-700 µS/cm, T°C 7.5-19.5, pH 7.3-8.2). Ces derniers se caractérisent par des spécificités faunistiques et écologiques originales, considérées parfois comme atypiques par rapport au contexte régional. Leur communauté se caractérise, tout comme pour *C. mantetanus* sp. n., par des formes crénophiles ou sténothermes d'eau froide qui correspondent à de véritables indicateurs biologiques et écologiques du milieu naturel et du réchauffement climatique.
Le genre *Cricotopus*, groupe *tremulus*, est actuellement représenté par six espèces : *C. nevadensis* Casas & Vilchez-Quero, 1992 (connue uniquement d'Espagne et du Portugal) ; *C. leleji* Makarchenko & Makarchenko, 2016 et *C. storozhenkoi* Makarchenko & Makarchenko, 2016 (récemment décrites de Russie orientale) ; *C. tremulus* ; *C. mantetanus* sp. n., *C. royanus* sp. n. Les présentes descriptions de *C. mantetanus* sp. n. et de *C. royanus* sp. n., et les nouvelles citations de *Thienemannia corsicana* Moubayed-Breil, 2013 ; *T. spiesi* Moubayed-Breil & Ashe, 2016 ; *Bryophaenocladius xanthogyne* (Edwards, 1929) portent le nombre d'espèces valides connues de France continentale de **742** à **747**.
Enfin, des clés d'identification se rapportant aux adultes et aux exuvies nymphales mâles des deux espèces nouvelles et du nouveau morphotype sont fournies. Un commentaire et des discussions sur la position systématique, l'écologie, la conservation et la distribution géographique des deux nouvelles espèces sont également donnés.

1- Introduction

Worldwide the knowledge and database recently provided on the taxonomy, geographical distribution and ecology of the genus *Cricotopus* v. d. Wulp, 1874 (*tremulus*-group) and related species (HIRVENOJA 1973, COFFMAN et al. 1986, MOUBAYED-BREIL & HIRVENOJA 1986, CRANSTON et al. 1989, LANGTON 1991, CASAS & VILCHEZ-QUERO 1992, LANGTON & PINDER 2007, ASHE & O'CONNOR 2012, ANDERSEN et al. 2013, SÆTHER & SPIES 2013, DRAYSON et al. 2015, MAKARCHENKO & MAKARCHENKO 2016, MOUBAYED-BREIL & ASHE 2016a) show that only four valid species are currently known: *C. tremulus* (Linnaeus, 1758); *C. nevadensis* Casas & Vilchez-Quero, 1992; *C. storozhenkoi* Makarchenko & Makarchenko, 2016 and *C. leleji* Makarchenko & Makarchenko, 2016. In this paper two additional new species and one new morphotype of the genus *Cricotopus* (*tremulus*-group) are described based on material composed of associated pharate material (male and female adults) and pupal exuviae collected in helocrenes and pristine high and middle mountain cold stenothermic streams located in both southern France and Corsica.

2. Material and methods

The studied material was collected using some standard methods: Langeron, or Troubleau net for larvae and floating pupae; Brundin drift nets for pharates and pupae; sweep net and light trap for flying imagines. In each collecting site (especially helocrenes, waterfalls and rhithral) a square (15x15 to 20x20 cm^2) of bryophytes including livewort were sampled. Benthic fauna was collected into a 500 µm mesh and then fixed in 7 to 8% formaldehyde. Hunted insects were preserved in 85% ethanol for later identification and analysis. In each of the collecting sites, altitude, depth, flow velocity and environmental data (conductivity, pH and temperature of water) were recorded before benthic and drifting sampling.

Soques and Alemany streams, crystalline water, E-Pyrenees, S-France

Four sampling stations are delimited by the Soques and Alemany streams, which are extending along an altitudinal gradient (2200-1600 m). Sampling sites are: spring zones (2000-2200; 1800-2140 m); confluence of Alemany stream and the Mantet River (1400 m). Investigations were done five times between 2005 and 2010 during the two major annual hydrological phases: from May to June, during the snowmelt; from August to September at low water level. Additional details about the description of sites are provided by MOUBAYED-BREIL (2005).

Roya River basin, calcareous water, Maritime Alps, S-E France

Up to 35 sampling sites were located along the Roya River basin between high mountain streams (alt. 1800-2000 m) and the estuarine zone at Ventimiglia (Italian boarder). Localities where *C. royanus* sp. n. is present are situated along the upper and middle basins of the karstic Roya River and some tributaries including the following streams and localities: Guiou (380-390 m); Bendola (400 m); Levensa (500-800 m); Caïros (600-800 m); Roya River between St-Dalmas-de-Tende and Breil-sur-Roya (350-700 m); Casterino (1500-1750 m); Minière (1300-1650 m); Bevera at Sospel (360-370 m), Bevera at Olivetta (300-320 m). The sampling sites were investigated three times between 2011 and 2016 during the two major annual hydrological periods: in June during snowmelt and in September at low water level. Additional database and more valuable information on the Mercantour National Park are provided by GIUDICELLI & DERRIEN (2009), LECCIA & MORAND (2013), DOLE-OLIVER et al. (2015).

The adult specimens were 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. Compared to clearing with potassium hydroxide, or other clearing solutions, no deterioration of the typical "original" structure is reported by using lactic acid. All examined material was mounted in polyvinyl lactophenol, remaining material including paratypes were preserved in 85% ethanol. The eye on one side has been dissected from the head, which ensures that the hairs on the inner margin of eye are more clearly visible. Before the final slide mountings (dorsally) of the type and paratype material, the hypopygium including the IX^{th} tergum, the anal point, the gonocoxite and the gonostylus, were viewed ventrally and laterally to examine and draw in both side all the necessary details of the species.

Morphological terminology and measurements largely follow SÆTHER (1977, 1980) and DRAYSON et al. (2015) for the imagines and pupal exuviae.

Photo 1. Soques stream (Fonts des Soques), type locality of *Cricotopus mantetanus* sp. n.: spring zone, presence of 'glacial moraine' (arrows) and Pine Hook forest (*Pinus uncinata*), Nature Reserve of Mantet, E-Pyrenees, alt. 2000-2140 m. Photo A. Arasa.

Photo 1. Ruisseau des Soques (Fonts des Soques), localité-type de *Cricotopus mantetanus* sp. n. : sources frontales, présence de moraines glaciaires (voir flèches) et de Pins à crochets (*Pinus uncinata*), Réserve naturelle de Mantet, Pyrénées-Orientales, S-France, alt. 2000-2140 m. Photo A. Arasa.

Photo 2. Soques stream (Fonts des Soques), upper stream and rhithral zones, Pin Hook forest, Nature Reserve of Mantet, E-Pyrenees, alt. 1800-2000 m. Photo A. Arasa.

Photo 2. Ruisseau des Soques (Fonts des Soques), cours supérieur et rhithral, forêt de Pins à crochets, Réserve naturelle de Mantet, Pyrénées-Orientales, S-France, alt. 2140 m. Photo A. Arasa.

Photo 3. Roya River (sampling method, drift net), middle basin, rhithral zone, type locality, Mercantour National Park, S-E France, Maritimes Alps, alt. 350-800 m. Photo J. Moubayed-Breil.

Photo 3. Rivière Roya (échantillonnage : filets de dérive), bassin moyen, rhithral, localité-type, Parc national du Mercantour, S-E France, Alpes-Maritimes, alt. 350 -800 m. Photo de l'auteur.

Photo 4. Caïros stream, a tributary of the Roya River, middle basin, rhithral, type locality (paratypes), Mercantour National Park, S-E France, Maritimes Alps, alt. 500 - 700 m. Photo M.-F. Leccia.

Photo 4. Ruisseau du Caïros, affluent de la Roya, bassin moyen, rhithral, localité-type (paratypes), Parc national du Mercantour, S-E France, Alpes-Maritimes, alt. 500 - 700 m. Photo M.-F. Leccia.

3. Results

The first new species (*C. mantetanus* sp. n.) is occurring in the upper basin of the Soques and Alemany streams (Mantet Nature Reserve, Eastern Pyrenees, alt. 1600-2000 m; Photos 1, 2). The second one (*C. royanus* sp. n.) is placed near *C. nevadensis*. It belongs to *Cricotopus* sp. 1, which is reported by MOUBAYED-BREIL & ASHE (2016a) from the Maritime Alps. This new species is known from the upper and middle basin of the karstic Roya River including its tributaries (National Park of Mercantour, Maritime Alps, S-E France, alt. 350-1600 m; Photos 3, 4). The new morphotype *Cricotopus* sp. 1 is only reported from the Canaglia high mountain stream (crystalline water, central Corsica, alt. 1350 m). One additional new morphotype of the *tremulus*-group (*C.* sp. 2) is occurring in the upper and middle basin of the Casterino stream (northern part of the Mercantour National Park, alt. 1300-1750 m). This latter, which keys near *C. mantetanus* sp. n. and *C. tremulus*, is not described in the present paper.

The male adult and pupal exuviae of the two new species and the new morphotype belong to the *tremulus*-group, which was emended by HIRVENOJA (1973), then modified by CASAS & VILCHEZ-QUERO (1992) and currently improved as in the present paper. However, according to HIRVENOJA (1973, pp. 184-185), MOUBAYED-BREIL & HIRVENOJA (1986), CASAS & VICHEZ-QUERO (1992), MOUBAYED-BREIL & ASHE (2011), the main differentiating morphological features in the male adults and pupal exuviae of the *tremulus*-group can be supplemented or improved based on the following summarized combination of characters:

- in the male adult (tarsomere 5 darker than preceding tarsomeres, apex of femur and base of tibia of PI, PII, PIII blackish; tergites I-II whitish, remaining tergites blackish; chaetotaxy and distribution pattern of setae on median part of tergites; anal point absent; gonocoxite with or without a dorsal sub-triangular projection placed little upper to inferior volsella; inferior volsella long nose-like to foot-shaped, unilobed, lacking notch and projecting downwards;

- in the pupal exuviae (coloration brownish or contrasting whitish to blackish; frontal setae inserted on prefrons, ventral to antennal sheaths; cephalothorax with or without a distinct transversal posteromedian blackish shading placed between the thoracic suture (Dc_3 ad Dc_4) and base of wing sheath; thoracic horn lobe-like, elongated, foliate to ellipse-like, smooth or weakly spinulated; anterior and posterior fields of spinulae on tergites III-VI clearly separated; anal lobe with or without a distinct dense or sparse rows of small spines on apical part; macrosetae pin-like and short, <0.5 anal lobe length or nearly half as long as the anal lobe). Therefore, based on the previous diagnosed *tremulus*-group, the *tremulus*-group currently includes 4 valid known species from southern Europe: *C. nevadensis* Casas & Vilchez-Quero, 1992; *C. tremulus* (Linnaeus, 1758); *C. mantetanus* sp. n.; *C. royanus* sp. n.

Nevertheless, the *levantinus*-group, which includes *C. levantinus levantinus* Moubayed & Hirvenoja, 1986 and *C. levantinus occidentalis* Moubayed-Breil & Ashe, 2011 still represent a separate valid sister-group to the *tremulus*-group (MOUBAYED-BREIL & HIRVENOJA 1986) based on the following distinguishing characters:

- in the male adult (inferior volsella uni- or bi-lobed, broader and not nose-like);

- in the pupal exuviae (rows of small spines absent on apical area of the anal lobe).

Furthermore, in a recent paper on the genus *Cricotopus* from Australia (DRAYSON et al. 2015), 11 species were listed including 10 new species. Among the 11 reported species, *C. how-*

ensis Cranston, 2015 and *C. wangi* Cranston & Krosch, 2015 probably key in the *levantinus*-group based on the combination of characters previously provided.

The larvae of the two new described species are known but not described. Localities where the larval, imaginal and pupal material were collected consist of shaded pristine helocrenes and rhithral located in high and middle basins of rivers and streams. Emergence for *C. mantetanus* sp. n. is mainly observed in summer and autumn, from July to September, occasionally till October. Emergence of *C. royanus* sp. n. is recorded from May till September-October. The morphotype *C.* sp. 1 is only obtained in the late spring (May-June). Parasitism of imagines of both *C. mantetanus* sp. n. and *C. royanus* sp. n. by water mites is often reported during the late spring period. Imagines and pupal stages of *C. royanus* sp. n. are generally contrasted whitish to blackish becoming darker in high altitude areas.

While the new morphotype *C.* sp. 1 is only known from the insular Province of the Tyrrhenian Region (Central Corsica), the geographical distribution of the two new described *Cricotopus* species is restricted to the continental Province of the Tyrrhenian Region: *C. mantetanus* sp. n. is exclusively occurring in the upper basin of the siliceous high mountain Soques stream (water conductivity 15-25 µS/cm, temperature 6.5-8.5, pH 5.1-5.5; Nature Reserve of Mantet, Eastern Pyrenees, S-France, alt. 1600-2000 m; Photos 1, 2); *C. royanus* sp. n. is apparently confined to the upper and middle basins of the karstic Roya River and its tributaries, which are located in South-Eastern France (calcareous water, presence of tufa concretions, conductivity 95-700 µS/cm, temperature 7.5-19.5, pH 7.3-8.2; southern part of the National Park of Mercantour, alt. 350-1600 m, Photos 3, 4). This highlights the importance of some high local mountain range, considered as cold enclaves in the Mediterranean Region. The currently two new described species (*C. mantetanus* sp. n. and *C. royanus* sp. n.) and the two new morphotypes (*C.* sp. 1, *C.* sp. 2) are believed to characterize the Tyrrhenian Region where are reported other Tyrrhenian elements previously documented by MOUBAYED-BREIL & ASHE (2012, 2015a, 2015b, 2015c, 2016a), MOUBAYED-BREIL (2016a) and MOUBAYED-BREIL & ORSINI (2016). In addition, the occurrence of all these new rheophilic species in both continental and insular Tyrrhenian Provinces reinforces the necessity of constructive implanted plans for conservation preservation and persistence of autochthonous glacial relic species, which are considered as biogeographic representative and biological indicators of the global warming and climate change.

The *tremulus*-group currently comprises six valid species including: *C. nevadensis* (only known from Spain and Portugal); *C. storozhenkoi* and *C. leleji* (recently described from the Russian Far East); *C. tremulus*; *C. mantetanus* sp. n. and *C. royanus* sp. n. The recent updated list of **740** species provided by MOUBAYED-BREIL & ASHE (2016a) on the Chironomidae of continental France was recently upgraded to **742** known valid species by MOUBAYED-BREIL & ORSINI (2016) including *Potthastia dominicii* Moubayed-Breil & Orsini, 2016 and *P. valserina* Moubayed-Breil, 2016. Moreover, in this paper 3 additional new records are discovered from the Maritime Alps (*Thienemannia corsicana* Moubayed-Breil, 2013; *T. spiesi* Moubayed-Breil & Ashe, 2016) and E-Pyrenees (*Bryophaenocladius xanthogyne* (Edwards, 1929). *T. corsicana* was reported from central Corsica (Golu River, upper stream, alt. 1100 m; MOUBAYED-BREIL 2013), *T. spiesi* from Germany (Schapbach springs, Nationalpark Berchtesgaden, Bavaria, alt. 1170 m; MOUBAYED-BREIL & ASHE 2016b). These 3 new records (*T. corsicana*, *T. spiesi* and *B. xanthogyne*) are reported here for the first time from continental France. Localities where the three latter new records were collected are: *T. corsicana* (Minière stream, upper basin, alt. 1500-1650 m; *T. spiesi* (Casterino stream, helocrenes, alt. 1700-1750 m); *B. xanthogyne* (Soques springs, alt. 1800-2000 m).

Consequently, the previously **742** listed species from continental France is currently increased to **747** known valid species, including *C. mantetanus* sp. n, *C. royanus* sp. n. and the 3 previous new records for the chironomid fauna of France.

Morphological terminology and measurements follow: SÆTHER (1980), LANGTON & WISSER (2007), DRAYSON et al. (2015) for the imagines; LANGTON (1991) and DRAYSON et al. (2015) for the pupal exuviae. Taxonomic remarks on some related *Cricotopus* species with key to male adults and pupae of known *Cricotopus* species (*tremulus*-group) from Europe are provided. Discussion and comments on the ecology, conservation and geographical distribution of the new species are also given.

3. Descriptions

Cricotopus mantetanus sp. n.

Material examined

Holotype. **Continental France**. Soques stream, Mantet Nature Reserve, Eastern Pyrenees, S-W France, rhithral and waterfalls, altitude 1800-2000 m, 1 male pharate, leg. J. Moubayed-Breil, 05.VIII.2008. Environmental data of water are: crystalline water, conductivity (Cd) 20-25 µS/cm; temperature (T°C), 7.5-10.5 during late spring till Jun, 8-12 during the late summer till September; pH acid, 5.1-5.5. Pharate adult: 1 male, leg. J. Moubayed-Breil, 14.IX.2014. The holotype locality is situated in zone 8a, after MOUBAYED-BREIL & ASHE (2016a).

Paratypes, **Continental France.** All leg. J. M-B. Soques upper basin; same locality and same environmental data as the holotype, Pe (5 males, 5 females), 05.VIII.2005 and 08.08.2008. Alemany stream, spring zone and upper basin including lateral springs, rhithral and waterfalls, alt. 1600-1800 m (Cd 15-20 µS/cm, T°C 6.5-10.5), Pe (2 males, 3 females), leg. K. Chevrot, A. Arasa, Cl. Guisset, J. Moubayed-Breil, 10.VIII.2015.

Holotype on 2 slides (male adult and its pupal skin) with 2 additional paratypes are deposited in the collections of the Zoologische Staatssammlung (ZSM), Munich, Germany. Remaining paratypes are deposited in the author's collection.

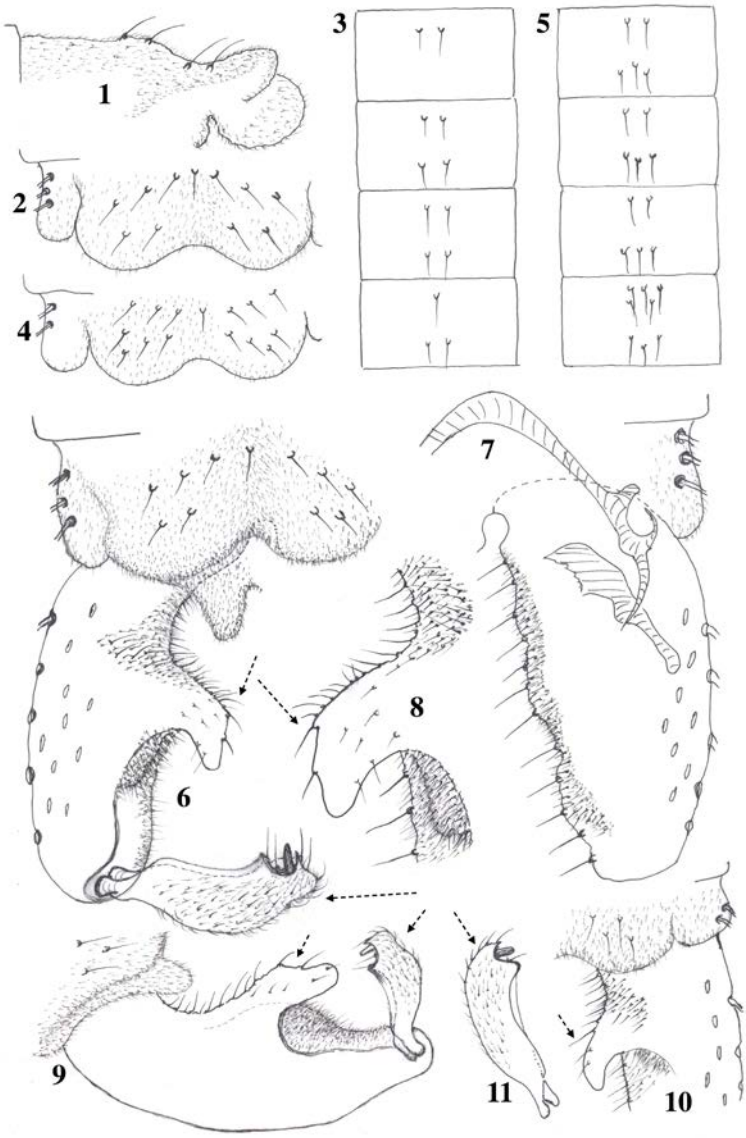
Type material was preserved in 80% alcohol, and later mounted in polyvinyl lactophenol. For each adult, the head, thorax and abdomen were cleared in 90% lactic acid then washed in 80% ethanol before mounting on slides.

Diagnostic characters

C. mantetanus sp. n. belongs to the *tremulus*-group based on the previously provided diagnosis of characters found in the male adult and Pe. However, *C. mantetanus* sp. n. can be separated from other members of the *tremulus*-group in having:

-in the male adult (median area of tergites III to VIII with 2-5 setae, distal half of the inferior volsella distinctly bent downward at a right angle, distal part of the gonostylus projecting and bearing 4-5 curved setae);

- in the Pe (frontal setae inserted on prefrons, ventral to antennal sheaths; thoracic horn oval, distinctly spinulated on one side; fields of spinulae on tergites III-V well separated; anal lobe with rows of small spines on its apical part; macrosetae pin-shaped and short (<0.5 anal lobe length).



Figures 1-11. Male imago of *Cricotopus* spp. *C. mantetanus* sp. n.: tergite IX in lateral (1) and dorsal view (2); distribution pattern of setae on median area of tergites II-V (3). *C. tremulus*: tergite IX in dorsal view (4); distribution pattern of setae on median area of tergites II-V (5). *C. mantetanus* sp. n.: hypopygium, dorsal (6) and ventral (7); inferior volsella (dorsal, 8); gonocoxite and left gonostylus in lateral view (9). *C. tremulus*: inferior volsella (dorsal, 10); right gonostylus (dorsal, 11).

Figures 1-11. Imago mâle de *Cricotopus* spp. *C. mantetanus* sp. n. : tergite IX en vues latérale (1) et dorsale (2) ; distribution des soies sur l'aire médiane des tergites I-V (3). *C. tremulus* : tergite IX en vue dorsale (4) ; distribution des soies sur l'aire médiane des tergites II-V (5). *C. mantetanus* sp. n. : hypopyge, vues dorsale (6) et ventrale (7) ; volselle inférieure en vue dorsale (8) ; gonocoxite et gonostyle gauche en vue latérale (9). *C. tremulus* : volselle inférieure en vue dorsale (10) ; gonostyle droit (11).

Etymology: the new species is named *mantetanus* after the Nature Reserve of Mantet, which is situated in the Eastern Pyrenees (S-France) where the type material was collected in the Alemany stream.

Male imago

(n = 2: 1 pharate male adult, 1 male adult; Figs 1-3, 6-9)

Medium to big sized species. Total length 4.00-4.30 mm. Wing length 1.90-1.95 mm. General colouration contrasting brown to dark brown except for the mesonotal stripes which are blackish. Head dark brown, antennae pale brown, thorax brown to dark brown, mesonotal stripes distinctly blackish; wing pale to pale brown. Legs contrasting brown to dark brown; distal half of femur and tibia and apex of tibia of all legs blackish. Tergites I-II whitish, tergites III-VIII entirely greenish to blackish, anal segment brown to dark brown.

Head. Eyes hairy, inner eye margin bare. Temporals consist of 8 nearly uniserial setae including 6 outer verticals and 2 inner verticals. Clypeus nearly square shaped with 18 setae. Palp 5-segmented; first palpomere weakly developed; length (µm) of segments 70, 120, 260, 250, 280; sensilla chaetica present on segments III-IV. Antenna 940-945 µm long, 13-segmented; first segment 70 µm long, segments 2-3 35-40 µm long, segments 4-12 40-45 µm long (nearly subequal); sensilla chaetica present on segments 3-4 and 13; antennal groove beginning on segments 2-3 and reaching ultimate flagellomere; ultimate flagellomere 445-450 µm long, distinctly clubbed distally and bearing a brush of curved sensilla chaetica apically. AR 0.95.

Thorax. Lateral antepronotals 4-5 grouped close together; acrostichals 16-18, dorsocentrals, 23-24 in 1-2 rows, prealars 4-5. Scutellum with 15-16 setae placed in one row. Wing. Brachiolum with one seta. Distribution of setae on veins: R, 9-10; R_1, 4-5; R_{2+3} and R_{4+5} bare. Squama with 10-11 uniserial setae.

Legs. Tarsomere 4 of PI, PII and PIII respectively 190, 130 and 140 µm long; ta_4 distinctly shorter than ta_5. Sensilla chaetica densely present only on tarsomeres ta_1 to ta_5 of PI, PII and PIII. Length (µm) and proportions of legs:

	fe	**ti**	**ta_1**	**ta_2**	**ta_3**	**ta_4**	**ta_5**	**LR**	**BV**	**SV**	**BR**
PI	1110	955	560	365	260	190	135	0.59	3.76	3.69	1.15
PII	1050	865	435	250	205	130	120	0.50	3.33	4.40	2.60
PIII	940	880	450	310	225	140	125	0.51	1.78	4.04	1.80

LR = Length of tarsomere ta1 divided by length of tibia (ti); BV = Combined length of femur (fe), tibia and ta1 divided by combined length of tarsomeres ta2-ta5; SV = Ratio of femur plus tibia to tarsomere ta1; BR = Ratio of longest seta of ta1 divided by minimum width of ta1, measured one third from apex.

Abdomen. Distribution pattern of setae on median area of tergites II-V as illustrated in Fig. 3: II (2, anteriorly), III-IV (4 including 2 anteriorly and 2 posteriorly), V (3, including 1 anteriorly and 2 posteriorly). Hypopygium. Tergite IX in lateral (Fig. 1) and dorsal view (Fig. 2); posterior margin bilobed dorsally (Figs 2, 6); laterosternite (Fig. 6) lobe-like indistinctly separated from tergite IX; 11 setae are placed in 2 rows, on dorsal side of tergite IX, posterior row with 4 setae (2 on each side). Hypopygium in dorsal (Fig. 6), ventral (Fig. 7) and lateral (Fig. 9) view. Anal point absent; laterosternite IX with 3 setae; transverse sternapodeme and phallapodeme as in figures 7, sternapodeme orally produced, bow-like and nearly inversed V-shaped; phallapodeme swollen medially. Gonocoxite 220-230 µm long, base distinctly swollen, apex rounded. Inferior volsella 40-42 µm long, wider at base and broadly narrowed distally, maximum width at base

28-30 µm, minimum width 8-10 µm at apex, hyaline, nose-like, abruptly bent downwards medially at a right angle; 6-7 small setae are present on dorsal area; outer margin bearing several curved setae proximally and 2 strong setae distally; inner ventral margin with 2 downwardly directed setae. Gonostylus (Figs 6, 9) 100-110 µm long, markedly projecting apically; basal margin distinctly swollen medially, anterior margin concave medially and bearing 2 orally directed strong setae placed before the megaseta. Crista dorsalis tooth-like placed close to the megaseta. Megaseta 18-21 µm long and slender.

Female imago

(n = 2: 2 female pharate adults; Figs 12-13, 16-20)

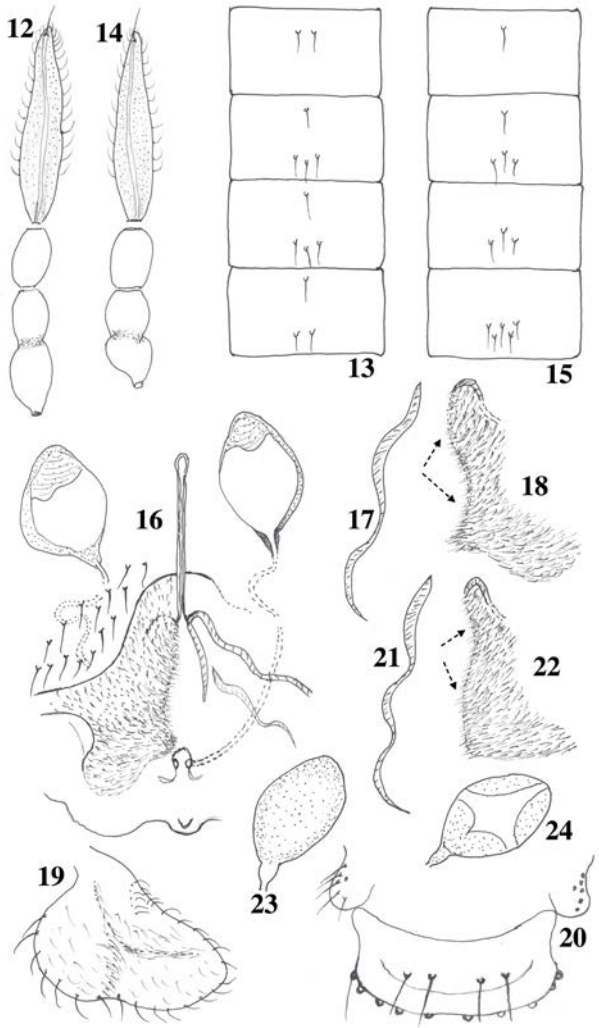
Coloration as in the male adult except for the last flagellomere of antenna which is blackish. Total length 4.20-4.50 mm. Wing length 2.20-2.30 µm. Antenna length 380 µm, last flagellomere 120 µm long, remaining segments 260 µm long; AR 0.46. Head: eyes hairy; temporal setae 5, including 5 inner and 3 outer verticals. Clypeus with 16 setae. Palp 5-segmented; length (µm) of segments: 21, 25, 67, 83, 97. Antenna (Fig. 16) 6-segmented; length (µm) of segments: 22, 40, 43, 43, 44, 79; ultimate flagellomere moderately clubbed, with one preapical seta, apical part bearing a tuff of curved setae including several sensilla chaetica; antennal groove restricted to last flagellomere. Thorax: chaetotaxy as in the male. Wing: distribution of setae on veins: R, 8-11; R_{2+3} baring 5 setae distally; R_1, and R_{4+5} bare. Squama with 11-13 setae. Abdomen. Distribution pattern of setae on median area of tergites II-V as illustrated in Fig. 13: tergite II (2 setae, anteriorly), III-IV (4, one anteriorly and 3 posteriorly), V (3, one anteriorly and 2 posteriorly).

Genitalia in dorsal and ventral view as illustrated (Fig. 16). Notum 125-130 µm long, rami indistinct. Gonapophysis VIII including ventrolateral and dorsomesal lobes (Fig. 16-18). Sternite VIII with 28-30 setae (14-15 on each side of the notum). Dorsomesal and ventrolateral lobes (Fig. 18), dorsomesal lobe slightly swollen proximally and consistently concave medially and distally, ventrolateral lobe broadly projecting downwards; apodeme lobe (Fig. 17) undulating with 2 peaks. Seminal capsules (Fig. 16) 110 µm long, 75 µm maximum width, sub-oval with narrowed tip; sclerotized part located distally and laterally on one side and occupying about 10% of the total surface. Spermathecal ducts with loops and separate openings. Tergite IX (Fig. 20) nearly semi-circular, with 14 setae (4 placed anteromedially, 2 on each side; 10 posteriorly close to the posterior margin). Gonocoxite (Fig. 20) globular, bearing 6 short setae. Cercus (Fig. 19) normally developed.

Male pupal exuviae

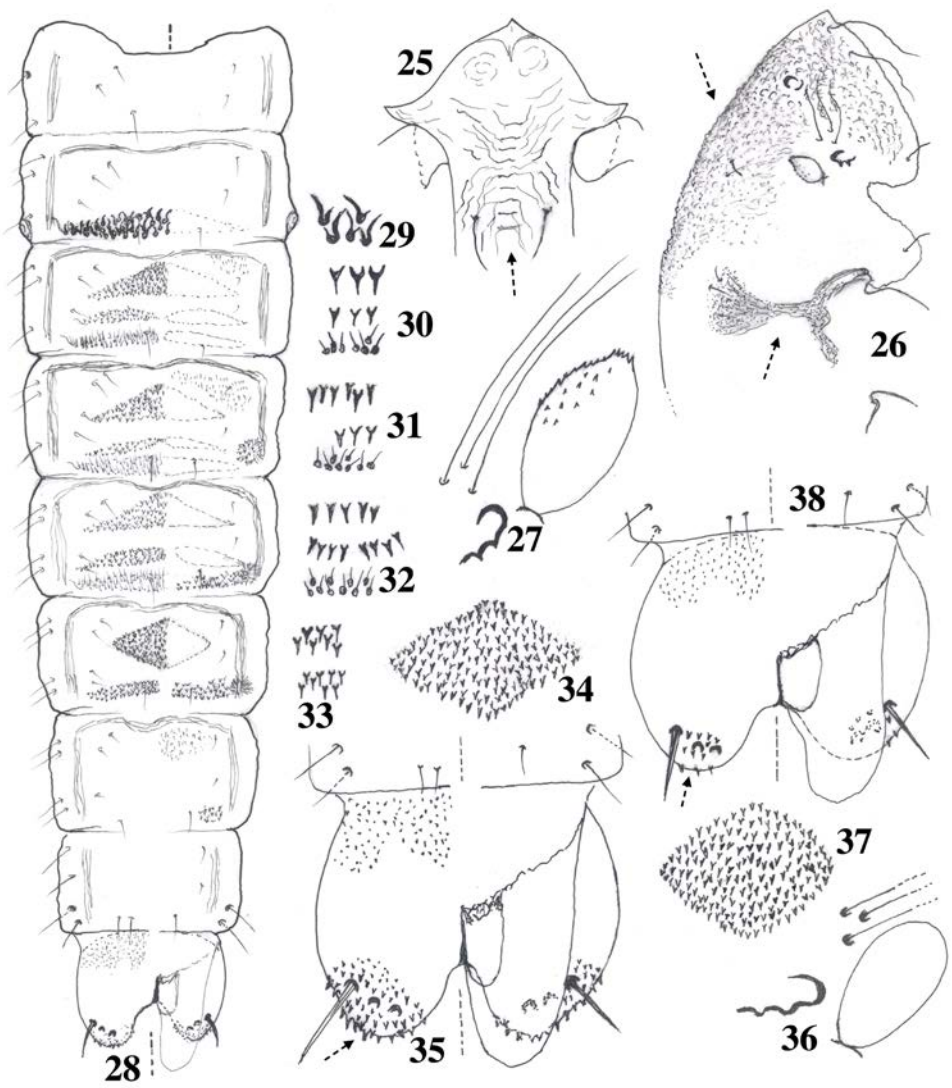
(n = 5; Figs 25-35, 80-81)

Coloration in general brownish to dark brown. Frontal apotome moderately wrinkled. Cephalothorax brown to dark brown, densely wrinkled and granulose; granulation and wrinkles strongly covering the anteromedian area including the thoracic suture and the antepronotal zone; posteromedian area less granulose; presence of a characteristic transversal posteromedian blackish shading extending between Dc_3-Dc_4 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 present on tergites II-VII, indistinct on sternites II-VII; muscles marks distinct on segments I-VIII.



Figures 12-24. Female imago of *Cricotopus* spp. *C. mantetanus* sp. n.: segments 1-3 and last flagellomere of antenna (12), distribution pattern of setae on median area of tergites II-V (13). *C. tremulus*: segments 1-3 and last flagellomere of antenna (14), distribution pattern of setae on median area of tergites II-V (15). *C. mantetanus* sp. n.: genitalia, ventral and dorsal view including gonapophysis VIII, sternite VIII and seminal capsule (16); apodeme lobe (17); dorsomesal and ventrolateral lobes (18); cercus (19); tergite IX (20). *C. tremulus*: apodeme lobe (21); dorsomesal and ventrolateral lobes (22); seminal capsule (23). *C. lev. levantinus*: seminal capsule (24).

Figures 12-24. Imago femelle de *Cricotopus* spp. *C. mantetanus* sp. n. : segments 1-3 et dernier flagellomère de l'antenne (12), des soies sur l'aire médiane des tergites II-V (13). *C. tremulus* : segments 1-3 et dernier flagellomère de l'antenne (14), des soies sur l'aire médiane des tergites II-V (15). *C. mantetanus* sp. n. : genitalia, vues ventrale et dorsale y compris le sternite VIII et la capsule séminale (16) ; lobe de l'apodème (17) ; lobe dorsomésal et ventrolatéral (18) ; cercus (19) ; tergite IX (20) ; capsule séminale (23). *C. tremulus* : lobe de l'apodème (21) ; lobe dorsomésal et ventrolatéral (22) ; capsule séminale (23). *C. lev. Levantinus* : capsule séminale (24).



Figures 25-38. *Cricotopus* spp., male pupal exuviae. *C. mantetanus* sp. n.: frontal apotome (25); cephalothorax (26); thoracic horn (27); armament and chaetotaxy of abdominal segments I-IX, tergites (left) and sternites (right) (28); details of the hook rows on tergite II (29); details of armaments on tergites III-VI: III (30), IV (31), V (32) and VI (33); median patch of spines on tergite VI (34); anal segment, dorsal and ventral view (35). *C. tremulus*: thoracic horn (36); median patch of spines on tergite VI (37); anal segment, dorsal and ventral view (38).

Figures 25-38. *Cricotopus* spp., exuvie nymphale mâle. *C. mantetanus* sp. n. : apotome frontale (25) ; céphalothorax (26) ; corne thoracique (27) ; ornementation et chaetotaxie des segments abdominaux I-IX, dorsalement et ventralement (28) ; détails de la rangée de crochets du tergite II (29) ; détails de l'ornementation des tergites III-VI : III (30), IV (31), V (32) and VI (33) ; détails du groupe d'épines sur l'aire médiane du tergite VI (34) ; segment anal en vues dorsale et ventrale (35). *C. tremulus* : corne thoracique (36) ; détails du groupe d'épines sur l'aire médiane du tergite VI (37) ; segment anal en vues dorsale et ventrale (38).

Total length 4.10-4.40 mm. Frontal apotome (Fig. 25) weakly domed, lateral margin projecting laterally and orally; frontal setae bristle-like, inserted on prefrons ventral to antennal sheaths, 80-85 µm long and separated by about 95-100 µm.

Cephalothorax (Figs 25-26). Thorax. Antepronotals 3 including 2 median antepronotals (140 and 170 µm long) and 1 lateral antepronotal 60-70 µm long; 1 prealar 70-80 µm long; precorneal setae nearly sub-equal (175, 170 and 180 µm long); dorsocentrals: Dc_1- Dc_2 80-85 µm long, Dc_1-Dc_4 55-60 m long, Dc_1 and Dc_4 setae-like, Dc_2 and Dc_3 bristle-like, distance between Dc_2 to Dc_3 200-220 µm. Thoracic horn (Fig. 27) ellipse-like shaped, toothed apically and medially on one side.

Abdomen (Figs 28-35). Armament and distribution pattern of shagreen, patches of spinules and points, chaetotaxy and lateral setation of abdominal segments as illustrated in Fig. 28 (dorsal view: tergites, left, sternites, right) and Fig. 80 (lateral view). Distribution of lateral setae on segments I-VIII: I (2), II-IV (3), V-VIII (4). Tergite I bare. Transverse posterior margin of tergite II (Figs 28-29) armed with 2-3 rows of hooks, orally projecting and occupying about 60-65% of segment width. Anteromedian patches of spines present on tergites III-V (Fig. 28) is triangular and laterally extensive, becoming diamond-like shaped on tergite VI (Figs 28, 34, 81), size of spines of tergites III-IV (Figs 30-31) becoming gradually smaller on tergites V-VI (Figs 32-33). Posteromedian transverse patches of spines on tergites III-VI (Fig. 28) nearly interrupted medially, gradually more extensive laterally and almost reaching muscles marks, size of spines remains nearly similar. Posteromedian transverse rows of orally projecting small spines or pin-shaped (Figs 28, 30-32) are restricted to tergites III-V, occupying about 3/4 width of segments. Pedes spurii B on segment II weak but distinct. Pedes spurii A present on sternites IV-VI. Sternites I-II bare; field of shagreen and points present on anteromedian area of sternites III-VI; posterior transverse rows of spinules present on sternites V-VI. Apophyses markedly distinct only on tergites II-VI (Figs 28, 80). Anal segment (Figs 28, 35) 270-280 µm long, 320-330 µm maximum width, slightly narrowed towards apices; apical area densely covered with small spines placed near the posterior margin and between bases of macrosetae. Macrosetae 85-90 µm long, stout, pin-shaped and slightly curved apically, number of macrosetae can be occasionally reduced from 3 to 2. Genital sac 330-350 µm long, rounded apically and overreaching apical margin of anal lobe by 80-85 µm.

Larva: known but not described.

Cricotopus royanus sp. n.

Material examined

Holotype, **Continental France, Maritime Alps, S-E France, National Park of Mercantour.** Roya River, middle basin up to Breil-Sur-Roya village, alt. 350-800 m. Environmental data of water are: calcareous water, conductivity (Cd) 265-275 µS/cm; mean temperature (T°C) 12-16; pH 7.3-7.8. Pharate adult: 1 male, leg. J. Moubayed-Breil, 14.IX.2014. The holotype locality is situated in zone 10, after MOUBAYED-BREIL & ASHE (2016a).

Paratypes, **Continental France, Maritime Alps, National Park of Mercantour.** All leg. J. M-B. Same locality and date as holotype, pharate adult (2 males, 3 females), Pe (6 males, 10 females). Roya River, at Breil-Sur-Roya village, alt. 350-370 m, pharate adult (1 male, 2 females), Pe (5 males, 10 females). Bevera stream, middle basin at Sospel village, alt. 350-370 m; environmental data of water are: calcareous water (tufa concretions), Cd 780-790 µS/cm, T°C 17-21, pH 7.3-8.2; Pe (2 males, 2 females),

15.IX.2014. Guiou karstic stream, alt. 420-430 m: - lateral spring (Cd 295-297 µS/cm, T°C 12-14, pH 7.1-7.3; - Guiou stream (Cd 560-580 µS/cm, T°C 17-19 °C, pH 7.3-8.2; Pe (2 males, 1 female), 24.VI.2016. Levensa stream, spring zone at 'Notre-Dame-des-Fontaines', rhithral and waterfalls, alt. 750-800 m (Cd 100-105 µS/cm, T°C 8-9 °C), Pe (1 male, 1 female); middle basin, up to the 'Brigue village', alt. 700-760 m (Cd 278-280 µS/cm, T°C 12-15), Pe (2 males, 2 females). Caïros stream, middle basin, rhithral and waterfalls, alt. 550-750 m; lateral springs (Cd 295-305 µS/cm, T°C 9-11), Pe (1 male, 1 female); main stream (Cd 225-230 µS/cm, T°C 11-14), Pe (4 males, 6 females). Minière stream, middle basin, alt. 1600-1300 m; rhithral and waterfalls around the Gîte of 'Neige et merveilles' (T°C 9-10), 2 male adults, Pe (4 males, 3 females).

Holotype on 1 slide (male adult and its pupal skin) with 2 additional paratypes (male Pe) are deposited in the collections of the Zoologische Staatssammlung (ZSM), Munich, Germany. Remaining paratypes are deposited in the author's collection.

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

Etymology: the new species is named *C. royanus* sp. n. after the Roya River, which is situated in the National Park of Mercantour (Maritime Alps, S-E France). The type material was collected between St-Dalmas-de-Tende and Breil-sur-Roya at the altitude of 350-800 m.

Diagnostic characters

C. royanus sp. n. is a sister species of *C. nevadensis* which is described from the Sierra Nevada Mountains (S-E Spain). These two species can be easily confused because of the resemblance between some characters of the imagines (shape of inferior volsella) and pupal stages (shape of thoracic horn, morphology of anal lobe). However, *C. royanus* sp. n. can be easily separated from *C. nevadensis* on the basis of the following diagnostic characters.

- Adult male: general colour ground dark brown to blackish; distribution pattern of setae on median area of tergites II-IV: II (4), III (5), IV (5); tergite IX with 10 setae (5 on each side the median area), posterior margin bearing 2 distinct elongated and curved lobes projecting downwards (lobes are not fused); inferior volsella nearly globular, bent downwards at a right angle and bearing a distinct dorsal crest, ventral margin with a row of 4 strong posteriorly directed setae; gonostylus projecting apically, posterior margin sinuous and swollen.

- Adult female: last flagellomere blackish; shape of the 3 first segments which are fused one to another forming almost 1 single segment; distribution pattern of setae on median area of tergites II-IV (II, 3 setae; III 5, IV, 8); dorsomesal lobe straight proximally and concave distally; apodeme lobe broad basally, undulating with 2 peaks; ventrolateral lobe broadly projecting posteriorly; seminal capsule oval and sclerotized laterally except for the apical area; tergite IX bearing about 18-20 setae placed in 3 rows, posterior margin slightly rounded.

- Pupal exuviae: colouration contrasted whitish to blackish, sternites V-VII blackish, specimens collected at high altitude (up to 1300 m) are darker and more contrasting; granulation on cephalothorax covering almost the entire anteromedian area and thoracic suture; posteromedian area of cephalothorax bearing a characteristic blackish shading placed between Dc_3-Dc_4 and base of the antennal sheath; anteromedian area of sternites IV-VII densely covered with shagreen and small points; thoracic horn moderately toothed medially, distally and apically on one side; median patch of spines on tergite VI spinning top-like; posteromedian transverse patches of posteriorly projecting small spines nearly interrupted medially.

Male imago

(n = 5: 3 pharate male adults, 2 male adults; Figs 39-41, 43-46)

Medium to small sized species. Total length 3.60-3.80 mm. Wing length 2.60-2.70 mm. General colouration contrasting blackish to whitish including head, thorax, abdomen, legs and anal segment which is whitish to pale brown. Segments 1-12 of antennae distinctly ringed, median area pale brown, base and apex of each segment dark brown. Thorax contrasting with distinct blackish mesonotal stripes. Legs weakly spotted, distal half of femur and apex of all legs blackish. Tergites I-II whitish, remaining tergites (III-VIII) greenish to blackish; anal segment pale to clear brown. Specimens collected at high altitude (up to 1300 m) are darker and more contrasting.

Head. Eyes hairy, inner eye margin bare. Temporals 10-12 including 6-7 inner and 4-5 outer verticals. Clypeus trapezoidal, bearing 12-13 setae in 2 rows. Palp 5-segmented; length (µm) of palpomeres: 70, 53, 85, 105, 155; sensilla chaetica present on 2th and 4th palpomeres. Antenna 950-960 µm long, 13-segmented; antennal groove beginning on segment 3 and reaching ultimate flagellomere; ultimate flagellomere distinctly clubbed distally, bearing a brush of curved sensilla chaetica apically; first segment 65 µm long, segments 2-12 linear and sub-equal (35-40 µm long); last flagellomere 475-480 µm long. AR 1.05-1.10.

Thorax. Thoracic setae very small and nearly indistinct, acrostichals with 25-27, antepronotum with only 3 lateral antepronotal setae, dorsocentrals with 18-20 setae in 1-2 rows, prealars with 10-12 setae, preepisternum bare. Scutellum with 10 setae placed in 1 row (5 on each side of the median area). Wing. Brachiolum with 1 seta; distribution of setae on veins: R, 6-7; R_1, R_{2+3} and R_{4+5} bare. Squama with 10 setae in 1 row.

Legs. Tarsomere 4 of PI, PII and PIII respectively 105, 150 and 160 µm long, tarsomeres 4 and 5 of PII significantly sub-equal. Sensilla chaetica consistently present on tibia and tarsomeres 1-5 of all legs. Length (µm) and proportions of legs:

	fe	**ti**	**ta$_1$**	**ta$_2$**	**ta$_3$**	**ta$_4$**	**ta$_5$**	**LR**	**BV**	**SV**	**BR**
PI	695	685	325	195	165	105	105	0.47	3.00	4.25	1.40
PII	555	760	490	230	205	150	110	0.64	2.60	2.68	1.35
PIII	610	725	435	225	215	160	110	0.60	2.49	3.07	2.30

LR = Length of tarsomere ta1 divided by length of tibia (ti); BV = Combined length of femur (fe), tibia and ta1 divided by combined length of tarsomeres ta2-ta5; SV = Ratio of femur plus tibia to tarsomere ta1; BR = Ratio of longest seta of ta1 divided by minimum width of ta1, measured one third from apex.

Abdomen. Distribution pattern of setae on median area of tergites II-IV as illustrated in Fig. 41: II (4, 1 anteriorly and 3 posteriorly), III-IV (5, 2 anteriorly and 2 posteriorly), V (3, 1 anteriorly and 2 posteriorly). Hypopygium in dorsal (Fig. 43), ventral (Fig. 44) and lateral (Fig. 46) view. Anal point absent. Tergite IX in lateral (Fig. 39) and dorsal view (Fig. 40): posterior margin sub-rectangular dorsally (Figs 40, 43) ending with 2 posteriorly projecting curved lobes delimiting a proximal clear area; laterosternite (Fig. 43) lobe-like distinctly separated from tergite IX; 10 setae are placed in 2 rows bow-like on dorsal side of tergite IX (5 on each side of the median area), posterior row with 4 setae (2 on each side). Laterosternite IX with 3 setae; transverse sternapodeme and phallapodeme as in figure 44, sternapodeme orally produced, wider apically, bow-like shaped; phallapodeme hummer-like. Gonocoxite 175-180 µm long, apex rounded; both dorsal and ventral inner margins sinuous and distinctly bi-lobed, basal ventral lobe

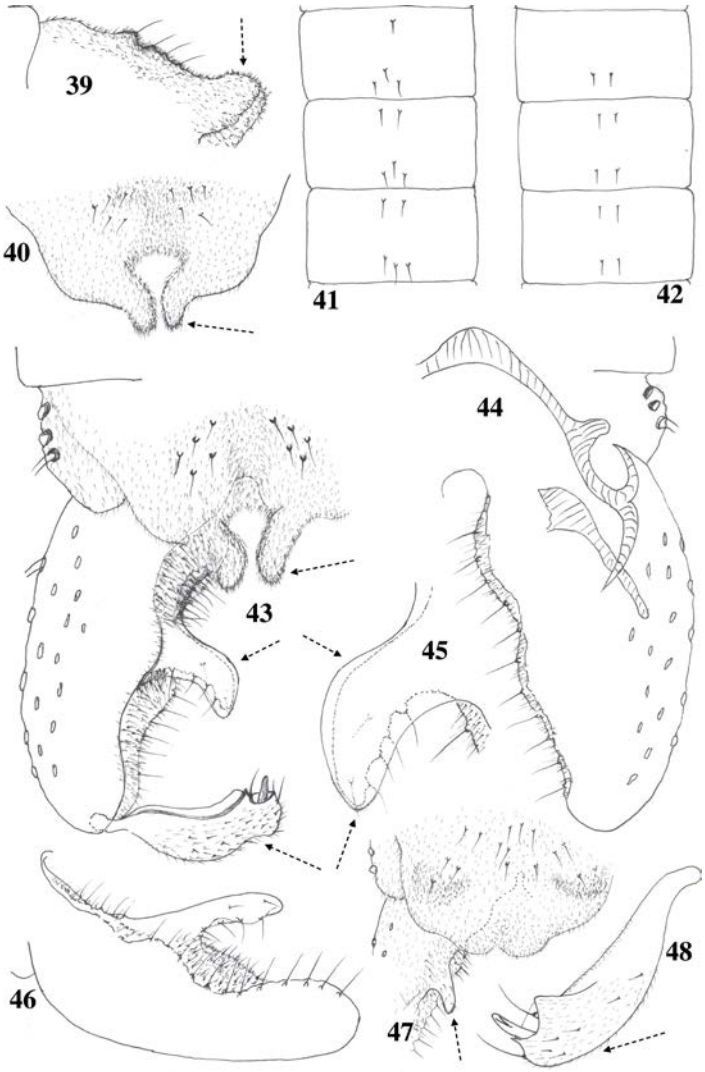
broader than distal one. Inferior volsella (Figs 43, 45-46) 30-35 µm long, slightly wider at base, broadly narrowed distally, maximum width at base 20-22 µm, minimum width 10-15 µm at apex; hyaline, nearly nose-like, abruptly bent downwards medially at a right angle; dorsal side bare, ventral side with 2 setae (1 medially and 1 distally); outer margin bare proximally and distally; inner ventral margin bearing a characteristic anterior crest and 4 downwardly directed setae; posterior margin of the crest is swollen medially and bearing 2 downwardly directed setae visible in lateral view (Fig. 46). Gonostylus (Fig. 43) 90-95 µm long, maximum width 35-40 µm, markedly projecting apically; basal margin distinctly swollen medially, anterior margin concave medially and bearing 2 orally directed strong setae placed on each side of the megaseta. Crista dorsalis tooth-like placed close to the megaseta. Megaseta 18-21 µm long and slender.

Female imago

(n = 2: 1 female pharate adult, 1 female adult; Figs 49-50, 53-58)

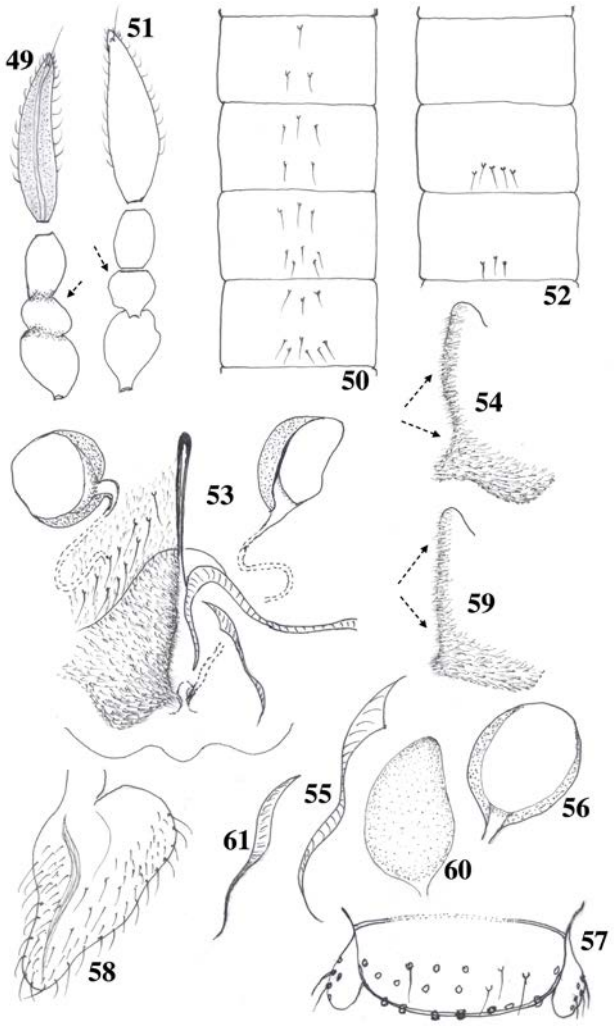
Medium to small sized species. Coloration as in the male adult except for the last flagellomere of antenna which is blackish. Total length 3.90-4.00 mm. Wing length 2.30-2.40 µm. Antenna length 400-410 µm, last flagellomere 120-125 µm long, remaining segments 280-285 µm long; AR 0.44. Head: eyes hairy; temporal setae 9-10, including 7 inner and 2-3 outer verticals. Clypeus with 18 setae placed on 3 rows (9 on each side of the median area). Palp 5-segmented; sensilla chaetica present on segments 3-5; length (µm) of segments: 60, 65, 110, 115, 175. Antenna (Fig. 49) 6-segmented; segments 1-3 distinctly fused forming almost one single segment; ultimate flagellomere weakly clubbed, gradually narrowed to tip with 1 preapical seta, apical part bearing a tuff of curved setae including several sensilla chaetica; antennal groove restricted to last flagellomere; antenna length 400-410 µm, last flagellomere 120-125 µm long, remaining segments 280-285 µm long; AR 0.44. Thorax: chaetotaxy as in the male. Wing: distribution of setae on veins: R, 7-8; R_1, 4-5 placed distally; R_{2+3} and R_{4+5} bare. Squama with 6-7 setae. Distribution pattern of setae on median area of tergites II-V as illustrated in Fig. 50: tergite II (3, 1 anteriorly and 2 posteriorly), III (5, 3 anteriorly and 2 posteriorly), IV (8, 3 anteriorly and 5 posteriorly), V (9, 3 anteriorly and 6 posteriorly).

Genitalia in dorsal and ventral view as illustrated in Fig. 53. Notum 135-140 µm long, rami indistinct. Gonapophysis VIII including ventrolateral, dorsomesal and apodeme lobes (Figs. 53-55). Sternite VIII with 24-26 setae (12-13 on each side of the notum); dorsomesal and ventrolateral lobes (Fig. 54), dorsomesal lobe slightly swollen proximally and markedly concave distally; ventrolateral lobe broadly projecting downwards; apodeme lobe (Fig. 55) 50-55 µm long, sinuous with 2 peaks, broad at base. Seminal capsules (Figs 53, 56) 85-90 µm long, maximum width 70 µm, sub-circular to sub-oval; sclerotized laterally and basally. Spermathecal ducts with loops and separate openings. Tergite IX (Fig. 57) rectangular, with 18-20 setae placed in 2-3 rows. Gonocoxite (Fig. 57) elongated lobe-like, bearing 5 short setae. Cercus (Fig. 58) normally developed, wide at bas and narrowed distally.



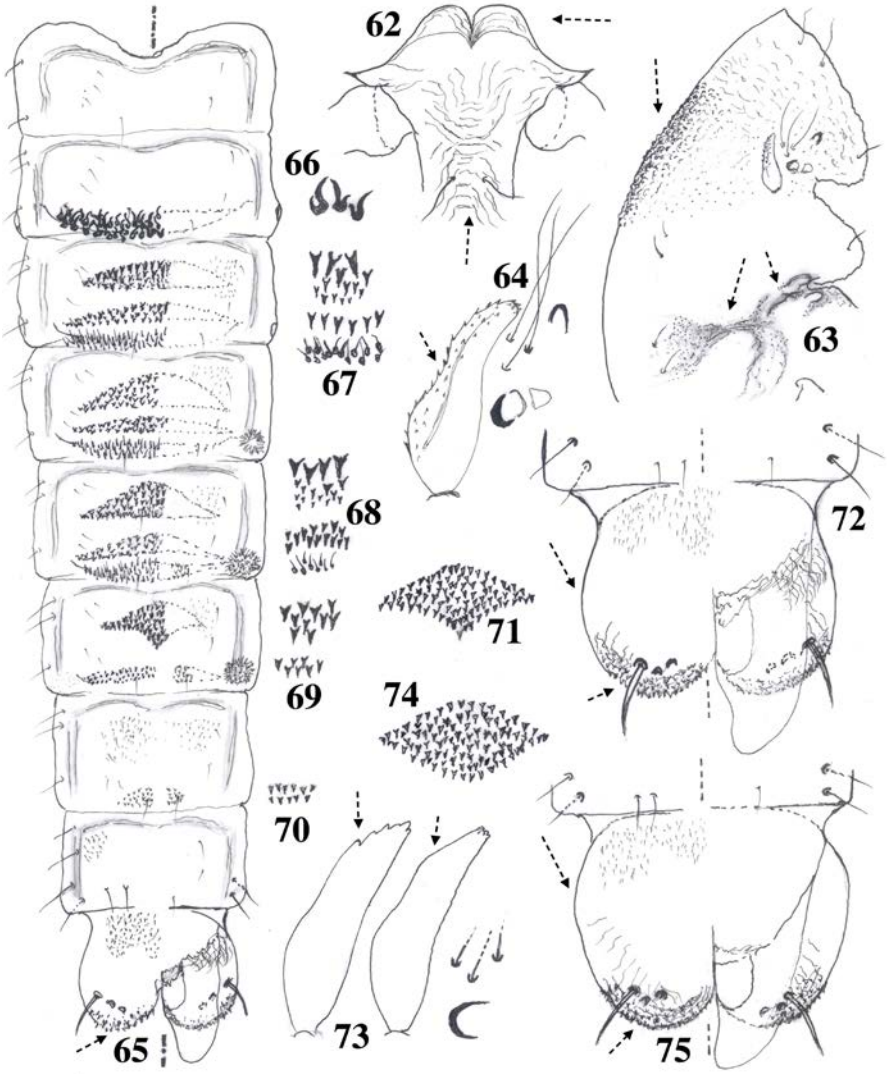
Figures 39-48. Male imago of *Cricotopus* spp. *C. royanus* sp. n.: tergite IX in lateral (39) and dorsal view (40); distribution pattern of setae on median area of tergites III-V (41). *C. nevadensis*: distribution pattern of setae on median area of tergites III-V (42), after CASAS & VILCHEZ-QUERO (1992). *C. royanus* sp. n.: hypopygium, dorsal (43) and ventral (44); inferior volsella (dorsal, 45); gonocoxite in lateral view (46). *C. nevadensis*: tergite IX and inferior volsella in dorsal view (47), right gonostylus (dorsal, 48), after CASAS & VILCHEZ-QUERO (1992).

Figures 39-48. Imago mâle de *Cricotopus* spp. *C. royanus* sp. n. : tergite IX en vues latérale (39) et dorsale (40) ; distribution des soies sur l'aire médiane des tergites III-V (41). *C. nevadensis* : distribution des soies sur l'aire médiane des tergites III-V (42), d'après CASAS & VILCHEZ-QUERO (1992). *C. royanus* sp. n. : hypopyge, vues dorsale (43) et ventrale (44) ; volselle inférieure en vue dorsale (45) ; gonocoxite en vue latérale (46). *C. nevadensis* : tergite IX et volselle inférieure en vue dorsale (47), gonostyle droit en vue dorsale (48), d'après CASAS & VILCHEZ-QUERO (1992).



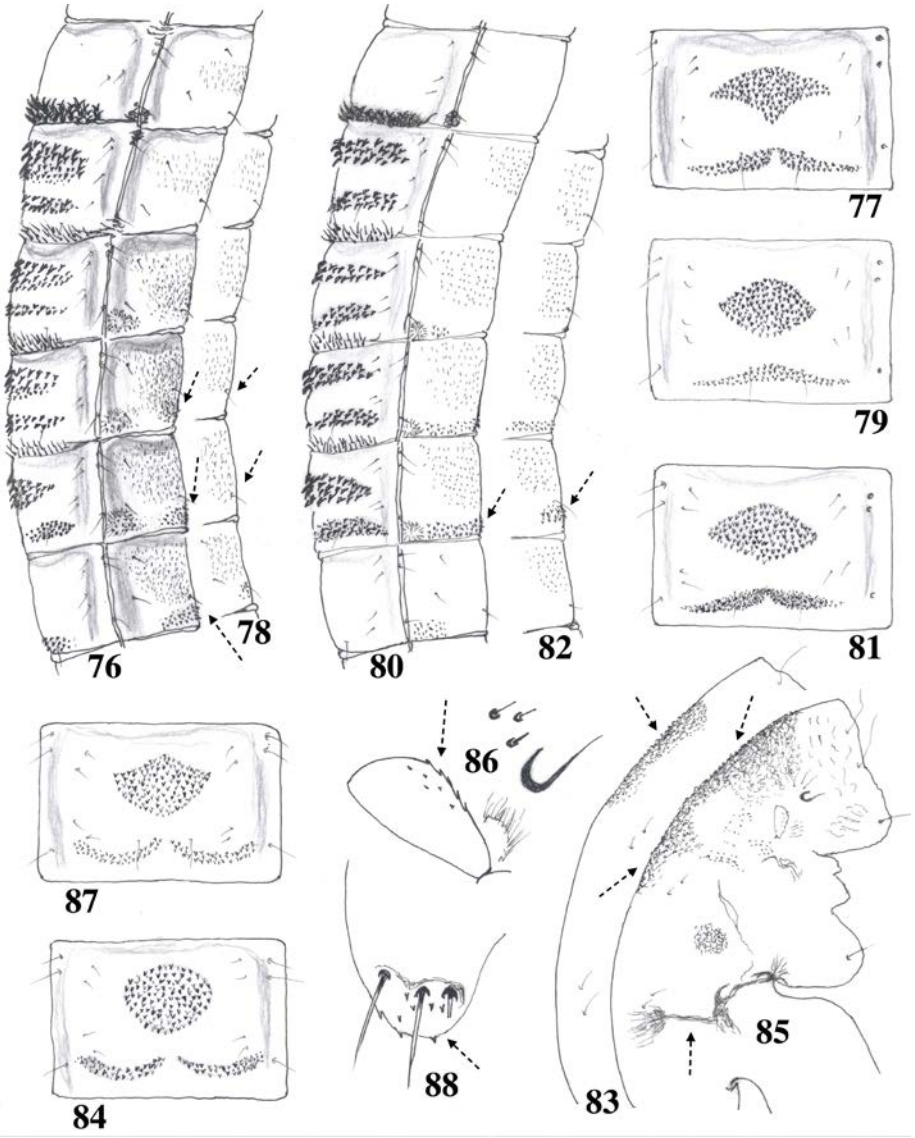
Figures 49-61. Female imago of *Cricotopus* spp. *C. royanus* sp. n.: segments 1-3 and last flagellomere of antenna (49), distribution pattern of setae on median area of tergites II-V (50). *C. nevadensis*: segments 1-3 and last flagellomere of antenna (51), distribution pattern of setae on median area of tergites II-IV (52), after CASAS & VILCHEZ-QUERO (1992). *C. royanus* sp. n.: genitalia, ventral and dorsal view including gonapophysis VIII, sternite VIII and seminal capsule (53); dorsomesal and ventrolateral lobes (54); apodeme lobe (55); seminal capsule (56); tergite IX (57); cercus (58). *C. nevadensis*: dorsomesal and ventrolateral lobes (59); seminal capsule (60); apodeme lobe (61), after CASAS & VILCHEZ-QUERO (1992).

Figures 49-61. Imago femelle de *Cricotopus* spp. *C. royanus* sp. n. : segments 1-3 et dernier flagellomère de l'antenne (49), distribution des soies sur l'aire médiane des tergites II-V (50). *C. nevadensis* : segments 1-3 et dernier flagellomère de l'antenne (51), distribution des soies sur l'aire médiane des tergites II-IV (52), d'après CASAS & VILCHEZ-QUERO (1992). *C. royanus* sp. n. : genitalia, vues ventrale et dorsale y compris le sternite VIII et la capsule séminale (53) ; lobe dorsomésal et ventrolatéral (54) ; lobe de l'apodème (55) ; capsule séminale (56) ; tergite IX (57) ; cercus (58). *C. nevadensis*: lobe dorsomésal et ventrolatéral (59), capsule séminale (60), lobe de l'apodème (61), d'après CASAS & VILCHEZ-QUERO (1992).



Figures 62-75. *Cricotopus* spp., male pupal exuviae. *C. royanus* sp. n.: frontal apotome (62); cephalothorax (63); thoracic horn (64); armament and chaetotaxy of abdominal segments I-IX, tergites (left) and sternites (right) (65); details of the hook rows on tergite II (66); details of armaments on tergites III and V-VII: III (67), V (68), VI (69) and VII (70); median patch of spines on tergite VI (71); anal segment, dorsal and ventral view (72). *C. nevadensis*: thoracic horn (73); median patch of spines on tergite VI (74); anal segment, dorsal and ventral view (75).

Figures 62-75. *Cricotopus* spp., exuvie nymphale mâle. *C. royanus* sp. n. : apotome frontale (62) ; céphalothorax (63) ; corne thoracique (64) ; ornementation et chaetotaxie des segments abdominaux I-IX, dorsalement et ventralement (65) ; détails de la rangée de crochets du tergite II (66) ; détails de l'ornementation des tergites III et V-VII : III (67), V (68), VI (69) et VII (70) ; détails du groupe d'épines sur l'aire médiane du tergite VI (71) ; segment anal en vues dorsale et ventrale (72). *C. nevadensis*: corne thoracique (73) ; détails du groupe d'épines sur l'aire médiane du tergite VI (74) ; segment anal en vues dorsale et ventrale (75).



Figures 76-88. *Cricotopus* spp., male pupal exuviae. Armament and chaetotaxy of abdominal segments II-VII in lateral view of: *C. royanus* sp. n. (76), *C. nevadensis* (78), *C. mantetanus* sp. n. (80), *C. tremulus* (82). Tergite VI of: *C. royanus* (77), *C. nevadensis* (79), *C. mantetanus* (81), *C. tremulus* (84). *C.* sp. 1, central Corsica (87). Cephalothorax of: *C. tremulus* (83), *C.* sp. 1 (85). Thoracic horn of *C.* sp. 1 (86). Anal lobe, left side of *C.* sp. 1 (88).

Figures 76-88. *Cricotopus* spp, exuvie nymphale mâle. Ornementation et chaetotaxie des segments abdominaux II-VII en vue latérale de : *C. royanus* sp. n. (76), *C. nevadensis* (78), *C. mantetanus* sp. n. (80), *C. tremulus* (82). Tergite VI de : *C. royanus* (77), *C. nevadensis* (79), *C. mantetanus* (81), *C. tremulus* (84), *C.* sp. 1, Corse centrale (87). Céphalothorax de : *C. tremulus* (83), *C.* sp. 1 (85). Corne thoracique de *C.* sp. 1 (86). Lobe anal, côté gauche de *C.* sp. 1 (88).

Male pupal exuviae

(n = 10; Figs 62-72, 76-77)

Coloration contrasted whitish to blackish in general; specimens collected at high altitude are darker and more contrasting. Frontal apotome wrinkled; cephalothorax brown to dark brown, wrinkled, granulose and bearing a characteristic posteromedian dark brown to blackish shading between Dc_3-Dc_4 and base of wing sheath; abdomen including anal segment contrasting whitish to blackish; dark brownish apophyses present on segments I-VIII; muscles marks distinct on segments I-VIII. Total length 3.70-3.90 mm. Frontal apotome (Figs 22-23) distinctly domed, frontal setae bristle-like, inserted on prefrons ventral to antennal sheaths, 70-80 µm long and separated by about 50-55 µm.

Cephalothorax (Figs 62-63). Thorax. Antepronotals 3 including 2 median anteporontals (130 and 140 µm long) and 1 lateral antepronotal 70-80 µm long; 1 prealar 60-70 µm long; precorneal setae nearly sub-equal 110-120 to 140-150 µm long; dorsocentrals length (in µm) of: Dc_1 50, Dc_2 90, Dc_3 85, Dc4 50; distance between Dc_2 to Dc_3 170-180 µm. Thoracic horn (Fig. 64) horn-like shaped, bi-lobed medially and toothed apically and medially on one side.

Abdomen (Figs 65-70). Armament and distribution pattern of shagreen, patches of spinules and points, chaetotaxy and lateral setation of abdominal segments as illustrated in Fig. 65 (dorsal view: tergites, left, sternites, right) and Fig. 76 (lateral view). Distribution of lateral setae on segments I-VIII: I (2), II-VI (3), VII (3-4), VIII (4). Tergite I bare. Transverse posterior margin of tergite II (Figs 65-66) armed with 2-3 rows of hooks, orally projecting and occupying about 60-70% of segment width. Anteromedian patches of spines present on tergites III-V (Fig. 65) is bow-like and laterally extensive, becoming spinning top-like shaped on tergite VI (Figs. 65, 71, 77); spines of tergites III-V (Fig. 67-68) consist of big and smaller spines becoming gradually smaller on tergites IV-V (Figs 67-68). Posteromedian transverse patches of spines on tergites III-VI (Fig. 65) continuous, extensive laterally and almost reaching muscles marks, size of spines remains nearly similar. Posteromedian transverse rows of orally projecting small spines or pin-shaped (Figs 65, 67-68) are restricted to tergites III-V, occupying about 3/4 width of segments. Pedes spurii B on segments II-III weak but distinct. Pedes spurii A present on sternites IV-VI. Field of shagreen and points: absent on sternite I; present on anteromedian area of sternites III-VII, becoming intense on sternites IV-V/VI (Fig. 76). Posteromedian transverse rows of spinules is distinctly present on sternites V-VII. Apophyses markedly distinct on tergites I-VIII (Figs 65, 76). Anal lobe (Figs 65, 72) 260-270 µm long, 300-310 µm maximum width, slightly narrowed proximally and wider towards apices; apical area circular, posterior margin broadly rounded, densely covered with small spines placed near the posterior margin and between base of macro-setae. Macrosetae 70-90 µm long, stout, pin-shaped and slightly curved apically, number of macrosetae can be occasionally reduced from 3 to 2. Genital sac 315-320 µm long, narrowed apically and overreaching apical margin of anal lobe by 55-60 µm.

Larva: known but not described.

Cricotopus sp. 1

(Male pupal exuviae: 1 male, 1 female; Figs 85-88)

Coloration contrasted brown to dark brown with blackish pedes spurii B. Frontal apotome wrinkled and granulose; cephalothorax brown to dark brown, densely wrinkled and granulose anteromedially between the thoracic suture and the thoracic horn, presence of a characteristic

posteromedian blackish shading between Dc_3-Dc_4 and base of wing sheath; area of Pedes spurii B on segments I-III/IV distinctly dark brown to blackish. Abdomen including anal segment contrasting brown to dark brown; apophyses brownish on tergites and sternites; muscles marks distinct on segments I-VIII. Total length 4.50 mm. Cephalothorax (Fig. 85). Frontal apotome moderately domed, frontal setae bristle-like, inserted on prefrons ventral to antennal sheaths; frontal setae 90-95 µm long and separated by 105 µm. Thorax with: 3 antepronotals including 2 median antepronotals 115-125 µm long and 1 lateral antepronotal 85 µm long; 1 prealar 65 µm long; precorneal setae nearly sub-equal 110-115 µm long; dorsocentrals (length in µm) Dc_1- Dc_2 about 35, Dc3-Dc4 sub-equal 50-60, distance between Dc_3 and Dc_4 230 µm. Thoracic horn (Fig. 86) foliate to sub-triangular, obliquely truncate apically, wider at apex and toothed laterally and medially on one side.

Abdomen. Distribution of lateral setae on segments I-VIII: I (2), II-VII (3), VIII (4). Tergite and sternite I bare, tergites VII-VIII with faint shagreen. Transverse posterior margin of tergite II armed with 2-3 rows of hooks, orally projecting and occupying about 66% of segment width. Anteromedian patches of spines present on tergites III-V, sub-triangular to bow-like and laterally extensive, becoming chandelier-like shaped on tergite VI (Fig. 87); spines of tergites III-V composed of similar sized spines becoming gradually smaller on tergites IV-V. Posteromedian transverse patches of spines on tergites III-VI continuous and extensive laterally on tergites III-V, becoming interrupted medially on tergite VI; almost reaching muscles marks on tergites III-V, size of spines remains nearly similar. Posteromedian transverse rows of orally projecting small spines or pin-shaped are restricted to tergites III-V, occupying about 3/4 width of segments. Pedes spurii B present on segments II-III/IV. Pedes spurii A present on sternites IV-VI. Field of shagreen and points: absent on sternite I, faint on anteromedian area of sternites II-VII. Posteromedian transverse rows of spinules is distinctly present on sternites V-VI. Apophyses markedly distinct on tergites I-VI and sternites II-VI. Anal segment (*Cricotopus* type) broad proximally and slightly narrowed towards apices; apical area not broad, weakly covered with small spines placed near the posterior margin and between base of macrosetae. Macrosetae 110 µm long, stout, pin-shaped and slightly curved apically.

4. Taxonomic position

The male adult and pupal exuviae of the two new described species and the new morphotype *C.* sp. 1 belong to the *tremulus*-group, which was emended by Hirvenoja (1973), and then, modified by Casas & Vichez-Quero (1973), HIRVENOJA & MOUBAYED (1989) and MOUBAYED-BREIL & ASHE (2011). According to HIRVENOJA (1973, pages 184-185), HIRVENOJA & MOUBAYED (1989), CASAS & VILCHEZ-QUERO (1992), MOUBAYED-BREIL & ASHE (2011) MAKARCHENKO & MAKARCHENKO 2016, the main differentiating morphological features in the male and female adults and pupal exuviae of the *tremulus*-group can be supplemented by the following summarized combination of characters:

- In the male adult: tergites I-II whitish; tergites III-VIII dark green to blackish; distribution pattern of setae on median area of tergites; gonocoxite with or without a dorsal sub-triangular projection placed little upper to inferior volsella; inferior volsella hyalin, unilobed and lacking notch, long nose-like lobe to foot-shaped, moderately or distinctly elongated and projecting downward.

- In the female adult: colour ground of the antenna, especially the last flagellomere; shape and structure of the first 3 antennal segments which are fused in general; distribution pattern of setae on median area of tergites II-V; morphology of the gonapophysis VIII including that of seminal capsules and lobes; shape of tergite IX and gonocoxite.

- In the pupal exuviae: frontal setae inserted on prefrons, ventral to antennal sheaths; thoracic horn lobe-like, small or elongated, foliate to ellipse-like, smooth or weakly spinulated medially and laterally on one side; cephalothorax with or without a distinct transversal posteromedian blackish shading placed between Dc_3-Dc_4 and base of wing sheath; fields of spinulae on tergites III-V well separated; shape of median patch of spines on tergite VI; anal lobe with or without a distinct dense to sparse rows of small spines on its apical part; macrosetae pin-shaped, slightly curved apically and short (<0.5 anal lobe length).

Therefore, based on the previous diagnosis of characters, the *tremulus*-group currently includes 4 valid known species from Europe: *C. nevadensis*, *C. tremulus*, *C. mantetanus* sp. n. and *C. royanus* sp. n. The two new described species *C. mantetanus* sp. n. and *C. royanus* sp. n. and the new morphotype *C.* sp. 1 can be separated from other known European members of the *tremulus*-group by a combination of the following characters found in the male adult and male pupal exuviae.

***C. mantetanus* sp. n.**

C. mantetanus sp. n. is easily separated from other members of the *tremulus*-group and in particular from its nearest species *C. tremulus* on the basis of the main following distinguishing characters.

In the male adult:

- distribution pattern of setae on the median area of tergites II-V as illustrated in Fig. 3 for *C. mantetanus* sp. n. and in Fig. 5 for *C. tremulus*;

- distribution of setae on tergite IX in *C. mantetanus* sp. n. (Figs 2, 6), differently figured in *C. tremulus* (Fig. 4);

- inferior volsella broad and bearing stout dorsal setae on outer margin in *C. mantetanus* sp. n. (Figs 6, 8-9) while it is slender and lacking dorsal setae on outer margin in *C. tremulus* (Fig. 10; Figs. 112.5-112.6, HIRVENOJA 1973);

- gonostylus projecting apically in *C. mantetanus* sp. n. (Figs 6, 9), normally developed and lacking projection apically in *C. tremulus* (Fig. 11; Fig. 112.5, HIRVENOJA 1973).

In the female adult:

- segments 1 and 2 of antenna elongated in *C. mantetanus* sp. n. (Fig. 12), closed firmly in *C. tremulus* (Fig. 14);

- distribution pattern of setae on the median area of tergites II-V is differently figured in *C. mantetanus* sp. n. (Figs 13) than in *C. tremulus* (Fig. 15);

- seminal capsules laterally and apically sclerotized in *C. mantetanus* sp. n. (Fig. 16), entirely sclerotized in *C. tremulus* (Fig. 23; Fig. 113.6, HIRVENOJA 1973) and markedly cross-like in *C. levantinus* (Fig. 24, *levantinus*-group);

- dorsomesal lobe concave distally in *C. mantetanus* sp. n. (Fig. 18), swollen in *C. tremulus* (Fig. 22); ventrolateral lobe broadly projecting in *C. mantetanus* sp. n. (Fig. 18), linear in C. *tremulus* (Fig. 22).

In the pupal exuviae:

- thoracic horn ellipse-like, laterally and apically toothed in *C. mantetanus* sp. n. (Fig. 27), entirely smooth and lobe to balloon-like in *C. tremulus* (Fig. 36; Fig. 113.3, HIRVENOJA 1973);

- granulation on cephalothorax dense in *C. mantetanus* sp. n. (Fig. 26), very weak to absent in *C. tremulus* (Fig. 83);

- posteromedian blackish shading extending between Dc_3-Dc_4 and base of wing sheath present in *C. mantetanus* sp. n. (Fig. 26), indistinct to absent in *C. tremulus* (Fig. 83);

- median patch of spines on tergite VI diamond-like in *C. mantetanus* sp. n. (Figs 34, 81), rounded in *C. tremulus* (Figs 37, 84);

- apical part of anal lobe strongly toothed in *C. mantetanus* sp. n. (Fig. 35), weakly toothed in *C. tremulus* (Fig. 38, Fig. 113.2, HIRVENOJA 1973).

***C. royanus* sp. n.**

C. royanus sp. n. is considered as a sister species of *C. nevadensis* which is only known from S-E Spain (Sierra-Nevada) and Portugal. Despite the resemblance of some characters found in the male imagines (inferior volsella) and pupal stages (thoracic horn, anal lobe) these two species can be easily separated on the basis of the following main distinguishing characters.

In the male adult:

- distribution pattern of setae on the median area of tergites II-IV as illustrated in Fig. 41 for *C. royanus* sp. n. and in Fig. 42 for *C. nevadensis*;

- shape and distribution of setae on tergite IX in *C. royanus* sp. n. (Figs 40, 43), differently figured in *C. nevadensis* (Fig. 47);

- posterior margin bearing 2 posteriorly projecting curved lobes in *C. royanus* sp. n. (Figs 40, 43), broadly bilobed in *C. nevadensis* (Fig. 47);

- inferior volsella bent downwards at a right angle (Figs 43, 45) and broader in *C. royanus* sp. n., abruptly bent downwards from its base at an acute angle and weaker in *C. nevadensis* (Fig. 47);

- gonostylus projecting apically in *C. royanus* sp. n. (Fig. 43), not projecting apically (normally ending) in *C. nevadensis* (Fig. 48; Figs 1A-1B, CASAS & VILCHEZ-QUERO 1992).

In the female adult:

- segments 1-3 of antenna entirely fused in *C. royanus* sp. n. (Fig. 49), distinctly separated in *C. nevadensis* (Fig. 51; Fig. 2D, CASAS & VILCHEZ-QUERO 1992);

- distribution pattern of setae on the median area of tergites II-IV is differently figured in *C. royanus* sp. n. (Fig. 50), than in *C. nevadensis* (Fig. 52);

- seminal capsules sub-circular, laterally and basally sclerotized in *C. royanus* sp. n. (Figs 53, 56), entirely sclerotized in *C. nevadensis* (Fig. 60; Fig. 2A, CASAS & VILCHEZ-QUERO 1992);

- dorsomesal lobe concave distally in *C. royanus* sp. n. (Fig. 54), linear in *C. nevadensis* (Fig. 59; Fig. 2A, CASAS & VILCHEZ-QUERO 1992);

- ventrolateral lobe distinctly projecting in *C. royanus* sp. n. (Fig. 54), weakly swollen in *C. nevadensis* (Fig. 59).

In the pupal exuviae:

- colour contrasted whitish to blackish becoming darker in specimens collected in high altitude for *C. royanus* sp. n., brown to dark brown and not contrasted in *C. nevadensis*;

- thoracic horn apically and laterally toothed on one side in *C. royanus* sp. n. (Fig. 64), only toothed apically, occasionally toothed pre-apically on one side in *C. nevadensis* (Fig. 73; Fig. 4F, CASAS & VILCHEZ-QUERO 1992);

- granulation on anteromedian area of cephalothorax dense in *C. royanus* sp. n. (Fig. 63), very weak in *C. nevadensis* (Fig. 4E, CASAS & VILCHEZ-QUERO 1992);

- posteromedian blackish shading extending between Dc_3-Dc_4 and base of wing sheath distinctly present in *C. royanus* sp. n. (Fig. 63), apparently indistinct in *C. nevadensis* (not illustrated in Fig. 4E, CASAS & VILCHEZ-QUERO 1992);

- median patch of spines on tergite VI spinning top-like in *C. royanus* sp. n. (Figs 71, 77), sub-oval to nearly diamond-like in *C. nevadensis* (Figs 74, 79; Fig. 3A, CASAS & VILCHEZ-QUERO 1992);

- anal lobe *nevadensis*-type, rounded in *C. royanus* sp. n. (Fig. 72), sub-trapezoidal in *C. nevadensis* (Fig. 75; Fig. 4D, CASAS & VILCHEZ-QUERO 1992).

The main differentiating morphological features found in the male adults and pupal exuviae of the six treated species can be supplemented or improved based on the combination of characters summarized in the following key to male adults and pupal exuviae of known species of *Cricotopus* (*Cricotopus*) *tremulus*-group from the western Palaearctic Region. Nevertheless, it is not feasible at present to provide a definitive and complete key for pupal exuviae, until more additional material of the *tremulus*-group can be examined.

Key to male adults and pupal exuviae of known species of *Cricotopus* (*Cricotopus*) *tremulus*-group from the western Palaearctic Region

Male adults

1. - Gonocoxite bearing a distinct sub-triangular projection placed dorsally little upper to inferior volsella (Figs 1, 18, 20, MAKARCHENKO & MAKARCHENKO 2016) …..……. 2

- Gonocoxite lacking a such dorsal projection (Figs 6, 8, 9, 43, 46), or bearing a slightly protruding rounded projection (Fig. 1A, CASAS & VILCHEZ-QUERO 1992; Fig. 112.6, HIRVENOJA 1973)……3

2. - Inferior volsella nose-like, wider at base and broadly narrowed distally, distinctly bent downwards at a right angle; metanotal vittae distinctly expressed and contrasting, distal area of metanotum yellowish (Figs 10-11, MAKARCHENKO & MAKARCHENKO 2016); gonostylus slightly projecting apically; crista dorsalis tooth-like and pointed apically (Fig. 1, MAKARCHENKO & MAKARCHENKO 2016) ……..……..... *C. leleji*

- Inferior volsella long foot-shaped, uniformly elongated from base to apex, moderately bent downwards; metanotal vittae indistinct and not expressed, distal area of metanotum dark brown (Figs 12-13, MAKARCHENKO & MAKARCHENKO 2016); gonostylus not projecting apically (Figs 18-20, MAKARCHENKO & MAKARCHENKO 2016); crista dorsalis sub-triangular and distinctly broad …….. *C. storozhenkoi*

3. - Gonostylus projecting apically, posterior margin sinuous and distinctly swollen medially (Figs 6, 9); gonocoxite lacking dorsal projection above the inferior volsella; inferior volsella with or without strong dorsal setae on outer margin, dorsal setae present or absent, dorsal crest present or absent, ventral margin with or without a row of strong posteriorly directed setae 4

- Gonostylus not projecting apically, posterior margin not sinuous and weakly swollen medially (Figs 11, 48); gonocoxite bearing a rounded dorsal projection above the inferior volsella; inferior volsella lacking strong dorsal setae on outer margin, dorsal crest absent, inner ventral margin without a row of strong posteriorly directed setae..……...….5

4. - Inferior volsella nose-like, bearing 2 strong dorsal setae on outer margin, dorsal crest absent, presence of 6-7 small setae on dorsal area, distinctly bent downwards at a right angle (Figs 6, 8-9), wider at base and broadly narrowed distally, inner ventral margin lacking a row of strong posteriorly directed setae; metanotal vittae well expressed, distinctly contrasting blackish to brown, distal area of metanotum yellowish; ventral inner margin of gonocoxite slightly sinuous and lacking lobes…….……. *C. mantetanus* sp. n.

- Inferior volsella long foot-shaped, lacking strong dorsal setae on outer margin, dorsal crest present, dorsal setae on dorsal area absent, slightly bent downwards at a right angle (Figs 43, 45-46), uniformly elongated from base to apex and broadly narrowed distally, ventral margin bearing a row of strong posteriorly directed setae; metanotal vittae dark brown, indistinct and not expressed, distal area of metanotum dark brown; ventral inner margin of gonocoxite sinuous and distinctly bi-lobed…….……...…...*C. royanus* sp. n.

5. - Inferior volsella abruptly bent downwards from its base at an acute angle (Fig. 47; Figs 1A-1B, CASAS & VILCHEZ-QUERO 1992), gradually and moderately narrowed distally, outer margin lacking dorsal setae, presence of 4 small setae on dorsal area, ventral area bearing 3 small posteriorly directed setae; metanotal vittae dark brown to blackish and indistinct, distal area of metanotum dark brown ……..……*C. nevadensis* (Spain, Portugal)

- Inferior volsella smoothly bent from its base (Fig. 10; Figs 112.5-112.6, HIRVENOJA 1973), almost uniformly elongated distally, outer margin bearing dorsal setae, dorsal area bearing occasionally 1-2 small setae, ventral area lacking posteriorly directed setae; metanotal vittae well expressed, distinctly contrasting blackish to brown, distal area of metanotum brownish (Figs 112.1-112.2, HIRVENOJA 1973) ……..…….…….. *C. tremulus*

Male pupal exuviae

1. - Thoracic horn about three times or less than two times as long as broad, balloon, lobe-like, foliate, ellipse-like; entirely smooth or toothed distally on one side (Figs 27, 36, 64, 73; Fig. 113.3, HIRVENOJA 1973; Figs 21-24, 28-30, MAKARCHENKO & MAKARCHENKO 2016)..... 2

- Thoracic horn more than five times as long as broad, elongated lobe-like, moderately toothed and spinulated medially and distally on one side (Figs 2-4, MAKARCHENKO & MAKARCHENKO 2016); anal lobe of *tremulus*-type, progressively narrowed distally with rounded apical margin, moderately covered with small spines placed near the base of macrosetae (Figs 35, 38, 88; Fig. 113.2, HIRVENOJA 1973; Fig. 15, MAKARCHENKO & MAKARCHENKO 2016); median patch of spines on tergite VI oval (Fig. 15, MAKARCHENKO & MAKARCHENKO 2016) …..…… *C. leleji*

2. - Anal lobe of *tremulus*-type, narrowed distally, entirely smooth or moderately to weakly covered with small spines placed near the apical margin (Figs 35, 38, 88; Fig. 113.2, HIRVENOJA 1973; Fig. 15, MAKARCHENKO & MAKARCHENKO 2016) ……..…….. 3

- Anal lobe of *nevadensis*-type (Figs 72, 75), distinctly broad and widely rounded apically, densely or sparsely covered with rows of small spines placed near the apical margin and between base of macrosetae ……..…...…….4

3. - Median patch of spines on tergite VI diamond-like (Figs 34, 81) or chandelier shaped (Fig. 87); thoracic horn ellipse-like (Fig. 27) or foliate and obliquely truncate apically (Fig. 86), toothed apically and medially on one side..…….……..…..5

- Median patch of spines on tergite VI markedly circular to sub-circular (Figs 37, 84; Fig. 113.5, HIRVENOJA 1973; Fig. 32, MAKARCHENKO & MAKARCHENKO 2016); thoracic horn small balloon-like, little elongated lobe, entirely smooth (Fig. 36; Fig. 113.3, HIRVENOJA 1973)……..6

4. - Sternites IV-VII blackish (Figs 65, 76), anteromedian area of sternites IV-VII densely covered with shagreen and points (Fig. 76); posteromedian transverse rows of small spines present on sternites V-VII; thoracic horn (Fig. 64) moderately toothed medially, distally and apically on one side; median patch of spines on tergite VI spinning top-like (Figs 71, 77); posteromedian transverse patches of posteriorly projecting small spines (Figs 28, 81) interrupted medially ……..…..... *C. royanus* sp. n.

- Sternites IV-VII pale brown (Fig. 78; Fig. 3B, CASAS & VILCHEZ-QUERO 1992), anteromedian area weakly covered with shagreen and small points (Fig. 78); posteromedian transverse rows of small spines only present on sternite VII (Fig. 78); thoracic horn only toothed preapically to apically on one side (Fig. 73; Fig. 4F, CASAS & VILCHEZ-QUERO 1992); median patch of spines on tergite VI sub-oval to nearly diamond-like (Figs 74, 79; Fig. 3A, CASAS & VILCHEZ-QUERO 1992); posteromedian transverse patches of posteriorly projecting spines continuous (Fig. 79; Fig. 3A, CASAS & VILCHEZ-QUERO 1992) ..……..……..*C. nevadensis*

5. - Thoracic horn ellipse-like shaped (Fig. 27) or foliate and obliquely truncate apically (Fig. 86), toothed apically and medially on one side…..……..……...…. *C. mantetanus* sp. n.

- Thoracic horn foliate to sub-triangular (Fig. 86), obliquely truncate apically, wider at apex and toothed laterally and medially on one side…..……. *Cricotopus* sp. 1 (Corsica)

6. - Thoracic horn small sized, small lobe to balloon-like, moderately elongated, entirely smooth (Fig. 36; Fig. 113.3, HIRVENOJA 1973); sternites IV-VII pale to pale brown (Fig. 82); anteromedian area of sternites V-VII weakly covered with shagreen and small points (Fig. 82); posteromedian transverse rows of small spines only present on sternites V-VI (Fig. 82); ……..... *C. tremulus*

- Thoracic horn medium sized, horn-shaped to lobe-like, distinctly elongated, weakly toothed or smooth (Figs 21-24, 28-30, MAKARCHENKO & MAKARCHENKO 2016); posteromedian transverse rows of small spines on sternites V-VI is not figured in MAKARCHENKO & MAKARCHENKO (2016) ..... *C. storozhenkoi*

5. Ecology and geographical distribution

Male and female pharates adults and associated pupal exuviae of *C. mantetanus* sp. n. and *C. royanus* sp. n. were collected in the upper and middle basins of high to middle mountain springs and streams located in Eastern Pyrenees and the Maritime Alps. Both species are confined to

cold and stenothermic mountain streams (crystalline water for *C. mantetanus* sp. n.; calcareous water for *C. royanus* sp. n.). Localities where the larval, imagines and pupal material of the two new species and the new morphotype consist of shaded pristine helocrenes and rhithral of cold stenothermic mountain streams including small waterfalls and riffles on stony to gravely and sandy substrata. Bryocolous and hygropetric lotic habitats enriched with rocks and stones densely covered by microalgae represent the most common and favored aquatic areas for larval populations in both Pyrenean and Alpine localities. Microalgae consist of Chlorophyceae, Cyanophyceae (*Nostoc parmelioides*), Xanthophyceae and occasionally the red alga *Hildenbrundia rivularis*, which is only present in some karstic streams (springs and rhithral) often located in the upper basin of the Roya River. The two new species and the two new morphotypes are typically representatives of helocrenes and thus belong to the crenobiontic and crenophilous community of species as documented by LINDEGAARD (1995). Imagines of both *C. mantetanus* sp. n. and *C. royanus* sp. n. are considered as potential hosts of water mites: parasitism is often observed during the late spring period. Emergence for *C. mantetanus* sp. n. is mainly reported in summer and autumn. That of *C. royanus* sp. n. is recorded from May till September-October. The morphotype *C.* sp. 1 is only obtained in the late spring. Colour of imagines and pupal stages of *C. royanus* sp. n. is generally contrasted whitish to blackish, becoming darker in high altitude areas.

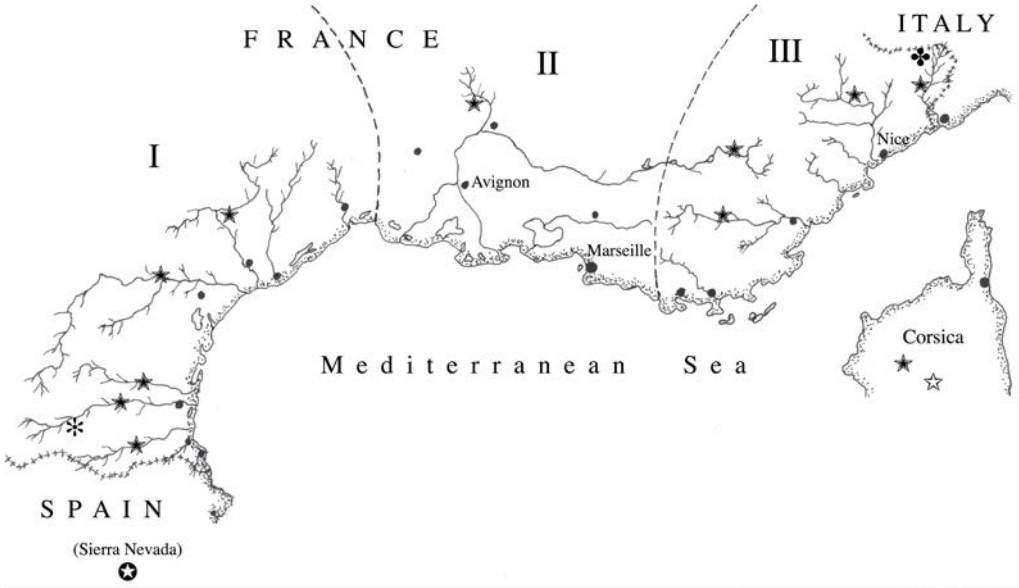


Figure 89. Geographical distribution of the five currently known *Cricotopus* taxa/species of the *tremulus*-group in the coastal Mediterranean ecosystem of continental France, Corsica and Spain: *C. mantetanus* sp. n. (✻), *C. royanus* sp. n. (✤), *C. tremulus* (★), *C. nevadensis* (✪), *C.* sp. 1 (☆). Other known taxa from southern France and Corsica include: *Potthastia dominicii, Rheocricotopus thomasi, Trissocladius orsinii*, Orthocladiinae genus. n., sp. n; *Rheotanytarsus dactylophoreus*. Delimitation of the three biogeographic zones (I, II and III), after MOUBAYED et al. (2000).

Figure 89. Distribution géographique des cinq taxons/espèces appartenant au genre *Cricotopus*, groupe *tremulus* dans l'écosystème méditerranéen côtier de France continentale, Corse et Espagne : *C. mantetanus* sp. n. (✻), *C. royanus* sp. n. (✤), *C. tremulus* (★), *C. nevadensis* (✪), *C.* sp. 1 (☆). Autres taxons connus du Sud de la France continentale et de Corse : *Potthastia dominicii, Rheocricotopus thomasi, Trissocladius orsinii*, Orthocladiinae genus. n., sp. n ; *Rheotanytarsus dactylophoreus*. Délimitation des trois zones biogéographiques (I, II et III), d'après MOUBAYED et al. (2000).

The two new described *Cricotopus* species are restricted to the continental Province of the Tyrrhenian Region. While *C. mantetanus* sp. n is exclusively occurring in the siliceous upper basin of both Soques and Alemany streams (Nature Reserve of Mantet, Eastern Pyrenees, S-France, alt. 1600-2000 m, Photos 1, 2), *C. royanus* sp. n. is apparently confined to some calcareous rivers and mountain streams located in south eastern France (upper and middle basins of the Roya River and its tributaries, National Park of Mercantour, Maritime Alps, S-E France, alt. 350-1600 m, Photos 3, 4). This indicates and highlights the importance of some Mediterranean mountain range in the preservation and persistence of autochthonous relic species, which appear as cold enclaves throughout the Mediterranean coastal ecosystem (MYERS et al. 2000, MOUBAYED-BREIL 2008, GIUDICELLI & OLIVARI 2010, MOUBAYED-BREIL & ASHE 2013, 2015a, 2015b, 2015c, 2016). Such endangered communities, are generally composed of relevant biogeographic representative and bio-indicator elements of the global warming and climate change, which deserve greater attention, protection and consideration. In addition, these habitats consist of endangered hotspots of diversity similar to what is found in many coastal ecosystems around the world (MOUBAYED-BREIL 2008, MOUBAYED-BREIL et al. 2013, MOUBAYED-BREIL & ASHE 2015a, MOUBAYED-BREIL & ASHE 2012, 2016, MOUBAYED-BREIL & ORSINI 2016). Their biogeographic significance is still underestimated and merits therefore greater attention, protection and preservation in the years to come.

Geographical distribution for the five actually known *Cricotopus* taxa/species of the *tremulus*-group in the Tyrrhenian subregion is provided in Figure 89. The currently two new described species (*C. mantetanus* sp. n. and *C. royanus* sp. n.) and the new morphotypes (*C.* sp. 1, *C.* sp. 2) are believed to characterize the Tyrrhenian Region where are reported other Tyrrhenian elements previously documented by MOUBAYED-BREIL & ASHE (2012, 2015a, 2016a), MOUBAYED-BREIL & ORSINI (2016) and MOUBAYED-BREIL (2016): *Potthastia dominicii* Moubayed & Orsini, 2016; *Rheocricotopus thomasi* Moubayed-Breil, 2016; *Trissocladius orsinii* Moubayed-Breil & Ashe, 2015; *Rheotanytarsus dactylophoreus* Moubayed-Breil, Ashe & Langton, 2012 and Orthocladiinae, genus nov., sp. nov. In addition the occurrence of all these new rheophilic species in both continental and insular Tyrrhenian Provinces reinforces biogeographic affinities, in one hand between the continental and insular Tyrrhenian Provinces and in another hand between the Iberian Peninsula, Eastern Pyrenees, Maritime Alps and the Italian Peninsula. Moreover, their presence in the later cited areas indicates that it is apparently more widespread in similar cold mountain springs and streams of the Tyrrhenian sub-region. Therefore, these species can be expected to occur in other similar geographic areas of the western Mediterranean basin, including for example similar high altitude pristine streams located in Spain or Italy.

Encountered species in the same localities as *C. mantetanus* sp. n. and *C. royanus* sp. n. include: *Boreoheptagyia legeri* (Goetghebuer, 1933); *B. rugosa* Saunders, 1930; *Diamesa cinerella* Meigen, 1835; *D. zernyi* Edwards, 1933; *D. lateralis* (Goetghebuer, 1921); *D. modesta* Serra-Tosio, 1968; *D. thomasi* Serra-Tosio, 1970; *D. tonsa* (Haliday, 1856); *Pseudodiamesa nivosa* (Goetghebuer, 1958); *P.* sp.1; *Pseudokiefferiella parva* (Edwards, 1932); *Bryophaenocladius aestivus* (Brundin, 1947); *B. nidorum* (Edwards, 1929); *B. subvernalis* (Edwards, 1929); *Cardiocladius fuscus* Kieffer, 1924; *Chaetocladius perennis* (Meigen, 1830); *Corynoneura celtica* Edwards, 1924; *Cricotopus annulator* Goetghebuer, 1927; *C. lanzavecchiai* Rossaro, 1990; *C. lygropis* Edwards, 1929; *C. spiesi* Ashe & O'Connor, 2012; *Eukiefferiella coerulescens* (Kieffer, 1926); *E. fittkaui* Lehmann, 1972; *E. minor* (Edwards, 1929); *E. pseudomontana* Goetghebuer, 1935; *Heleniella ornaticollis* (Edwards, 1929); *H. serratosioi* (Ringe, 1976); *H.* sp. 1; *Krenosmittia boreoalpina* (Goetghebuer, 1934); *K. camptophleps* (Edwards, 1929); *Nanocladius par-*

vulus (Kieffer, 1909); *Orthocladius rivulorum* Kieffer, 1909; *O. saxosus* (Tokunaga, 1939); *Parametriocnemus valescurensis* Moubayed & Langton, 1999; *P.* sp. 1; *Paraphaenocladius impensus impensus* (Walker, 1856); *P. pseudirritus* Strenzke, 1950; *Pseudorthocladius berthelemyi* Moubayed, 1989; *Rheocricotopus effusus* (Walker, 1856); *R. meridionalis* Moubayed-Breil, 2016; *Stilocladius montanus* Rossaro, 1979; *Thienemannia fulvofasciata* Kieffer, 1921; *T. gracilis* Kieffer 1909; *T. valespira* Moubayed-Breil & Ashe, 2013; *Tokunagaia excellens* (Brundin, 1956); *Micropsectra fallax* (Reiss, 1969); *M. roseiventris* (Kieffer, 1909); *Stempellinella flavidula* (Edwards, 1929).

- Associated species in the same localities as *C. mantetanus* sp. n., include: *Diamesa veletensis* Serra-Tosio, 1971; *D. aberrata* Lundbeck, 1898; *D. bertrami* Edwards, 1935; *D. bohemani* Goetghebuer, 1932; *Bryophaenocladius xanthogyne*[1]; *B.* sp. 1; *Chaetocladius laminatus* Brundin, 1947; *C. suecicus* (Kieffer 1916); *Parametriocnemus* sp. 2; *Psilometriocnemus* sp. 1[2]; *Rheocricotopus thomasi* Moubayed-Breil, 2015; *Trissocladius orsinii* Moubayed-Breil & Ashe, 2015; *Micropsectra auvergnensis* Reiss, 1969; *M. nohedensis* (Moubayed & Langton, 1996); *Rheotanytarsus dactylophoreus* Moubayed-Breil, Ashe & Langton, 2012.

- Associated species in the same localities as *C. royanus* sp. n., include: *Thienemannimyia pseudocarnea* Murray, 1976; *Boreoheptagyia alpicola* Serra-Tosio, 1989; *B. dasyops* Serra-Tosio, 1989; *Diamesa goetghebueri* Pagast, 1947; *D. lindrothi* Goetghebuer, 1931; *Potthastia dominicii* Moubayed-Breil & Orsini, 2016; *Eukiefferiella brulini* Moubayed-Breil & Ashe, 2015; *E. bedmari* Vilchez-Quero & Laville, 1987; *Heleniella* sp. 2; *Nanocladius* sp. 1; *Parametriocnemus* sp. 2; *Parakiefferiella gracillima* (Kieffer, 1922); *Thienemannia corsicana*; *T. spiesi*; *Micropsectra chinophila* (Edwards, 1933); *M. clastrieri* Reiss, 1969; *M. nana* (Meigen, 1818).

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[1] In this paper, *B. xanthogyne*, *Thienemannia corsicana* and *T. spiesi* are considered as new discovered records for the fauna of continental France. According to MOUBAYED-BREIL & ASHE (2016a) and MOUBAYED-BREIL & ORSINI (2016) an updated list of **742** known valid species was reported from France including the already **740** listed by MOUBAYED-BREIL & ASHE (2016a), and 2 additional new described species (*Potthastia dominicii* Moubayed-Breil & Orsini, 2016 and *P. valserina* Moubayed-Breil, 2016; MOUBAYED-BREIL & ORSINI 2016). Consequently, the previously provided list of **742** species on the Chironomidae of continental France is currently increased to **747** known valid species including *C. mantetanus* sp. n., *C. royanus* sp. n. and the 3 new recent records: *B. xanthogyne*, *T. corsicana* and *T. spiesi*.

[2] The record of this genus is new for French fauna.

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